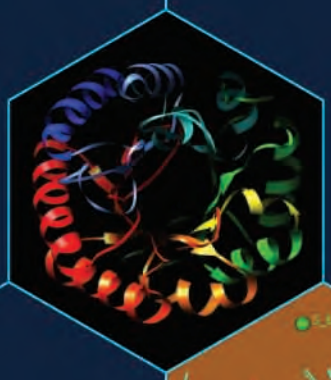
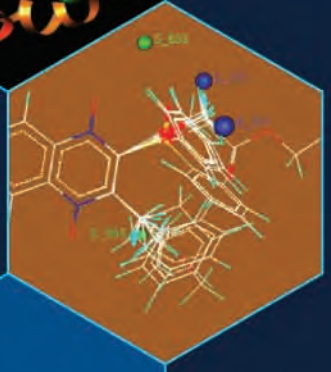
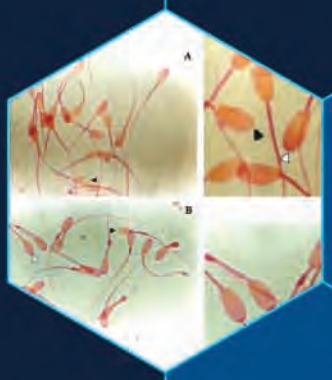
वार्षिक प्रतिवेदन

ANNUAL REPORT 2008-2009







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भारतीय रासायनिक जीवविज्ञान संस्थान

INDIAN INSTITUTE OF CHEMICAL BIOLOGY

(A Unit of Council of Scientific & Industrial Research)

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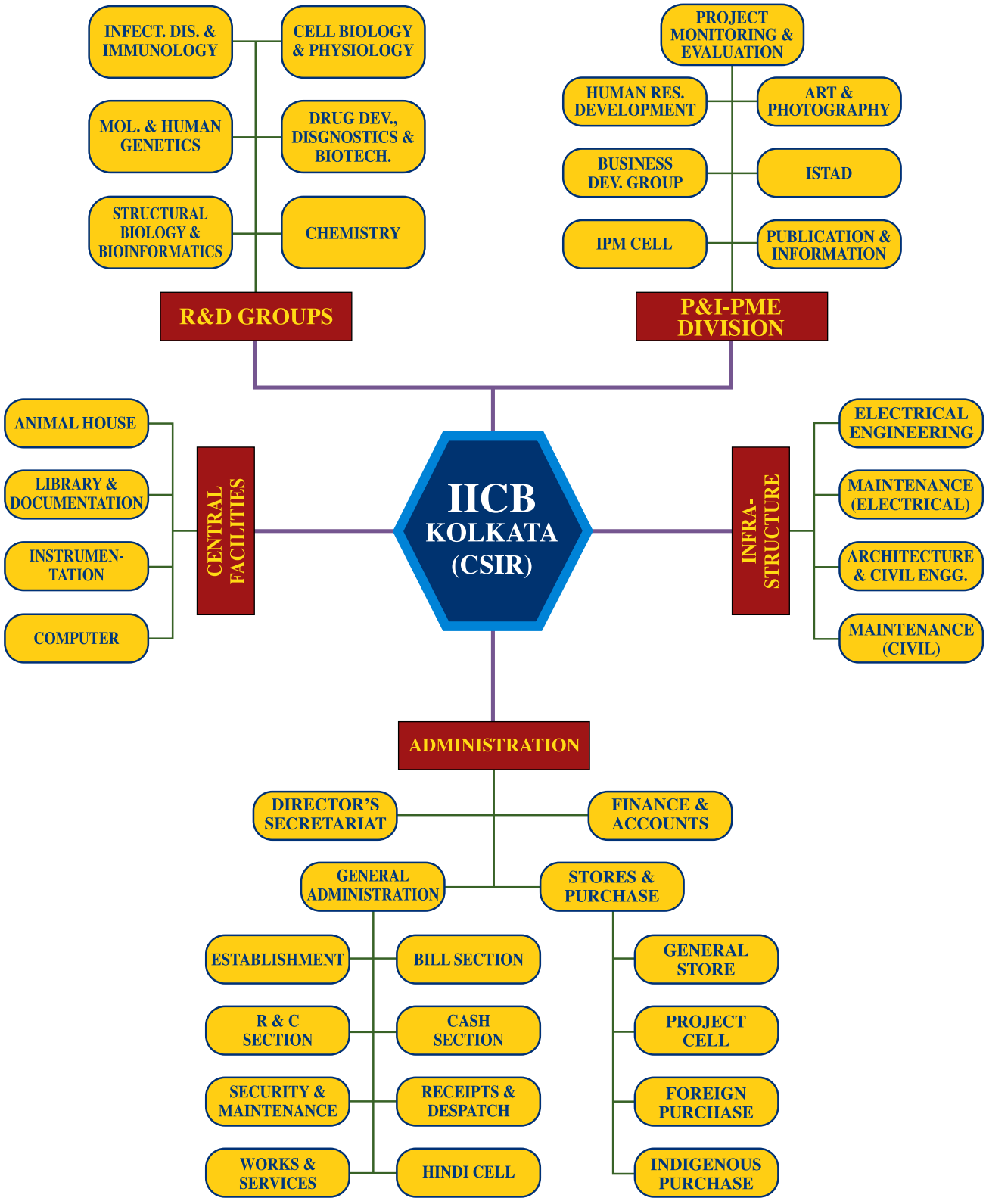
IICB
वार्षिक प्रतिवेदन
Annual Report
2008-2009

भारतीय रासायनिक जीवविज्ञान संस्थान
Indian Institute of Chemical Biology

(सी. एस. आई. आर. का एक प्रतिष्ठान)
(A Unit of Council of Scientific & Industrial Research)

4, राजा एस. सी. मल्लिक रोड, यादवपुर, कोलकाता - 700 032, भारत
4, Raja S. C. Mullick Road, Jadavpur, Kolkata - 700 032, India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निदेशक का प्रतिवेदन

मुझे इस संस्थान का अप्रैल 2008 से मार्च 2009 तक का वार्षिक प्रतिवेदन प्रस्तुत करते हुए संतोष का अनुभव हो रहा है। पूर्ववर्ती वर्षो की तरह इस वर्ष मित्रों, सहकर्मियों, पुराने विद्यार्थियों तथा संपूर्ण विश्व के वैज्ञानिक समुदायों की प्रकाशित कृतियों एवं एकस्वों के विशेष संदर्भ में वर्षभर चल रहे अनुसंधान कार्यकलापों के संक्षिप्त विवरण के प्रसार के लिए यह संस्थान वार्षिक प्रतिवेदन प्रकाशित कर रहा है। वैज्ञानिक योगदान के अलावा इस प्रतिवेदन में अवसंरचना, बाह्य निधीयन, बौद्धिक संपदा तथा वैज्ञानिक प्रबंधन एवं प्रशासन के अन्य विभिन्न पहलुओं से संबंधित कुछ महत्वपूर्ण सूचना भी शामिल है।

हमारे जैसे संस्थान की संवृद्धि मूलत: भारतीय रासायनिक जीवविज्ञान संस्थान के अनुसंधान एवं विकास कार्यकलापों पर निर्भर करती है तथा पूर्ववर्ती वर्षो की तरह इसने विज्ञान की गुणवत्ता को विकसित एवं संवर्धित करते हुए अपनी प्रगति जारी रखी। सामान्य रोगों के अध्ययन तथा स्वास्थ्यरक्षाविज्ञान में सुधार के लिए विभिन्न जैविक क्षेत्रों में छह प्रमुख प्रभाग परस्पर सक्रिय सहयोग से कार्य कर रहे हैं। हमने देशी भारतीय पादपों जैसे देशी एवं प्राकृतिक संसाधनों से औषध विकसित करने पर पर्याप्त ध्यान दिया है। **रसायन प्रभाग,** रसायन के सिद्धांतों के अनुप्रयोग से रसायन जैविकी अनुसंधान का सार्थक योगदान प्रदान करता है, जिसका लक्ष्य इस संस्थान के अन्य समूहों के सहयोग से कुछ प्रमुख रोगों के उपचार के लिए स्थानीय रूप से उपलब्ध औषधीय पादपों से नई औषधियाँ तैयार कर उनका उपयोग करते हुए प्रचुर मात्रा में उपलब्ध प्राकृतिक संसाधनों को महत्व प्रदान करना है। इस प्रभाग के वर्तमान अनुसंधान कार्यकलाप संश्लेषी एवं प्राकृतिक उत्पाद रसायन के विभिन्न पहलुओं अर्थात नए न्यूक्लियोटाइड के संश्लेषण, काइरल हेटरोसाइकिल, बेंत्सबलची मध्यम आकार के वलय, विषमचक्रीय रसायन संबंधी संश्लेषी अध्ययन, प्राकृतिक उत्पादों से संबंधित नए संश्लेषी मार्गो (एनैन्टियोसिलेक्टिव सिंथेसिस), लीशमैनियारोधी योगिको के संश्लेषण, जीवाण्विक कोशिकापृष्ठीय ऐन्टिजन संबंधी अध्ययन, पादप पॉलिसैकेराइड एवं नियोग्लाइकोप्रोटीन पदार्थो, जैवसक्रिय पदार्थ के लिए औषधीय पादपों के रासायनिक अन्वेषण तथा प्राकृतिक उत्पादों के न्यूक्लिक अम्ल जैसे ग्राही गुणधर्म संबंधी अध्ययन के संबंध में हैं। इस प्रभाग के वैज्ञानिकों ने पर्यावरण रसायन के अनुरूप स्वयं को ढाल लिया है जिससे अपेक्षाकृत अधिक पर्यावरण-अनुकूल उत्पादों एवं प्रक्रियाओं की सृष्टि होगी। **आण्विक एवं मानव आनुवंशिकी प्रभाग** भारत की जनता में पाए जाने वाले आम रोगों के आण्विक जनन आधार को समझने के लिए कार्य कर रहा है। इस प्रभाग के विशिष्ट उद्येश्यों में हीमोफीलिया, ग्लाकोमा, विल्सन रोग एवं नेत्रत्वचीय रंगहीनता जैसे मानवीय रोग से संबंधित आण्विक आनुवंशिकी का अध्ययन, ल्यूकोप्लाकिया व मुख के कैंसर से संबंधित सुग्राही जीन का पता लगाना, आनुवंशिकीय विषविज्ञान का अध्ययन तथा जैवरसायन एवं प्रतिलोम आनुवंशिकीय दृष्टिकोणों का उपयोग करते हुए काइनेटाप्लास्टिड प्रोटोजोआई लीशमैनिया के माइटोकांड्रिया नाभिकीय रूप से कूटबद्य tRNA के आयात के आण्विक आधार का अध्ययन करना शामिल है। **संक्रामक रोग एवं प्रतिरक्षाविज्ञान प्रभाग** लीशमैनिया, मलेरिया एवं हैजा जैसे विभिन्न जैविक क्षेत्रों में कार्य कर रहा है। इस प्रभाग के वैज्ञानिक, आण्विक संरचना एवं चिकित्सकीय विकास, आदर्श रोग के रूप में विसरल लीशमैनियासिस का उपयोग करते हुए मैक्रोफैग जैविकी के अध्ययन, मलेरिया संक्रमण में हेपैटोसाइट एपॉप्टॉसिस के संवर्धन के लिए माइटोकांड्रियल रोगविज्ञान एवं ऑक्सीकारी स्ट्रेस के विकास, वी.कोलेरी के E1 तोर बायोटाइप द्वारा क्लासिकी बायोटाइप के प्रतिस्पर्धात्मक अपवर्जन तथा संकर वी. कोलेरी 01 बायोटाइप E1 तोर के विकास के विशेष संदर्भ में डी एन ए टोपोआइसोमेराज के 1A, 1B तथा III टाइप के अध्ययन से संबंध हैं।

कोशिका जैविकी एवं शरीरक्रियाविज्ञान प्रभाग के वैज्ञानिक कई चयापचयी एवं अपहासी रोगों से संबंधित रोगशरीरक्रियाविज्ञान के आण्विक आधार को समझने के समान लक्ष्य के मद्येनजर कार्य कर रहे हैं। इस प्रभाग के हित हृदय में अत्यधिक वृद्धि, मधुमेह, नशीली दवा के व्यसन, तंत्रिकाअपहासी रोग, गर्भाशय एवं अंगशय की निष्क्रियता तथा हिर्मेटोपो-एटिक सिस्टम में पैथोजीन के प्रति अनुक्रिया से संबंधित क्षेत्रों के अंतर्गत आते हैं। वर्तमान में इन क्षेत्रों में कैंसरजनन संबंधी स्टेम कोशिका जैविकी, मानव में इस्तेमाल के उद्येश्य से प्रयोगशाला में कार्निया कोशिका का उत्पादन तथा न्यूरॉन संबंधी स्टेम कोशिका जैविकी, मानव में इस्तेमाल के उद्येश्य से प्रयोगशाला में कार्निया कोशिका का उत्पादन तथा न्यूरॉन संबंधी स्टेम कोशिका विभेद और पशु मॉडलों में उनका प्रत्यारोपण जुड़ गए हैं। हारमोनग्राही व्यवहित जीन एक्सप्रेशन संबंधी सामान्य कायिक प्रकार्यो ऑयन वहन विनियमन संबंधी जैवऔर्जिकी,

तंत्रिका-विकास सूत्रकणिकीय (माइटोकांट्रियल) प्रकार्यो तथा संकेत पारक्रमण में महत्वपूर्ण योगदान दिया गया है।

औषध विकास, नैदानिकी एवं जैवप्रौद्योगिकी प्रभाग, स्वास्थ्य में सुधार लाने व बेहतर जीवन के लिए तथा जैवप्रौद्योगिकी में नवीकरण के माध्यम से भावी आर्थिक संवृद्धि के संवर्धन के लिए जैवसक्रिय यौगिकों का अध्ययन कर रहा है। प्रमुख कार्यक्षेत्र में औषधीय पादपों एवं जीवविष संबंधी चिकित्सकीय सिद्धांत; जड़ी-बूटियों का विश्लेषणात्मक मूल्यांकन, नैनोकैप्स्यूलित दवाओं की सुपुर्दगी; त्रेहालोज उपापचय तथा सूक्ष्मजैविक ग्लाइकोसीडेज एन्जाइमों की आण्विक क्रियाविधि शामिल हैं जबकि **संरचना जैविकी एंव जैवसूचना-विज्ञान प्रभाग** उन क्षेत्रों में अनुसंधान करता है जो क्षयरोग, लीशमैनियासिस, हैजा, कैंसर, मधुमेह जैसे विभिन्न रोगों की चिकित्सा से संबंधित संभावित भावी जैविक वृहदअणुओं तथा अन्य लघु अणुओं के संरचनात्मक अभिलक्षण पर केंद्रित है। साथ ही, यह प्रभाग, प्रदाहरोधी, अपस्मार नियंत्रक एवं प्रतिरक्षानियामक कार्यकलापों से संबंधित अनुसंधान भी करता हैं। न्यूक्लियर मैग्नेटिक रेजोनेन्स (NMR), एक्स-रे क्रिस्टलोग्राफी, विश्लेषणात्मक अल्ट्रासेंट्रिफ्यूज, फ्लुअरोसेन्स कोरिलेशन स्पेक्ट्रोस्कोपी स्टॉप्ड फ्लो स्पेक्ट्रोमेट्री मास स्पेक्ट्रोमेट्री, क्वांटिटेटिव स्ट्रक्चर एक्टिविटी रिलेशनशिप (QSAR) तथा 2 डीक्यूएसए आर जैसी आधुनिक परिष्कृत प्रौद्योगिकियों का अनुप्रयोग करते हुए प्रोटीन प्रकार्य, प्रोटीन-प्रोटीन व प्रोटीन-न्यूक्लिक एसिड अंत:क्रिया संबंधी मूल अध्ययन भी किए जा रहे हैं। जिनोम/प्रोटेयोम विश्लेषण के लिए वृहद आण्विक संरचना के पूर्वानुमान, आशोधन एवं विश्लेषण तथा उनकी जैवसक्रिय अणुओं से अंत:क्रिया को स्पष्ट करने के लिए सॉफ्टवेयर विकसित किए जा रहे हैं।

विगत वर्षो में भारतीय रासायनिक जीवविज्ञान संस्थान (आईआईसीबी) ने भारत के विभिन्न जैविक क्षेत्रों में पहल की हैं। इस प्रयास को जारी रखते हुए संस्थान एक बार फिर आधुनिक जैविक क्षेत्र में प्रवेश कर रहा है तथा कायिक जैविकी (सिस्टम्स बायोलॉजी) और सांश्लेषिक जैविकी (सिंथेटिक बायोलॉजी) के क्षेत्र में अनुसंधान-कार्य का विस्तार कर रहा है। इस संबंध में संस्थान द्वारा कोलकाता में ''सिस्टम्स बायोलॉजी एंड प्रोटियोमिक्स इन बायोमेडिकल साइन्सेज'' विषय पर एक दो-दिवसीय लघु परिसंवाद का आयोजन किया गया। इस उभरते क्षेत्र और सहयोग के संभावित क्षेत्रों के दायरे पर चर्चा के लिए इस परिसंवाद में जापान और भारत के कई वैज्ञानिकों ने भाग लिया। इस परिसंवाद की प्रमुख उपलब्धि यह रही है कि भारत और जापान में कायिक जैविकी और उसके चिकित्सकीय एवं पर्यावरणीय अनुप्रयोगों को बढ़ावा देने के लिए सहयोगात्मक पहल के रूप में सी एस आई आर और सिस्टम्स बायोलॉजी इंस्टीट्यूट (एस बी आई, टोकियो, जापान) ने समझौता ज्ञापन (एम ओ यू) पर हस्ताक्षर किए हैं। भारतीय रासायनिक जीवविज्ञान संस्थान सहयोग कार्यक्रम का समन्वय करेगा।

एलेक्जेंडर हॉलैंडर कोर्स (ए एच सी) उन देशों में प्रतिवर्ष आयोजित किया जाता हैं जहाँ पर्यावरणीय उत्परिवर्तनजनन (म्यूटाजेनेसिस) तथा स्वास्थ्य के मुद्दे चिंता के प्रमुख विषय हैं। इस बार भारतीय रासायनिक जीवविज्ञान संस्थान के तत्वावधान में ''जेनेटिक टॉक्सिकोलॉजी जिनोंमिक एंड प्रोटियोमिक अप्रोचेज'' विषय पर 14वें एलेक्जेंडर हॉलैंडर कोर्स तथा ''आर्सेनिक एक्सपोजर असेसमेन्ट'' विषय पर एक विशेष कार्यशाला का आयोजन किया गया। यह पहला अवसर है जबकि भारत में इस तरह के कार्यक्रम का आयोजन किया गया है। कोर्स और कार्यशाला आयोजित करने का उद्देश्य पर्यावरणीय उत्परिवर्तजनन एवं स्वास्थ्य के क्षेत्र में हुई उन्नति की समीक्षा करना था।

भारतीय रासायनिक जीवविज्ञान संस्थान (आई आई सी बी) ने कोलकाता के अन्य अनुसंधान संस्थानों के साथ मिलकर ''कांप्लेक्स डिजीजज : अप्रोचेज टु जीन आइडेन्टिफिकेशन एंड थेराप्यूटिक मैनेजमेंट'' विषय पर ह्यूगो (मानव जिनोम संगठन) लघु परिसंवाद का आयोजन किया। इस परिसंवाद में विभिन्न अनुसंधान संस्थानों के वैज्ञानिकों एवं अध्येताओं ने बड़ी संख्या में भाग लिया। विश्व के कई प्रतिष्ठित वैज्ञानिकों को इस परिसंवाद में बोलने के लिए आमंत्रित किया गया, जिनमें ह्यूगो के अध्यक्ष डॉ. एडिशन लियू शामिल थे। इन वैज्ञानिकों ने इस परिसंवाद के केंद्रित क्षेत्रों में हुए नवीनतम विकास पर व्याख्यान दिए।

भारतीय रासायनिक जीवविज्ञान संस्थान तथा नेशनल मेडिकल कॉलेज एंड हॉस्पिटल (सी एन एम सी एच) ने संयुक्त रूप से तंत्रिकाविज्ञान सम्मेलन, न्यूरोअपडेट 2008, का आयोजन किया, जिसमें क्लिनिशियन एवं आधारिक तंत्रिकाविज्ञानियों ने सहभागिता की। इस सम्मेलन का प्रमुख आकर्षण ज्ञान के प्रभावी प्रसार तथा तंत्रिकाविज्ञान संबंधी आधारभूत एवं नैदानिक अनुसंधान में हुई नवीनतम उन्नति पर उपयोगी चर्चा के लिए चिकित्सा एवं आधारिक विज्ञान के आधारिक तंत्रिकाविज्ञानियों, तंत्रिकाविदों एवं विद्यार्थियों तथा रोगियों अथवा निकट संबंधियों को समान मंच प्रदान करना था।

राष्ट्रीय विज्ञान दिवस पर भारतीय रासायनिक जीवविज्ञान संस्थान ने अपने परिसर में आधारिक विज्ञान एवं स्वास्थ्यरक्षा में हुई नवीनतम उपलब्धियों पर प्रदर्शनी के साथ-साथ प्रतिष्ठित वैज्ञानिकों के व्याख्यान की श्रृंखला का आयोजन किया। संस्थान ने सी जी सी आर आई, बंगाल विज्ञान संस्थान तथा भारतीय विज्ञान संवर्धन संस्थान के साथ मिलकर संयुक्त रूप से 'राष्ट्रीय विज्ञान दिवस कार्यक्रम' का भी आयोजन किया। इसके अतिरिक्त, संस्थान द्वारा बर्दवान यूनिवर्सिटी के कैंपस में स्वास्थ्यरक्षा-विज्ञान में आई आई

सी बी के योगदान और भूमिका से संबंधित कई प्रदर्शों के साथ-साथ दो-दिवसीय प्रदर्शनी में सक्रिय रूप से सहभागिता की गई। भारतीय रासायनिक जीवविज्ञान संस्थान (आई आई सी बी) द्वारा पश्चिम बंगाल में वर्ष 2008 के युवा विज्ञान नेतृत्व संबंधी सी एस आई आर कार्यक्रम का समन्वय किया गया। इस कार्यक्रम में पश्चिम बंगाल के विभिन्न भागों के 110 विद्यार्थियों ने शिरकत की।

आई आई सी बी ने संस्थान पर ही एक वृत्तचित्र 'माइल्स टु गो....' का निर्माण किया है जिसे प्रतिष्ठित फिल्म निर्माता श्री गौतम घोष द्वारा निर्देशित किया गया है।

ग्यारहवीं पंचवर्षीय योजना में आई आई सी बी ने तीन विभिन्न क्षेत्रों अर्थात् (i) जैविकी एवं जैव प्रौद्योगिकी, (ii) फार्मास्यूटिकल्स, स्वास्थ्यरक्षा एवं औषधि तथा (iii) पारिस्थितिकी एवं पर्यावरण में नेटवर्क परियोजनाओं का प्रस्ताव किया है। आई आई सी बी को 16 परियोजनाएं स्वीकृत की गई हैं, जिनमें से चार नोडल नेटवर्क परियोजनाएं तथा 12 पार्टनर नेटवर्क परियोजनाएं हैं। पार्टनर नेटवर्क परियोजनाओं में दसवीं योजना की दो विस्तार परियोजनाएं हैं। फार्मास्यूटिकल्स, स्वास्थ्यरक्षा एवं औषधि क्षेत्र की एक नोडल नेटवर्क परियोजना के सिवाय सभी परियोजनाएं मुख्यत: जैविकी एवं जैवप्रौद्योगिकी क्षेत्र की हैं।

अति से अत्यधिक प्रभाव वाले जर्नलों के बेहतर प्रकाशन की नियमित संख्या अनुसंधान में संस्थान की प्रगति का प्रतीक है तथा प्रकाशनों का औसत प्रभाव निरंतर बढ़ रहा है। मुझे यह जानकर गर्व है कि आई आई सी बी के प्रकाशनों का औसत प्रभाव तीन वर्ष से अधिक का है।

समीक्षाधीन अवधि के दौरान आई आई सी बी ने कालाजार, प्रोस्टेट कैंसर, ब्लड कैंसर, मधुमेह तथा अन्य मानवीय सामान्य रोगों से लड़ने के लिए हर्बल संसाधनों से जैवसक्रिय यौगिकों के निष्कर्षण, संश्लेषण, निदान एवं टीकाकरण से संबंधित 13 राष्ट्रीय एवं अंतर्राष्ट्रीय एकस्वों के लिए आवेदन किया है। इस अवधि के दौरान कुल सात एकस्व (पेटेन्ट) स्वीकृत किए गए हैं तथा इनमें से छह की स्वीकृति विदेश में प्राप्त हुई है। प्रोस्टेट ग्रंथि की अत्यधिक वृद्धि के उपचार के लिए प्रोस्टेलिन औषधि को ईस्ट इंडिया फार्मास्यूटिकल वर्क्स लिमिटेड, कोलकाता द्वारा बाजार में उतारा गया है, जिसकी प्रौद्योगिकी का विकास आई आई सी बी के वैज्ञानिकों ने किया है। एन्टिहर्बल एक्सट्रैक्ट के लिए आई आई सी बी में विकसित प्रौद्योगिकी का दूसरे चरण में क्लिनिक में परीक्षण पीरामल लाइफ साइन्सेज लिमिटेड, मुंबई (पूर्ववर्ती नाम एन पी आई एल) द्वारा किया जा रहा है। यह प्रौद्योगिकी नेचर रिव्यू ड्रग डिस्कवरी में भी निर्दिष्ट है।

जैविक एवं रासायनिक क्षेत्रों में काम करने की आकांक्षा पाले होनहार वैज्ञानिकों के लिए आई आई सी बी हमेशा उनकी पसंद रहा है। आधुनिकतम अनुसंधान संबंधी अपेक्षा की पूर्ति के लिए इस वर्ष संस्थान ने जैविकी एवं रसायन के विभिन्न क्षेत्रों तथा संबंधित क्षेत्रों में पर्याप्त एवं प्रशिक्षित मानव संसाधन उत्पन्न करने के उद्देश्य से पूरे देश से कुशाग्र युवा अनुसंधान अध्येताओं एवं अनुसंधान सहयोगियों को बहुत बड़ी संख्या में आकर्षित किया है। 2008-09 के दौरान अनुसंधान के आधारिक एवं अनुप्रयुक्त क्षेत्रों में कार्य के लिए सुदृढ़ रूप से अभिप्रेरित लगभग 200 अध्येताओं एवं अनुसंधान सहयोगियों ने इस संस्थान में कार्य किया और उत्कृष्ट रहे। भारत और विदेश दोनों से ही बड़ी संख्या में प्रतिष्ठित वैज्ञानिक आई आई सी बी में आए, व्याख्यान दिए तथा अनुसंधान समूहों के साथ उन्होंने चर्चा की। भारत के विभिन्न विश्वविद्यालय एवं संस्थानों के लगभग 145 विद्यार्थियों ने ग्रीष्मकालीन प्रशिक्षण प्राप्त किया तथा अन्य प्रशिक्षण कार्यक्रमों में उन्होनें भाग लिया। बड़ी संख्या में वैज्ञानिकों पड़ोसी विश्वविद्यालयों एवं संस्थानों के शिक्षण एवं प्रशिक्षण कार्यक्रमों में भाग लिया। विभिन्न वैज्ञानिक परिसंवाद आयोजित करने के बावजूद संस्थान द्वारा अपना स्थापना दिवस एवं सी एस आई आर का स्थापना दिवस समारोह भी मनाया गया।

मैं अपने संस्थान के समस्त वैज्ञानिक, तकनीकी एवं प्रशासनिक स्टाफ के प्रति हार्दिक आभार व्यक्त करता हूँ जो आई आई सी बी की ख्याति को बनाए रखने व संवृद्धि को जारी रखने के लिए वर्षभर निष्ठा के साथ प्रयत्नशील रहे और सहयोग प्रदान करते रहे। मेरा यह भी विश्वास है कि मेरे सहकर्मियों की लगन से आने वाले दिनों में संस्थान नई गरिमा को प्राप्त कर लेगा।

प्रो. सिद्धार्थ राय
आई आई सी बी, कोलकाता

उपलब्धियों की एक झलक

सम्मान

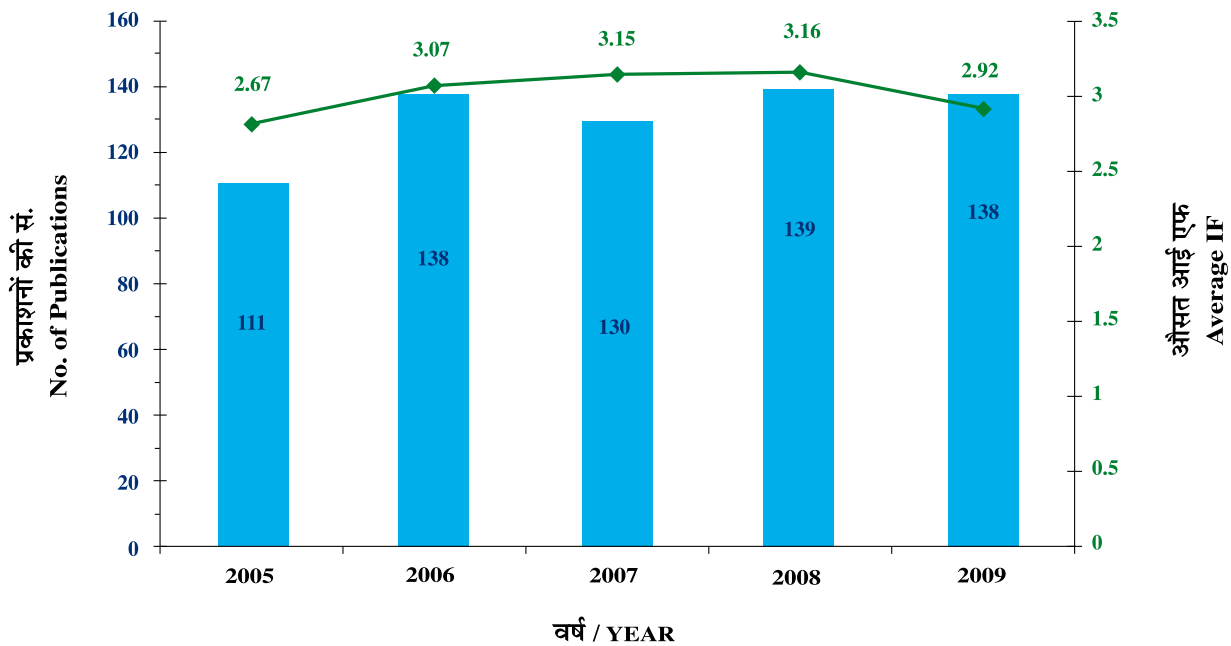
- डॉ. के. पी. मोहनकुमार को राष्ट्रीय विज्ञान अकादमी (भारत), इलाहाबाद के अध्येता (फेलो) के लिए मनोनीत किया गया।
- डॉ. उदय बंदोपाध्याय को राष्ट्रीय विज्ञान अकादमी (भारत), इलाहाबाद के अध्येता (फेलो) के लिए मनोनीत किया गया।
- डॉ. चित्रा मंडल को वर्ष 2008 के लिए 'राष्ट्रीय विज्ञान अकादमी' द्वारा 'सिनियर साइंटिस्ट ओरेशन पुरस्कार' से पुरस्कृत किया गया।
- 2008 में डॉ. एच. के. मजुमदार को 'राष्ट्रीय विज्ञान अकादमी' द्वारा 'प्रोफेसर बी. के. बचहावट मेमोरियल लेक्चर पुरस्कार' से पुरस्कृत किया गया।
- डॉ. बी. सी. पाल को पश्चिम बंगाल विज्ञान तथा प्रौद्योगिकी अकादमी के अध्येता (फेलो) के लिए मनोनीत किया गया।
- डॉ. जी. सुरेश कुमार को पश्चिम बंगाल विज्ञान तथा प्रौद्योगिकी अकादमी के अध्येता (फेलो) के लिए मनोनीत किया गया।
- डॉ. नाहीद को पश्चिम बंगाल विज्ञान तथा प्रौद्योगिकी अकादमी के अध्येता (फेलो) के लिए मनोनीत किया गया।
- डॉ. अगनेयो गांगुली को राष्ट्रीय विज्ञान अकादमी, इलाहाबाद द्वारा ''प्लेटिनम जुबलि यंग साइंटिस्ट पुरस्कार, 2008'' से पुरस्कृत किया गया।

उपलब्धियों की एक झलक

प्रकाशन

संस्थान के अनुसंधान की प्रगति के लिए उच्चकोटि का प्रकाशन एक श्रेष्ठसूचक चिह्न है। वार्षिक प्रकाशन* तथा पिछले पांच वर्ष का औसत प्रभावी कारक (आई एफ) निम्नलिखित है :-

आईआईसीबी प्रकाशन
IICB PUBLICATION



*2008-09 के लिए प्रकाशनों की विस्तृत सूची अन्दर अलग दिया गया है।

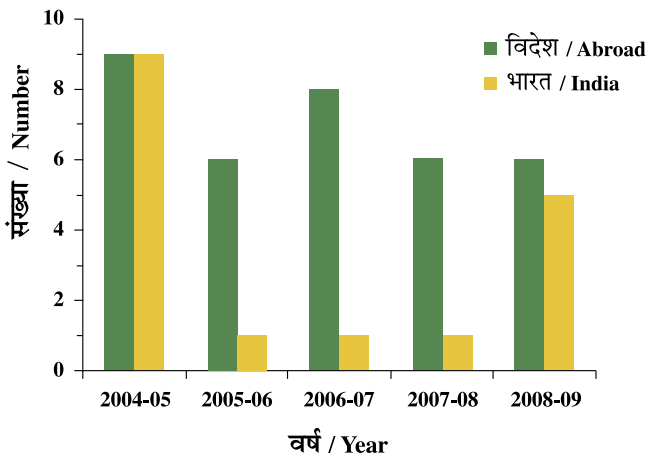
उपलब्धियों की एक झलक

पेटेन्टस

संस्थान में प्रत्येक वर्ष स्थायी रूप से कई पेटेन्ट का पंजीकरण* एवं स्वीकृति। निम्नलिखित आरेखों के द्वारा गत पाँच बर्षों का स्वीकृत पेटेन्टस एवं पंजीकृत पेटेन्टस चित्रित है :

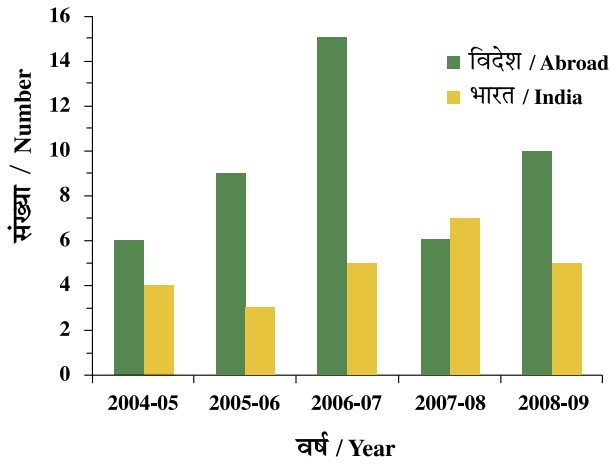
स्वीकृत पेटेन्ट

PATENTS GRANTED



पंजीकृत पेटेन्ट

PATENTS FILED



*वर्ष 2008–09 में पंजीकृत एवं स्वीकृत पेटेन्ट की सूची संस्थान के प्रकाशन एवं सूचना विभाग के रिपोर्ट में दर्ज है।

उपलब्धियों की एक झलक

उद्योग-संस्थान का गठजोड़

संस्थान, उद्योग के साथ निरंतर एकीकरण बनाए रखा है एवं सफलतापूर्वक ज्ञान को धन में परिवर्तित कर रहा है। इस वर्ष आई. आई. सी. बी. के वैज्ञानिको ने उद्योग के साथ पारस्परिक संबंध को बनाए रखने में एवं प्रर्याप्त मानवीय एवं वित्तीय संसाधन जुटाने में अपने को सक्षम बनाए रखा।

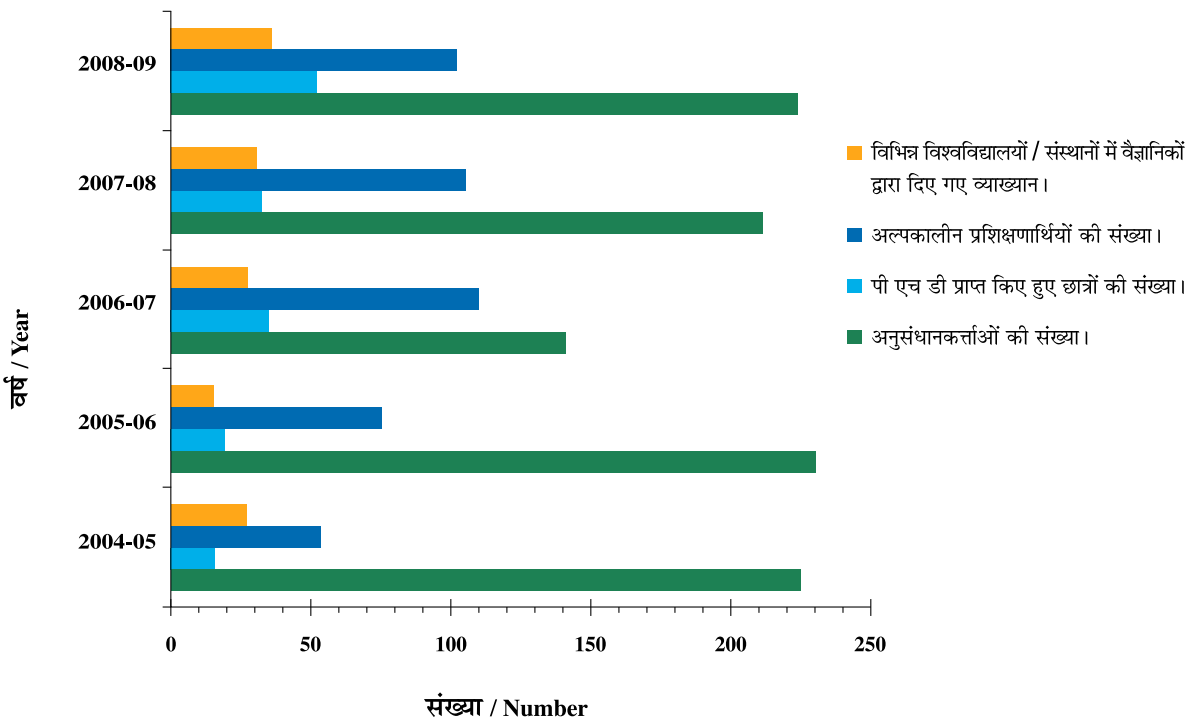
गेट (GATT)– भारत व्यवस्था के साथ सम्पूर्ण विकास के लिए हमारे सहयोगी इस प्रकार है:–

- एलबर्ट डेविड लिमिटेड, कोलकाता।
- एनर्जीओजेन फार्मास्यूटिकलस, आस्ट्रेलिया।
- बायोटेक कानसोरटीयम (आई) लिमिटेड, नई दिल्ली।
- चटर्जी मनेजमेन्ट सर्वीसेस प्राइवेट लिमिटेड, कोलकाता।
- केमबायोटेक रिसर्च इन्टरनेशनल प्राइवेट लिमिटेड, कोलकाता।
- क्वायर वोर्ड, कोची।
- दे मेडिकल स्टोर्स (मैनुफैक्चरिंग) लिमिटेड, कोलकाता।
- डी एन डी आई, फ्रांस।
- ईस्ट इंडिया फार्मास्यूटिकल्स वर्क्स लिमिटेड, कोलकाता।
- मेरियल एस ए एस लिन, फ्रांस।
- पीरामल लाइफ सर्वीसेस लिमिटेड, मुंबई।
- क्वालप्रो डायग्नोस्टिक, गोवा।
- शान्ता वायोटेकनिक्स लिमिटेड, हैदराबाद।
- जेफर बायोमेडिकल्स, गोवा।

उपलब्धियों की एक झलक

मानव संसाधन विकास

हर वर्ष कई अनुसंधानकर्ता डॉक्टरेट एवं पोस्टडॉक्टरेट स्तर पर अपना अनुसंधान जारी रखते हैं देश के विभिन्न विश्वविद्यालयों से अनेक विद्यार्थी यहाँ हर वर्ष अल्पकालीन प्रशिक्षण प्राप्त करते हैं। गत पाँच वर्षो का आँकड़ा ग्राफ के माध्यम से प्रस्ततु है:-



वैज्ञानिक आगंतुक

कई वैज्ञानिक भारतीय रासायनिक जीवविज्ञान संस्थान (IICB) आए और उन्होंने व्याख्यान दिया। व्यापक सूची निम्नलिखित है :

संख्या	दिनांक	वक्ता	संगोष्ठी का शीर्षक
1.	03.04.2008	डॉ. सुवर्ण कुलकर्णी, यूनिवर्सिटी ऑफ कैलिफोर्निया, यूएसए	वन-पॉट मेथड्स फॉर ग्लाइकोमिक्स
2.	04.04.2008	डॉ. संजय के बनर्जी, यूनिवर्सिटी ऑफ पिट्सबर्ग, यूएसए	जेनेटिक्स ऑफ कार्डियोवैस्कुलर डिजीजेज फ्राम पी.आर.के.ए. जी2 म्यूटेशन्स टु ग्लाइकोजीन स्टोरेज कार्डियोमायोपैथी
3.	07.04.2008	डॉ. लाल मोहन कुंडु, रिकेन, जापान	मॉडीफाइड न्यूक्लिक एसिड प्रोब्स फॉर डी एन ए डैमेज, रिपेयर एंड म्यूटेशनल स्टडीज
4.	08.04.2008	प्रो. स्टाफ़न जोहान्सन, उपसला यूनिवर्सिटी, स्वीडन	इंटीग्रिन सिगनलिंग वाया पी13 काइनेज
5.	29.05.2008	डॉ. मधुसूदन दे, एन आई एच, यू एस ए	मेकैनिस्टिक लिंक बिटवीन पी के आर डाइमेरिजेशन, ऑटो फास्फोरीलेशन एंड सेल्फ सबस्ट्रेट फास्फोरीलेशन
6.	13.06.2008	डॉ. अखिलेश पांडेय, इंस्टीट्यूट ऑफ बायोइंफार्मेटिक्स, बंगलोर	क्वांटिटेटिव प्रोटेओमिक्स : फ्रॉम थेराप्यूटिक टार्गेट्स टु बायोमार्कर्स
7.	24.06.2008	डॉ. नीलंजन रॉय, नाईपर, मोहाली, पंजाब भारत	स्ट्रक्चर फंक्शन एनलिसिस ऑफ लीशमेनिया सिर्तुइन: ऐन ऑसॉंबल ऑफ इन सिलिको एंड बायोकेमिकल स्टडीज़
8.	07.07.2008	अरूप इंद्र, ओरेगन स्टेट यूनिवर्सिटी, यू एस ए	न्यूक्लियर रिसेप्टर सिगनलिंग इन स्किन ट्यूमर माइक्रो एनवायरनमेन्ट
9.	07.08.2008	डॉ. कामलुद्दीन शेख, प्रधान अनुसंधान वैज्ञानिक, यूएसए एमआर आई आई डी, यू एस ए	अटेनुएशन ऑफ पैथोजीनिक कॉन्सीक्वेन्सन ऑफ सेप्टिक शॉक बाइ डिसरप्टिंग माइ डी88 पॉथवे
10.	06.11.2008	डॉ. पार्थ पी दत्ता, अल्बानी, यूएसए	एक्सप्लोरिंग मैक्रोमॉलेक्यूलर स्ट्रक्चरल डायनेमिक्स थ्रू क्रायो-इलेक्ट्रॉन माइक्रोस्कोपी: द राइबोसोम ऐज ऐन एक्जाम्पल
11.	02.12.2008	प्रो. आलेस्सांद्रो देसिदेरी, यूनिवार्सिटी ऑफ रोम, इटली	डायनेमिक्स फंक्शन कोरिलेशन ऑन ह्यूमन टोपोआइसोमराज 1 म्यूटैन्ट्स डिस्प्लेइंग रेजिस्टेंस अगेन्स्ट द कैंप्टोथीसिन एन्टिट्यूमर ड्रग
12.	03.12.2008	प्रो. मारिक जैदलेवित्स, निकोलाउस कोपरनिकस यूनिवर्सिटी, पोलैंड	एसिमोट्रिक सिंथेसिस ऑफ B-अमीनो अलकोहल्स एंड N-हाइड्रोक्सी यूरिया-5-लिपऑक्लीज-नाज इनहिबिटर
13.	10.12.2008	डॉ. सम्राट मुखोपाध्याय, स्क्रिप्स रिसर्च इंस्टीट्यूट, यूएसए	प्राइंग इनटु ए सेल्फ रेप्लिकेटिंग प्रॉयन एमिलॉयड
14.	11.12.2008	डॉ. ज्योतिर्मय नंदी, अपस्टेट मेडिकल सेन्टर, न्यूयॉर्क	मेकेनिज्म ऑफ गैस्ट्रिक एसिड सीक्रेशन: रोल ऑफ साइक्लो ऑक्सीजनाज़
15.	17.12.2008	डॉ. गौतम पंडा, सी डी आर आई, लखनऊ	सिंथेसिस ऑफ नेयुरल प्रोडक्ट्स एंड नेचुरल प्रोडक्ट्स लाइक प्रिविलेज्ड मॉलेक्यूल्स फ्रॉम अमीनो एडिस एंड साइनो-2, 3-डाइहाइड्रॉक्सी ईस्टर्स इन ड्रग डिस्कवरी रिसर्च

संख्या	दिनांक	वक्ता	संगोष्ठी का शीर्षक
16.	18.12.2008	डॉ. सुरजीत धारा, जॉन हॉप्किन्स यूनिवार्सिटी, यूएसए	हेज-हॉग पाथवे इनहिविसन इन कैंसर: क्वेश्चन्स एंड कन्सर्न्स
17.	22.12.2008	डॉ मणिदीपा बनर्जी	बायोलॉजिकल एंड स्ट्रक्चरल स्टडीज ऑफ नॉन-एनवेलप्ड वायरस एन्ट्री
18.	05.01.2009	प्रो. दीपंकर सेन	मेनी लाईव्स ऑफ डी एन ए
19.	07.01.2009	स्मिता मोहंती, ऑबर्न यूनिवर्सिटी, यूएसए	फेरोमोन परसेप्शन : स्ट्रक्चर एंड फंक्शन ऑफ फेरोमोन
20.	12.01.2009	प्रो. दीपक के बनर्जी, यूनिवर्सिटी ऑफ पुएर्तो रिको, यूएसए	मैननोजिलफास्फो डॉलिकोल सिंथाज (डीपीएमएस) : एक्टिवेटर ऑफ एंजियोजीनिक स्विच
21.	15.01.2008	डॉ. असिमा भट्टाचार्य, यूनिवर्सिटी ऑफ वर्जीनिया, यूएसए	एसेटिलेशन ऑफ एप्यूरिनिक/एपिरिमिडिनिक इंडोन्यूक्लियाज-1 रेगुलेट्स हेलिकोबैक्टर पाइलोरिमीडिएटेड गैस्ट्रिक एपिथेलियल सैल एपॉप्टॉसिस
22.	29.01.2009	डॉ. बरतीरा रोस्सी बर्गमान, ब्राजील	यूजिंग द म्यूकोसल रूट ऐज ए न्यू स्ट्रेटजी फॉर वैक्सिनेशन अगेन्स्ट लीशमानियासिस
23.	04.02.2009	डॉ. सौमेन बसाक, यूसीएसडी, यूएसए	क्रॉस टॉक बिटवीन इनफलैमेटरी एंड डेवलपमेन्टल सिगनलिंग वाया द एनएफ-कप्पा बी सिस्टम
24.	05.02.2009	प्रो. पी. वी. भारतम, नाईपर, मोहाली, पंजाब, भारत	फार्मेकोइनफॉर्मेटिक्स इन द डिजाइन ऑफ नॉवेल एन्टि-डायबेटिक एजेन्ट्स
25.	09.02.2009	डॉ. जार्ज शिमर, टीसीजी लाइफसाइन्सेज	डिस्कवरी ऑफ न्यू एन्टिबैक्टीरियल ड्रग्ज
26.	11.02.2009	डॉ. पीटर श्लॉशमाकर, एफ ई आई कंपनी, नीदरलैंड्स	ट्रांसमिशन इलेक्ट्रॉन माइक्रोस्कोपी इन बायोलॉजिकल साइन्स
27.	11.02.2009	डॉ. देवराज मुखर्जी, आई आई आई एम, जम्मू एवं कश्मीर	स्टडीज टुवर्ड्स सिंथेलिस ऑफ बॉयोलॉजिकली सिगनिफिकेंट कंपाउनड्स फ्राम कार्बोहाइड्रेट एंड नेचुरल प्रोडक्ट प्रीकर्सर्स
28.	13.02.2009	डॉ. मलंचा ता, मणिपाल इंस्टीट्यूट, बंगलोर	ए पीक ऐट द स्टेम सेल्स ऑफ अंबिलिकल कॉर्ड
29.	20.02.2009	डॉ. कैलाश चंद पांडेय, डिपार्टमेन्ट ऑफ मेडिसिन, यूसीएसएफ, यूएसए	स्ट्रक्चर-फंक्शन एनलिसिस ऑफ मलेरियल सिस्टाइन प्रोटेआसेज फैल्सीपेन्स
30.	16.03.2009	डॉ. कौशिक मुखर्जी, एमआईटी, यूएसए	पॉलीमर्स पॉलीइलेक्ट्रोलाइट मल्टिलेयर्स (पीईएमएस) एंड एंफीफाइल्स इन अप्लाइड बायोटेक्नोलॉजी
31.	20.03.2009	प्रो. अनुराधा लोहिया, वेलकम ट्रस्ट-डीबीटी, भारत	बायोमेडिकल रिसर्च कैरियर प्रोग्राम्स इन इंडिया फॉर रिसर्च स्कॉलर्स एंड फैकल्टी मेम्बर्स

घटनाक्रम 2008-2009

दिनांक	विशिष्ट विवरण
अप्रैल 02, 2008	02 अप्रैल, 2008 को भारतीय रासायनिक जीवविज्ञान संस्थान (IICB) का स्थापना दिवस मनाया गया। बंगाल इंजीनियरिंग एंड साइन्स यूनिवर्सिटी, हावड़ा के मानद प्रतिष्ठित प्रो. व भारतीय प्रौद्योगिकी संस्थान, खड़गपुर के भूतपूर्व निदेशक प्रो. अमिताभ घोष समारोह के मुख्य अतिथि थे। प्रो. टी.पी. सिंह, प्रतिष्ठित जैवप्रौद्योगिकीविद्, जैव भौतिकी विभाग, अखिल भारतीय आयुर्विज्ञान संस्थान, नई दिल्ली ने रावाँ जे. सी. राय स्मारक व्याख्यान दिया। भारतीय रासायनिक जीवविज्ञान संस्थान के वैज्ञानिक डॉ. अरिंदम बनर्जी द्वारा ''नेनोटेक्नोलॉजी : प्रजुक्तिर एक नूतन दिगंत'' विषय पर बंगाली में लोकप्रिय व्याख्यान दिया गया।
सितंबर 14, 2008	14.09.2008 को हिन्दी दिवस समारोह मनाया गया। इस समारोह की मुख्य अतिथि हिंदी शिक्षण योजना, गृह मंत्रालय, भारत सरकार, निजाम पैलेस, कोलकाता की उप निदेशक श्रीमती केशर जहाँ थी।
सितंबर 20-21, 2008	भारतीय रासायनिक जीवविज्ञान संस्थान (IICB) तथा कलकत्ता नेशनल मेडिकल कॉलेज एंड हॉस्पिटल (CNMCH) द्वारा संयुक्त रूप से असाधारण तंत्रिकाविज्ञान सम्मेलन न्यूरोअपडेट 2008 का आयोजन किया गया। पश्चिम बंगाल सरकार के माननीय स्वास्थ्य, पंचायत एवं ग्रामीण विकास मंत्री डॉ. सूर्यकांत मिश्रा ने इस दो-दिवसीय सम्मेलन का उद्घाटन किया। कोलकाता के तीन प्रसिद्ध वैज्ञानिकों अर्थात प्रो. जे.जे. घोष, प्रसिद्ध तंत्रिकारसायनविद् व तंत्रिकाविज्ञान के शताब्दी प्रो.; प्रो. के.एल. मुखर्जी, लब्धप्रतिष्ठित अध्यापक व नैछानिक जैस रसायनविद् तथा प्रो. श्यामल सेन, प्रसिद्ध तंत्रिका चिकित्सक का इस समारोह में अभिनंदन भी किया गया।
सितंबर 25-26, 2008	भारतीय रासायनिक जीवविज्ञान संस्थान में ह्यूगो बैठक : भारतीय रासायनिक जीवविज्ञान संस्थान ने कोलकाता के अन्य अनुसंधान संस्थानों (अर्थात भारतीय सांख्यिकीय संस्थान, चितरंजन राष्ट्रीय कैंसर संस्थान तथा साहा इंस्टीट्यूट ऑफ न्यूक्लियर फिजिक्स) के साथ मिलकर 25 एवं 26 सितंबर, 2008 को ''कांटलेक्स डिजीजेज: अप्रोचेज टु जीन आइडेन्टिफिकेशन एंड थेराप्यूटिक मैनेजमेंट'' विषय पर संगोष्ठी का आयोजन किया।
सितंबर 26, 2008	26.09.2008 को सीएसआईआर का स्थापना दिवस समारोह मनाया गया। इस समारोह में भारतीय रासायनिक जीवविज्ञान संस्थान के निदेशक, प्रो. सिद्धार्थ राय, ने स्वागत भाषण दिया। बोस इंस्टीट्यूट कोलकाता के निदेशक प्रो. शिवाजी राहा, ने उद्घाटन भाषण दिया। भारतीय विज्ञान संस्थान, बंगलोर के सूक्ष्मजैविकी एवं कोशिका जैविकी विभाग के प्रोफेसर वी. नागराज द्वारा स्थापना दिवस व्याख्यान दिया गया। व्याख्यान का विषय ''मेकैनिस्टिक एंड फंक्शनल इनसाइट्स इन्टु वेरियस डी एन ए ट्रांजैक्शन प्रोसेसेज'' था।
दिसंबर 10-12, 2008	''जेनेटिक टॉक्सिकोलॉजी : जिनोमिक ऐंड प्रोटेकयोमिक अप्रोचेज'' विषय पर 14वाँ अलेक्जेंडर हॉलैंडर पाठ्यक्रम तथा ''आर्सेनिक एक्सपोजर असेसमेंट'' पर विशेष कार्यशाला का आयोजन किया गया।
दिसंबर 29-30, 2008	28 एवं 29 दिसंबर, 2008 को विज्ञान में युवा नेतृत्व संबंधी सीएसआईआर कार्यक्रम (सीपीवाईएलएस-2008) का आयोजन किया गया। इस कार्यक्रम में कलकत्ता विश्व-विद्यालय के प्रतिकुलपति, प्रो. ध्रुवज्योति चट्टोपाध्याय, मुख्य अतिथि थे।
फरवरी 28, 2009	'राष्ट्रीय विज्ञान दिवस' मनाने के लिए भारतीय रासायनिक जीवविज्ञान संस्थान द्वारा अपने परिसर में आधारिक विज्ञान एवं स्वास्थ्यरक्षा में आई आई सी बी की नवीनतम उपलब्धियों की प्रदर्शनी के साथ-साथ प्रतिष्ठित वैज्ञानिकों के व्याख्यानों की श्रृंखला का आयोजन किया गया। भारतीय रासायनिक जीवविज्ञान संस्थान ने बंगाल विज्ञान संस्था, सी जी सी आर आई तथा भारतीय विज्ञान संवर्धन संस्था के साथ मिलकर संयुक्त रूप से मेघनाद साहा प्रेक्षागृह, सी जी सी आर आई में 'राष्ट्रीय विज्ञान दिवस कार्यक्रम' का आयोजन भी किया। इसके अतिरिक्त, भारतीय रासायनिक जीवविज्ञान संस्थान की बर्दवान यूनिवर्सिटी कैंपस में आयोजित दो-दिवसीय विज्ञान प्रदर्शनी में स्वास्थ्य रक्षा विज्ञान में आई आई सी बी के योगदान और भूमिका से संबंधित कई प्रदर्शों के साथ सक्रिय सहभागिता रही।
मार्च 27-29, 2009	सी एस आई आर, भारत और सिस्टम बायोजॉली इंस्टीट्यूट (एसबीआई), जापान के मध्य सहयोग के उभरते एवं संभावित क्षेत्रों के दायरे पर चर्चा करने के लिए कोलकाता में 27 से 29 मार्च 2009 तक ''सिस्टम्स बायोलॉजी एंड प्रोटेयोमिक्स इन बायोमेडिकल साइन्सेज'' विषय पर एक दो-दिवसीय लघु परिसंवाद का आयोजन किया गया। इस कार्यक्रम में प्रो. समीर कुमार ब्रह्मचारी, महानिदेशक, सी एस आई आर तथा प्रो. हीराआकी कीतानो, अध्यक्ष, एस बी आई भी उपस्थित थे।

CONTENTS

FROM DIRECTOR'S DESK

I would like to express satisfaction in presenting the Annual Report of this Institute for the period from April 2008 to March 2009. Like previous years, this year also the Institute publishes its Annual Report to disseminate a brief description of our year-long research activities with special reference to published works and patents to our friends, colleagues, alumni, well-wishers and scientific communities across the globe. Apart from the scientific contributions, this report also encompasses some critical information about our infrastructure, extramural funding, intellectual property and other various aspects of scientific management and administration.

The growth of an Institute, resembling ours, essentially depends on its R&D activities and IICB, like preceding years, continued its progress through developing and enhancing quality of science. The six major divisions are working in different biological fields with active collaboration among them to study common diseases and improve healthcare sciences. We have offered substantial attention to developing drug from our indigenous and natural resources like native Indian plants. The **Chemistry Division** provides meaningful contribution to Chemical Biology research by the application of principles of chemistry, with a target to add value to our abundant natural resources, by utilizing them to develop new drugs from locally available medicinal plants for the treatment of some major diseases in collaboration with other groups of this institute. The current research activities of this division are oriented on various aspects of synthetic and natural product chemistry *viz*. synthesis of novel nucleotides, chiral heterocycles, benz-annulated medium size rings, synthetic studies on heterocyclic chemistry, novel synthetic routes (enantioselective synthesis) to natural products, synthesis of anti-leishmanial compounds, studies on bacterial cell surface antigens, plant polysaccharides and neoglycoproteins, chemical investigation of medicinal plants for bioactive substances and studies on nucleic acid binding properties of natural products. The scientists of this division also have adapted themselves to Green Chemistry that will deliver more environmentally benign products and processes. The **Molecular & Human Genetics Division** is working to understand the molecular genetic basis of diseases common in Indian populations. The specific objectives of this division include study of molecular genetics on human diseases like haemophilia, glaucoma, Wilson disease and oculo-cutaneous albinism, to identify susceptible genes for leukoplakia and oral cancer, to study genetic toxicology, to study the molecular basis of the import of nuclear-encoded tRNAs into the mitochondria of the kinetoplastid protozoan Leishmania using a combination of biochemical and reverse genetic approaches. The **Infectious Disease & Immunology Division** is involved in various fields of biological sciences with special interest to Leishmania, Malaria and Cholera. Scientists of this division are involved in the studies of type IA, IB and III DNA topoisomerase with reference to molecular architecture and therapeutic development, macrophage biology using visceral leishmaniasis as model disease, status of micro RNA in Leishmania infection, development of mitochondrial pathology and oxidative stress to promote hepatocyte apoptosis in Malaria infection, competitive exclusion of classical biotype by El Tor biotype of *V. cholerae* and evolution of hybrid *V. cholerae* O1 biotype El Tor. The scientists in the **Cell Biology & Physiology Division** are working with a common goal of understanding the molecular basis of pathophysiology of a number of metabolic and degenerative diseases. The interests of this division fall under the areas of cardiac hypertrophy, diabetes, drug addiction, neurodegenerative diseases, utero-ovarian dysfunction and responses to pathogens in hematopoietic system. A recent addition to these areas is stem cell biology in relation to carcinogenesis, corneal limbal cell culture in the laboratory with an

aim to use in humans, and stem cell differentiation to neurons and their transplantation in animal models. Significant contributions have been made in normal physiological functions of hormone-receptor mediated gene expression, bioenergetics of ion transport regulation, neural development, mitochondrial functions, and signal transduction events. The **Drug Development, Diagnostics & Biotechnology Division** is involved in studies on bioactive compounds for improving health and quality of life, as also for promoting future economic growth through innovation in biotechnology. The major field of activity includes therapeutics principles from medicinal plants and venoms; mechanism of gastric ulceration; engineer plant genes for improved production of pharmaceuticals/nutraceuticales; immunodiagnostic strategies; analytical evaluation of herbal medicines; nanocapsulated drug delivery; molecular mechanisms of trehalose metabolism and microbial glycosidase enzymes whereas the **Structural Biology & Bio-informatics Division** carry out research in areas that focus on structural characterization of potentially prospective biological macromolecules and other small molecules of therapeutic interest against various diseases, *e.g.* tuberculosis, leishmaniasis, cholera, cancer, diabetes and for other anti-inflammatory, anti-convulsant and immunomodulatory activities. Fundamental studies on protein functions, protein-protein and protein-nucleic acid interactions applying modern sophisticated technologies like nuclear magnetic resonance (NMR), X-ray crystallography, analytical ultracentrifuge, fluorescence correlation spectroscopy, stopped-flow spectrometry, mass-spectrometry, quantitative structure activity relationship (QSAR) and 3D-QSAR are also being pursued. Softwares are being developed for genome / proteome analysis, prediction, modification and analysis of macromolecular structures and for elucidating their interactions with bioactive molecules.

In past years, IICB has pioneered several areas of biological sciences in India. In continuation to this effort, our Institute is once again entering into a modern field of biological sciences and expanding its research activities in Systems Biology and Synthetic Biology. In this regard, a two-days' mini-symposium on "Systems Biology and Proteomics in Biomedical Sciences" was organized by IICB at Kolkata. Several scientists from Japan and India participated in this symposium to discuss the scope of these emerging areas and possible areas of cooperation. As a major achievement in this symposium, CSIR and the Systems Biology Institute (SBI, Tokyo Japan) have signed a Memorandum of Understanding (MoU) to seek for collaborative initiatives to promote systems biology and its medical and environmental applications in India and Japan. IICB will coordinate the above collaborative programme.

The Alexander Hollaender Course (AHC) is organized every year in countries where environmental mutagenesis and health issues are of major concerns. This time, the "14th Alexander Hollaender Course on Genetic Toxicology: Genomic and Proteomic Approaches" and a Special Workshop on "Arsenic Exposure Assessment" were held under the auspices of IICB. This is the first occasion, this prestigious event has been hosted in India. The course and workshop were intended to review the advances in environmental mutagenesis and health.

IICB along with other research institutes of Kolkata organized HUGO (The Human Genome Organization) satellite symposium on "Complex Diseases: Approaches to Gene Identification and Therapeutic Management". The symposium was attended by a large number of scientists and scholars from various research institutes. Several eminent scientists from across globe were invited to speak including the president of HUGO, Dr. Edison Liu and they delivered lectures on latest development in the focused areas of the symposium.

IICB and Calcutta National Medical College & Hospital jointly organized a neuroscience conference, Neuroupdate 2008, participated by clinicians and basic neuroscientists. The hallmark of this conference was to bring together of basic neuroscientists, neurologists and students from both medical & basic sciences, as well as patients or the immediate relatives on a common platform for an effective dissemination of knowledge and fruitful discussion on the recent advances in basic and clinical researches on neuroscience.

On National Science Day, IICB organised a series of

lectures by eminent scientists in its premises along with an exhibition on recent achievements of IICB in basic science and healthcare. The Institute also jointly organised 'National Science Day Programme' with CGCRI, Science Association of Bengal and Indian Association for the Cultivation of Science. Moreover, IICB actively participated in a two-day Science Exhibition at Burdwan University campus with a number of exhibits relating to the contribution and role of IICB in Healthcare Sciences.

The CSIR Programme on Youth for the Leadership in Science for the year 2008 (CPYLS-2008) in West Bengal was coordinated by IICB. The programme was attended by 110 students from various parts of West Bengal.

IICB has produced a documentary film on the Institute itself - 'MILES TO GO.....' directed by eminent film-maker Mr. Goutam Ghose.

In Eleventh Five Year Plan, IICB proposed network projects in 3 different sectors *e.g.* (i) Biology & Biotechnology, (ii) Pharmaceuticals, Healthcare & Drugs and (iii) Ecology & Environment. Sixteen projects have been granted to IICB of which 4 are Nodal Network Projects and 12 are Partner Network Projects. In Partner Network Projects, there are two extension Projects of Tenth Plan. All the projects are mainly from Biology & Biotechnology sector except one nodal network project which is from Pharmaceuticals, Healthcare & Drugs sector.

A steady number of quality publications in high to very high impact journals are the hallmark of the Institute's progress in research and the average impact factor of publications is increasing continuously. I feel proud to notice that the average impact factor of publications of IICB is almost 3.0 this year.

During the reporting period, IICB has filed thirteen national and international patents related to synthesis, diagnosis, vaccination, extraction of bioactive compounds from herbal resources to combat against kala-azar, prostate diseases, blood cancer, diabetes and other common human diseases. Total seven patents have been granted in this period and out of them six patents are granted abroad. Prostalyn, a drug for the treatment of benign prostate hyperplasia has been launched in market by East India Pharmaceutical Works Limited, Kolkata, the technology of which is developed by the scientists of IICB. The technology developed in IICB for an anti-CML herbal extract is on Phase-II clinical trial by Piramal Life Sciences Limited, Mumbai (formerly known as NPIL) and also referred in Nature Review Drug Discovery.

IICB has always remained as a choice for budding scientists with aspiration to work in biological and chemical fields. This year the institute has attracted a large number of bright, young research fellows and research associates from all over the country to generate adequate and trained human resource in the different fields of Biology and Chemistry and related areas for meeting the requirement of cutting edge research. During 2008-09, around 200 fellows and research associates worked in this Institute with strong motivation of work in basic and applied fields of research and generated excellence. A large number of distinguished scientists both from India and abroad visited, delivered lectures and held discussions with the research groups in IICB. About 145 students from different Universities and Institutes of India received summer training and other training programmes. A large number of Scientists were involved in teaching and training programmes of neighbouring universities and institutes. Despite organizing different scientific symposia the Institute also observed Institute Foundation Day and CSIR Foundation Day.

I extend my cordial gratitude to all the scientific, technical and administrative staff of our Institute for their year long sincere activity and cooperation in sustaining growth and maintaining the reputation of IICB. I also believe that the dedication offered by my colleagues will raise the Institute to a new height in coming days.

Prof. Siddhartha Roy
IICB, Kolkata

Performance at a Glance

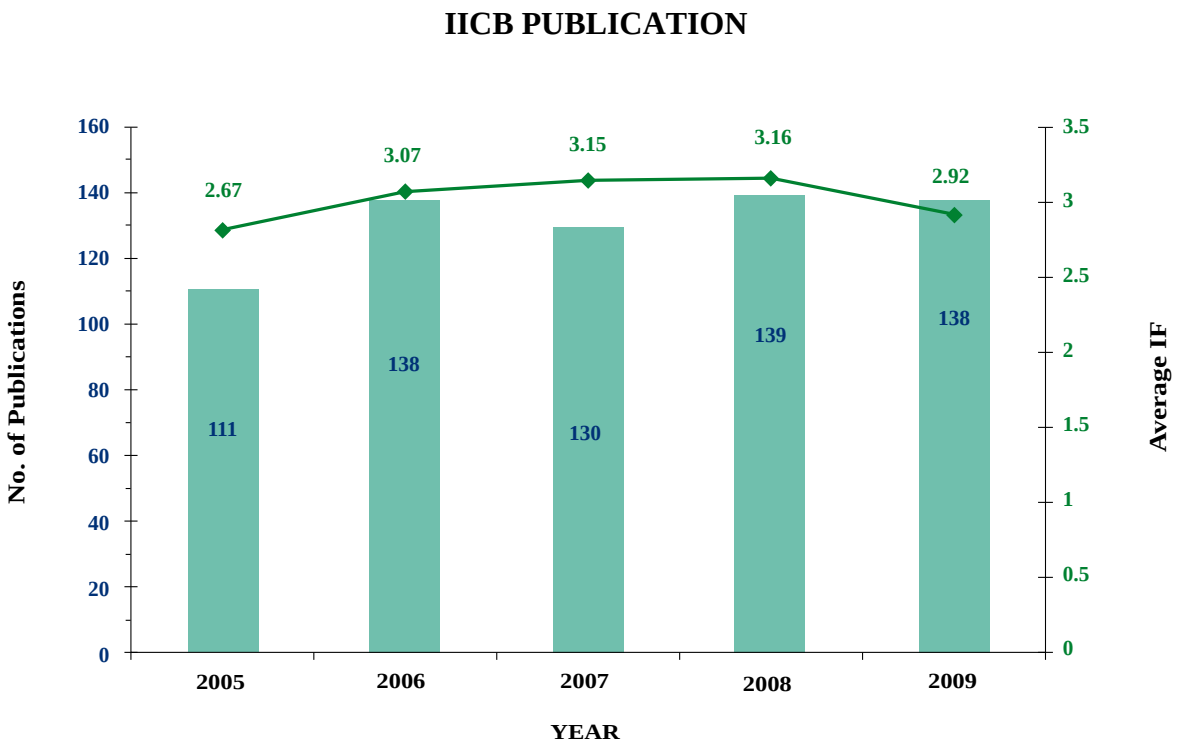
THE LAURELS

- Dr. K. P. Mohanakumar was elected Fellow of National Academy of Sciences (India), Allahabad
- Dr. Uday Bandhopadhyay was elected Fellow of National Academy of Sciences (India), Allahabad
- Dr. Chitra Mandal was awarded the Senior Scientist Oration Award for the year 2008 by the Indian Immunology Society
- Dr. H. K. Majumder was awarded Prof. B. K. Bachhawat Memorial Lecture Award by National Academy of Sciences, India in 2008
- Dr. B. C. Pal was elected Fellow of the West Bengal Academy of Science and Technology
- Dr. G. Suresh Kumar was elected Fellow of the West Bengal Academy of Science and Technology
- Dr. Nahid Ali was elected Fellow of the West Bengal Academy of Science and Technology
- Dr. Agneyo Ganguly was awarded the Platinum Jubilee Young Scientist Award, 2008 by National Academy of Sciences, Allahabad

Performance at a Glance

PUBLICATIONS

A steady number of quality publications are the hallmark of the Institute's progress in research. Year-wise publications* and average impact factor (IF) for the last five years are given below:



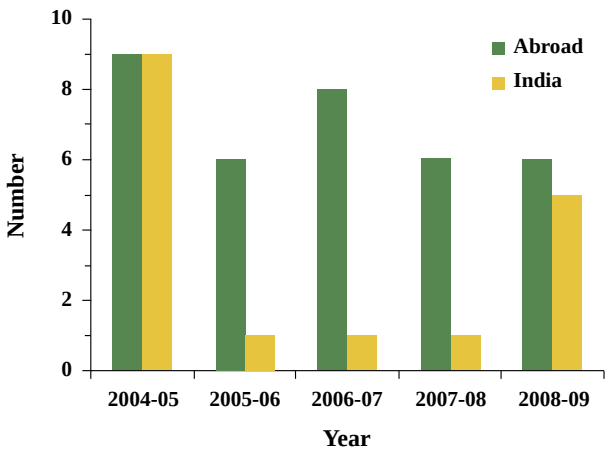
*Detailed list of publications for 2008-09 is given inside separately.

Performance at a Glance

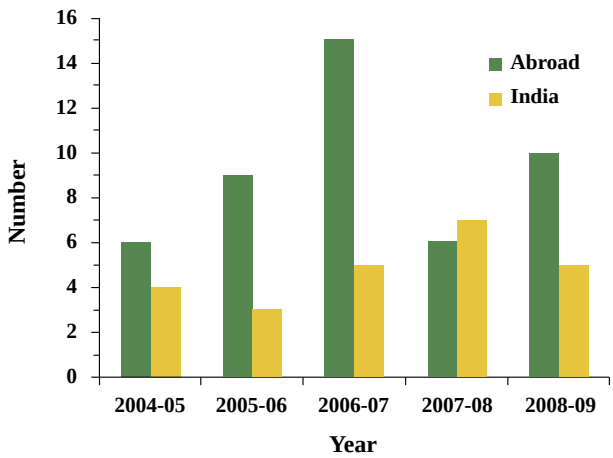
PATENTS

A steady number of patents* are filed and granted every year from the Institute. The following diagrams depict the number of patents granted and filed during the last five years.

PATENTS GRANTED



PATENTS FILED



*Lists of patents filed and granted in 2008-09 are given inside in the reports of P&I-PME Division.

Performance at a Glance

IICB-INDUSTRY PARTNERSHIP TIE-UPS

The Institute is continuously building synergy with the industries and successfully converting knowledge into wealth. This year, IICB scientists have managed to sustain the same level of interaction with the industry and earn a considerable amount of both human and financial resources.

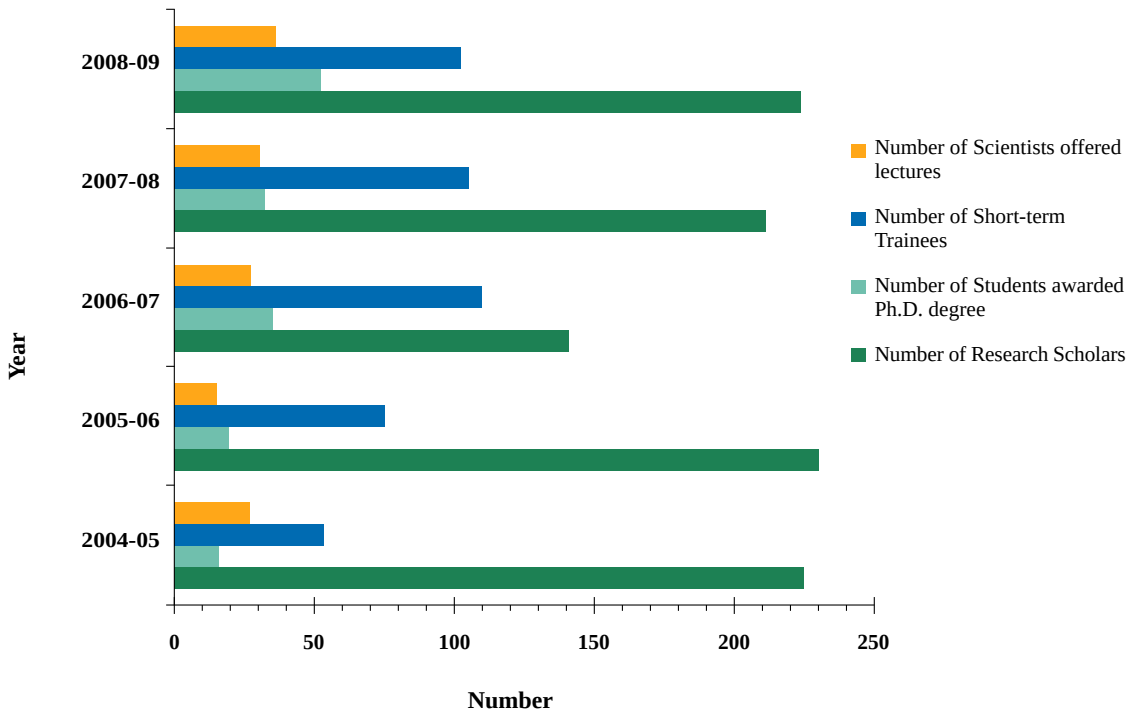
Our partners for the overall growth towards GATT-India regime are as follows:

- ⇨ Albert David Ltd., Kolkata
- ⇨ Angiogen Pharmaceuticals, Australia
- ⇨ Biotech Consortium (I) Ltd., New Delhi
- ⇨ Chatterjee Management Services Pvt. Ltd., Kolkata
- ⇨ Chembiotech Research Intl. Pvt. Ltd., Kolkata
- ⇨ Coir Board, Kochi
- ⇨ Dey's Medical Stores (Mfg.) Ltd., Kolkata
- ⇨ DNDi, France
- ⇨ East India Pharmaceutical Works Ltd., Kolkata
- ⇨ Merial SAS Lyn, France
- ⇨ Piramal Life Sciences Ltd., Mumbai
- ⇨ Qualpro Diagnostics, Goa
- ⇨ Santha Biotechnics Ltd., Hyderabad
- ⇨ Zephyr Biomedical, Goa

Performance at a Glance

HUMAN RESOURCE DEVELOPMENT

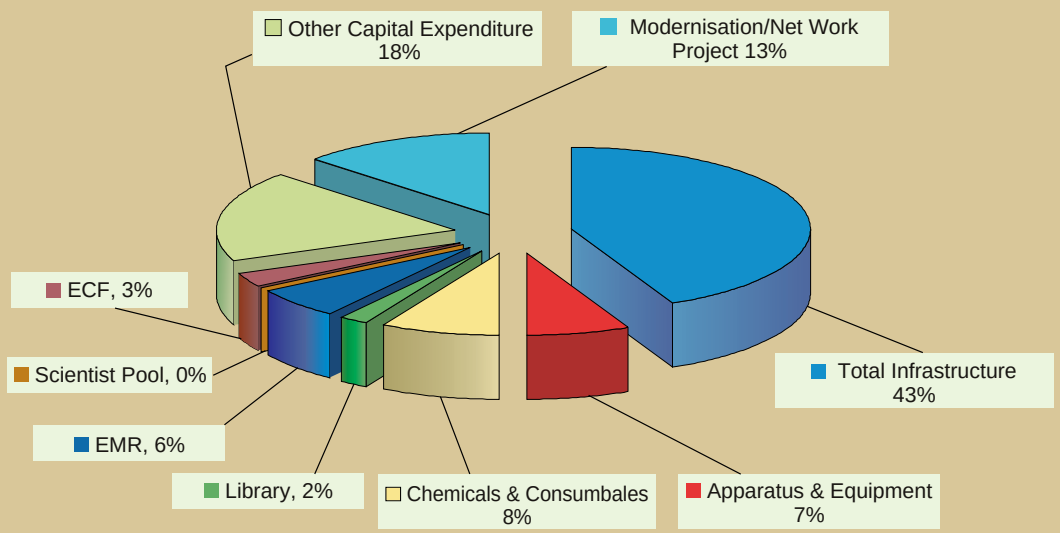
A number of research scholars carry out research at Doctoral and Post-doctoral levels each year. Several students from various universities of the country get short-term training in every year. Data for the last five years are presented graphically.



Performance at a Glance

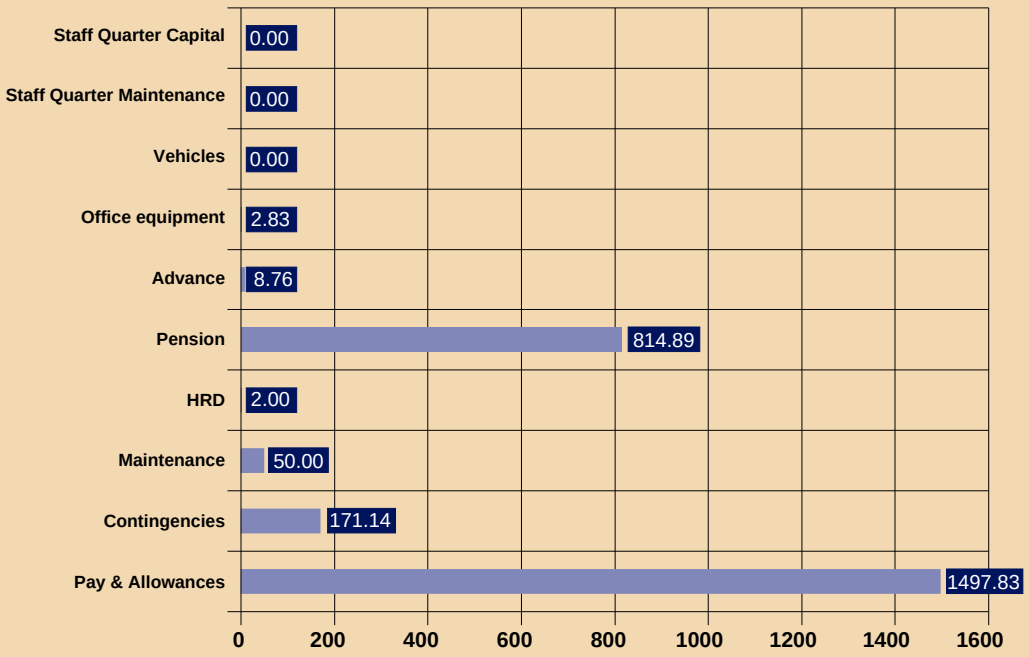
R & D AND TOTAL EXPENDITURE BREAK-UP 2008-09

SOURCE : IICB



INFRASTRUCTURAL BREAK-UP 2008-09

SOURCE : IICB



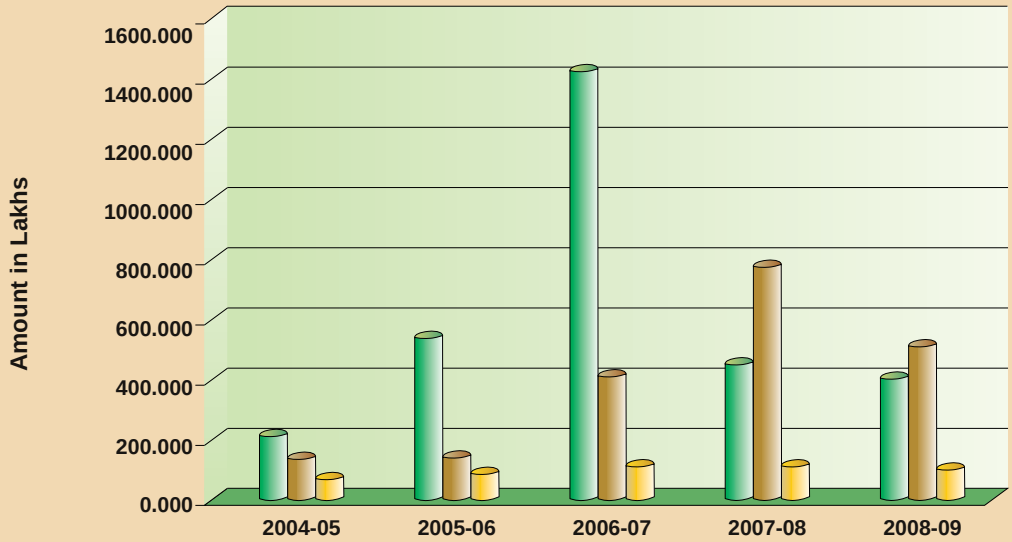
	Pay & Allowances	Contingencies	Maintenance	HRD	Pension	Advance	Office equipment	Vehicle	Staff Quarter Maintenance	Staff Quarter Capital
Amount in Lakhs	1497.83	171.14	50.00	2.00	814.89	8.76	2.83	0.00	0.00	0.00

Performance at a Glance

YEARLY EXPENDITURE

W.E.F. 2004-05 TO 2008-09

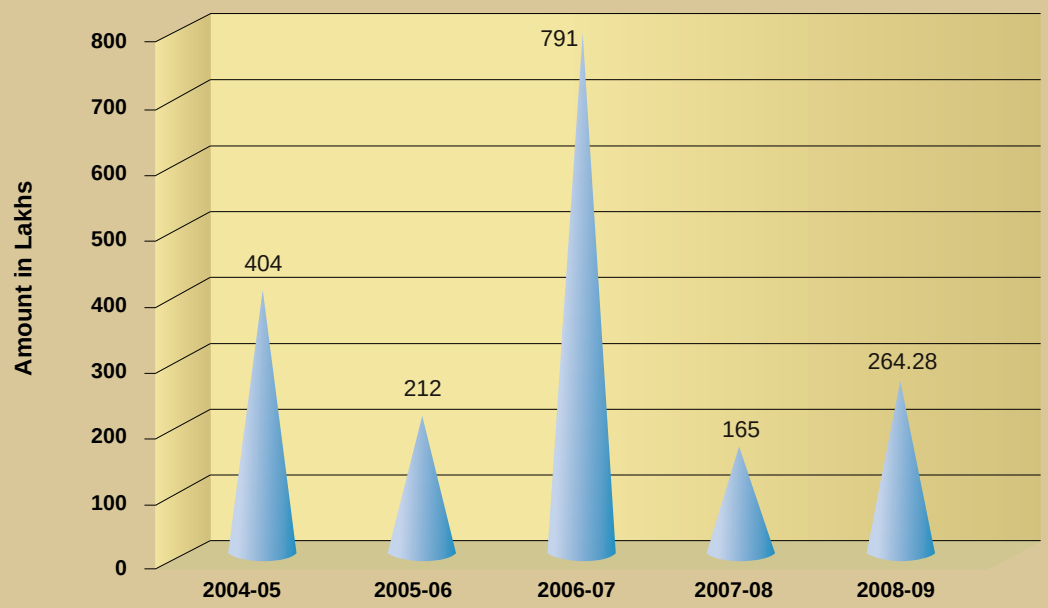
SOURCE : IICB



	2004-05	2005-06	2006-07	2007-08	2008-09
Apparatus & Equipment	1210.87	538.51	423.14	49.84	402.58
Chemicals & Consumables	135.73	129.01	409.15	775.00	509.74
Library	73.39	86.11	110.16	109.79	99.91

EXTERNAL CASH FLOW OF IICB

SOURCE : IICB

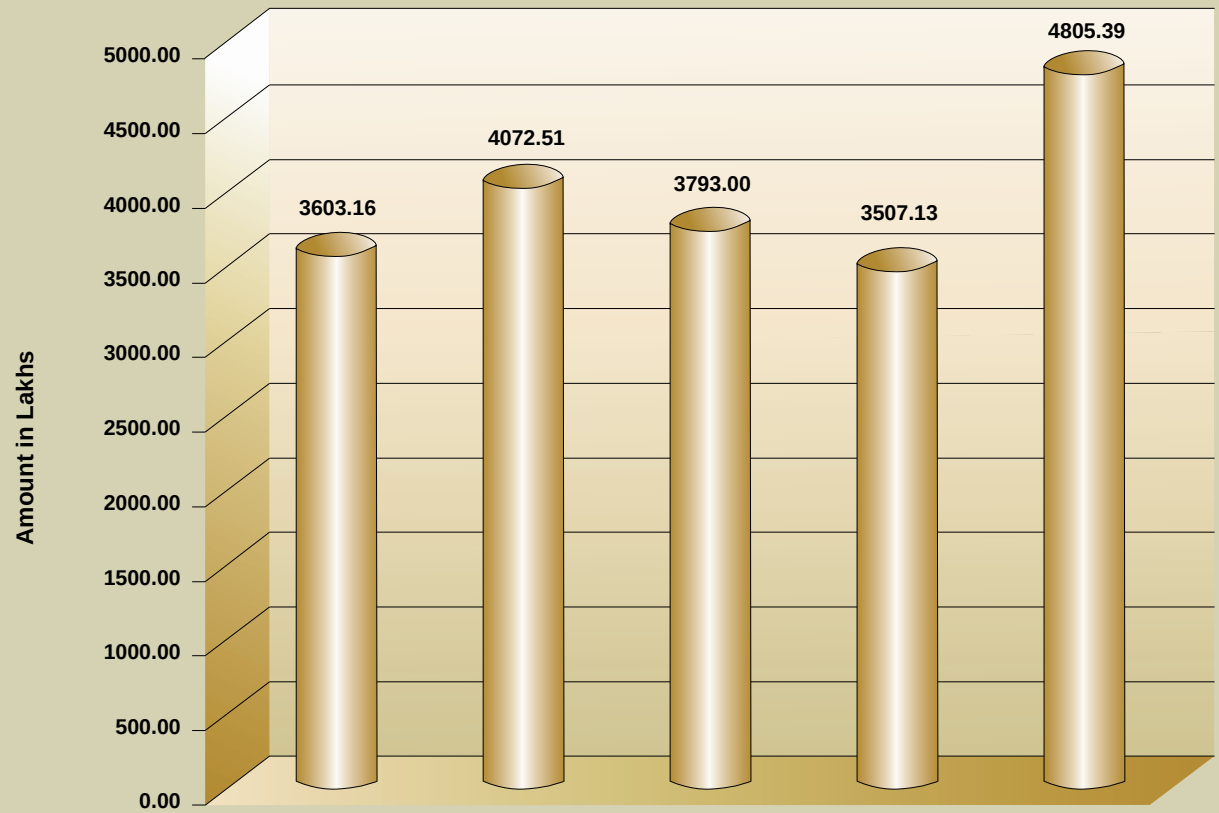


	2004-05	2005-06	2006-07	2007-08	2008-09
Amount in Lakhs	404	212	791	165	264.28

Performance at a Glance

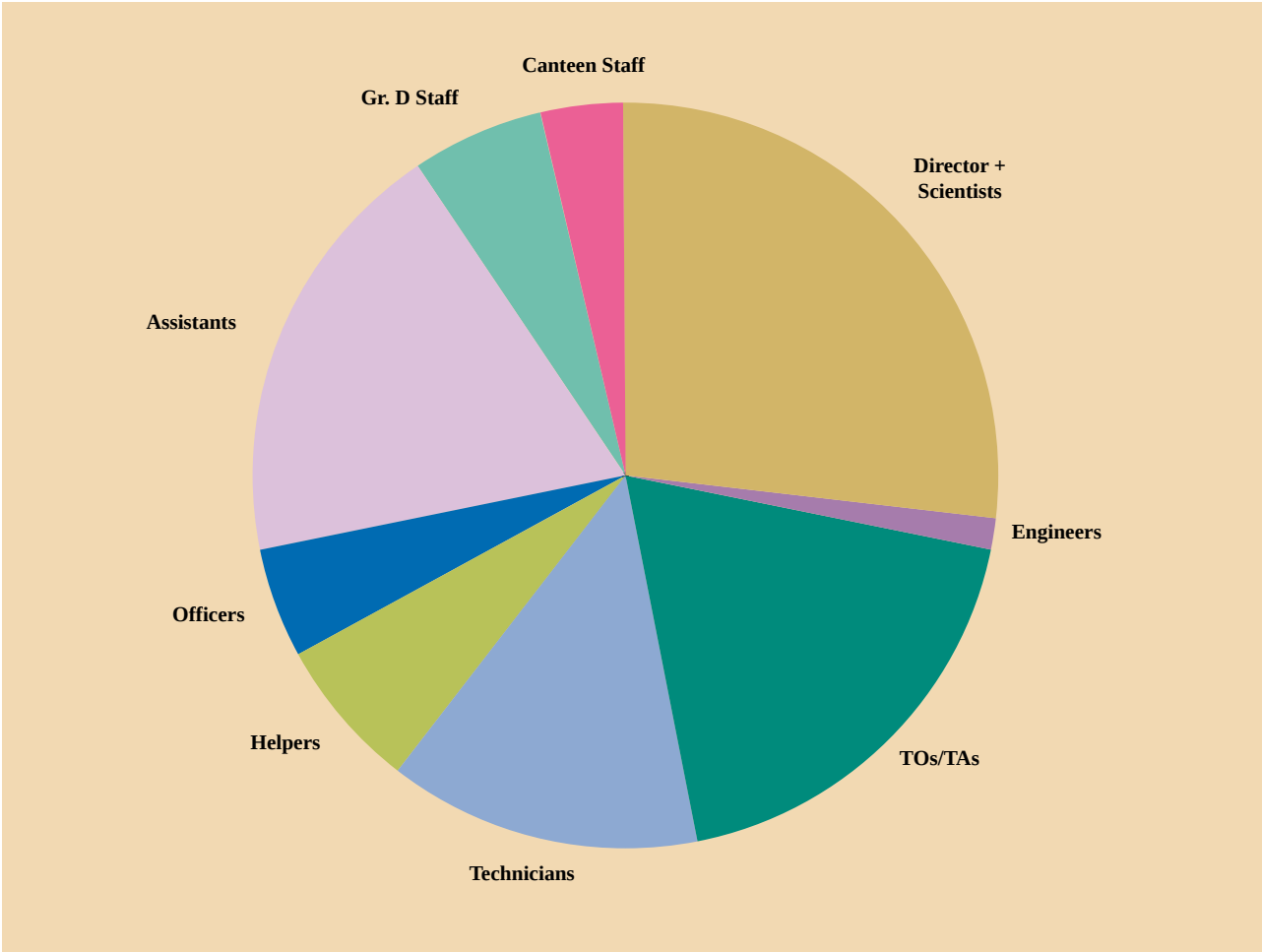
YEAR-WISE GRANT RECEIVED FROM CSIR

SOURCE : IICB



	2004-05	2005-06	2006-07	2007-08	2008-09
Amount in Lakhs	3603.16	4072.51	3793.00	3507.13	4805.39

STAFF STRENGTH AS ON MARCH 31, 2009



Total Staff : 279

S &T Staff : Director - 1, Scientists - 74, Engineers - 4, Technical Officers & Assistants - 53, Technicians - 37, Helpers - 19.

Administrative Staff : Officers - 13, Assistants - 53, Gr. D - 16, Canteen Staff - 10

<u>Staff Ratio</u>

Scientists : Technical Staff : Supporting Staff = 1 : 1.3 : 1.5

INFECTIOUS DISEASES AND IMMUNOLOGY

Drs. Hemanta K. Majumder, Pijush K. Das, Chitra Mandal, Syamal Roy, Santu Bandopadhyay, Nahid Ali, Rukhsana Chaudhury, Rupak Bhadra, Mrs. Neeta V. M. Khalkho, Debjani Mandal, Tripte De, Uday Bandopadhyay, Malini Sen, Mridula Misra, Mita Chatterjee Debnath

Research activity of infectious diseases and immunology group involves various fields of biological sciences with special interest to *Leishmania* and *Cholera*.

Dr. H. K. Majumder and group

Molecular architecture of type IB DNA topoisomerase of Leishmania with reference to identification of residues indispensable for catalytic activity of the enzyme

Topoisomerases are ubiquitious enzymes that resolve the torsional strain in DNA built up during vital cellular processes such as replication, transcription, recombination etc. The unusual bi-subunit topoisomerase IB of *Leishmania* is a paradigm shift in the evolution of type IB topoisomerases.

Kinetoplastid topoisomerase IB is an unusual bisubunit enzyme where reconstitution of the large (LdTOPIL or L) and small (LdTOPIS or S) subunits shows functional activity. From the vanadate complex crystal structure of *Leishmania donovani* topoisomerase I, several amino acid residues have been implicated to be involved in the catalytic reaction. Although several predictions and propositions have been made, the exact role of these amino acids has not yet been clearly demonstrated *in vitro*. Among these residues, lysine 352 and arginine 314 stand as potential candidates for playing the role of a general acid during the cleavage step. In this study, we have characterized the role of lysine 352 on the large subunit, by site-directed mutagenesis and have tried to identify the general acid that can protonate the 5'-O atom of the leaving strand. Studies with the mutant enzymes reveal that, relaxation activity was severely affected when Lys352 was mutated to arginine or alanine (K352R or K352A). Mutation of Arg314 to Lys (R314K) has very little effect on the relaxation activity. Detailed study reveals that both cleavage and religation steps are severely affected in case of K352R and K352A and the cleavage religation equilibrium is shifted towards the cleavage. On the contrary, the R314K mutant exhibits only a slightly slower rate of cleavage compared to wild-type enzyme. Cleavage assays with an oligonucleotide containing 5'-bridging phosphorothiolate indicate that Lys352 acts as a general acid in the cleavage step. Altogether, this study establishes the indispensable role of lysine 352 in the catalytic reaction of *L. donovani* topoisomerase I.

Type IB topoisomerase of Leishmania with reference to development of therapeutics

The enormous development of molecular and cellular biology in recent times have provided opportunity for discovering newer molecular targets for drug designing, which form a rational basis for the development of improved anti parasitic therapy. This laboratory has been involved in developing DNA topoisomerase targeted anti-leishmanial agents.

3,3'-Diindolylmethane (DIM), a novel poison targeting *Leishmania donovani* topoisomerase I (LdTOP1LS), induces programmed cell death in *Leishmania* parasites. The development of resistant parasites by progressive adaptation with increasing concentrations of DIM generates random mutations in LdTOP1LS. Single-nucleotide mutations result in the amino acid substitutions F270L and K430N in the large subunit and N184S in the small subunit of the enzyme. DIM failed to inhibit the catalytic activity of the recombinant mutant enzyme (LdTOP1DRLS). Transfection studies of the mutant genes showed that the mutated topoisomerase I confer DIM resistance on wild-type *Leishmania* parasites. Site-directed mutagenesis studies revealed that a substantial level of resistance is conferred by the F270L mutation alone; however, all three mutations (F270L, K430N, and N184S) together are required to reach a higher-resistance phenotype. DIM fails to stabilize the topoisomerase I–DNA covalent complexes in the F270 mutant. Moreover, DIM cannot interfere with the religation step in the catalytic cycle of the recombinant F270L mutant enzyme. Taken together, these findings identify novel mutations in topoisomerase I that hinder its interaction with DNA, thereby modulating enzyme catalysis and conferring resistance to DIM. These studies advance our understanding of the mechanism of cell poisoning by DIM and suggest a specific modification of the drug that may improve its efficacy.

Identification of Tyrosyl DNA Phosphodiesterase 1 (Tdp 1), a DNA repair enzyme

Tyrosyl DNA phosphodiesterase 1 (Tdp1) is a member of phospholipase D superfamily, conserved from yeast to humans, which cleaves a broad range of 3' DNA adducts, the best characterized of which is the phosphodiester bond formed between DNA and topoisomerase IB. This study describes for the first time the cloning and functional characterization of the enzyme in DNA damage repair pathway in kinetoplast parasite *Leishmania donovani*. The protein is termed as LdTdp1. Sequence analysis study confirmed conservation of the active site motifs typical for Tdp1 family. Transcriptional downregulation of the gene was observed during CPT and H_2O_2 mediated apoptotic death of the parasites indicating a regulatory role played by the gene. Enforced expression of the active enzyme protected the parasites against CPT and H_2O_2 mediated cytotoxicity. Overproduced Tdp1 reduced the DNA damage mediated by CPT inside the cells. The protein was found to localize inside the parasite nucleus harboring the nuclear localization signal (NLS) at its C-terminus. LdTdp1 transcripts and protein levels were observed to be higher during non dividing and oxidative stress resistant stationary phase of *L. donovani* parasites compared to proliferative logarithmic phase suggesting a role of LdTdp1 in handling DNA damage repair in highly oxidative environment. Recombinant LdTdp1 was found to be active in vitro on 3'-tyrosine linked oligonucleotide substrate that mimicked the in vivo substrate of the enzyme. Altogether, this study reports for the first time, a tyrosyl DNA phosphodiesterase 1 protein in kinetoplastid parasites, which actively participate in removing trapped topoisomerase 1 from topo I- DNA dead end complexes generated from endogenous or exogenous sources, enabling the parasites to gain resistance against topoisomerase inhibitors.

Identification of DNA topoisomerase IA and III

DNA topoisomerases of kinetoplastids represent a family of DNA processing enzymes that essentially solve the topological problems not only in nuclear DNA but also in kinetoplastid DNA. Type I topoisomerases are classified in two subfamilies, IA and IB, based on differences in amino acid sequence and reaction mechanisms. Role of IB type of topoisomerase is well studied in *L. donovani*. Apart from this, three type IA topoisomerases are there in the parasite genome, termed as topoisomerase IA, and two topoisomerase III.

Kinetoplastids are 'living bridges' in the evolution from prokaryotes to higher eukaryotes. A key member of this foray is DNA topoisomerase IA of *Leishmania* (LdTOPIA), which we have identified and functionally characterized for the first time *in vitro* and *in vivo*. The strong prokaryotic lineage of LdTOPIA is evident from the conservation of active site residues and its ability to complement bacterial TopA null mutant strains. The Mg^{2+} dependent relaxation activity of only negatively supercoiled plasmids and the preference for single stranded substrates exhibited by recombinant LdTOPIA overexpressed in *Leishmania* conclusively establishes its evolutionary ancestry from prokaryotes. But eukaryotic features include adaptation for the compartmentalized structure wherein the enzyme localizes in the nucleus and kinetoplast and has a codon bias for expression. The enzyme prevents DNA gyrase induced hypernegative supercoiling and thereby inhibits R-loop formation inside the TopA null mutant bacterial strain. All these properties of LdTOPIA make it an attractive molecular target for drug development. Our study on the basic understanding of the properties of LdTOPIA paves a future path in therapeutic interventions against leishmaniasis.

While the function of topoisomerase II and I are quite well established, the role of topoisomerase III in DNA metabolism has remained largely enigmatic. There is more known about its biochemical activities than its role in the cell. Genes encoding topoisomerase III enzymes are highly conserved in evolution from bacteria to human, and the phenotypic consequences of loss of topoisomerase III function are generally quite severe. It has been shown to possess a weak, ATP independent relaxation activity towards negatively supercoiled DNA only and strict dependence on magnesium. We have, for the first time, identified and characterized *L .donovani* homologue of bacterial and eukaryotic topoisomerase III *in vivo*, in order to get insight into its importance in *Leishmania* biology. The two topoisomerase III genes were cloned and amino acid sequence analysis revealed that one of the two proteins shares 47.84 % identity with *H. sapiens* top IIIβ and 45% identity with *D. melanogaster* top IIIβ and termed as LdtopIIIβ. The second topo III showed to be divergent from the first one and shares significant homology with top III of *A. thaliana*, termed as LdtopIIIα. Complementation study of wild type and mutant LdtopIIIβ with slow growing topo3 mutant yeast *S. cerevisiae* revealed the functional conservation of the leishmanial counterpart of topoIIIβ enzyme, the 327-tyrosine residue being the active site amino acid. A C-terminal deletion construct of LdtopIIIβ could not suppress the slow growth phenotype of mutant yeast revealing the requirement of C-terminal region for the enzyme function *in vivo*. Localization study with the LdtopIIIβ indicated nuclear specific localization of the protein whereas LdtopIIIβ localized inside the nucleus and also in the kinetoplast, which indicates organelle specific differential function played by the two proteins in the parasite.

Dr. Pijush K. Das and group

The work in my laboratory is centered on studying macrophage biology using visceral leishmaniasis as a model disease of macrophage. It may be broadly divided into two aspects: direct therapeutic approaches in general for macrophage-associated diseases and indirect therapeutic approaches based on unique cellular or metabolic events. In the indirect therapeutic approaches we concentrated on two fundamental problems of parasite biology 1) the homing of *Leishmania* parasites in their physiological address and 2) mechanism by which *Leishmania* parasites neutralize the hostile microbicidal machinery of activated macrophages in order to establish infection. In our direct therapeutic approaches, earlier we showed that cystatin, a natural cysteine protease inhibitor, could act as a strong macrophage actvating agent. We went on to dissect the minimal peptide sequence necessary for immunomodulatory

activity and showed that the peptide derived from cystatin has strong antileishmanial activity with curative effect on experimental visceral leishmaniasis associated with upregulation of nitric oxide and favourable T cell response. We further studied the transductional mechanisms underlying these cellular responses in the murine macrophage cell line RAW 264.7 and in the BALB/c mouse model of visceral leishmaniasis using specific inhibitors and dominant-negative constructs of various interacting kinases and transcription factors. Cystatin synergizes with IFN-γ in inducing ERK1/2 phosphorylation and NF-γB DNA binding activity. Pretreatment of cells with specific inhibitors of NF-κB or ERK1/2 pathway blocked the cystatin plus IFN-γ inducible NF-B activity and markedly reduced the expression of iNOS both at mRNA and protein level. Silencing of mitogen- and stress-activated protein kinase (MSK1) significantly reduced cystatin-mediated NF-κB-dependent iNOS gene transcription suggesting the involvement of MSK1 activation in ERK1/2 signaling. DNA binding as well as silencing experiments revealed the requirement of IFN-γ-mediated JAK-STAT activation even though cystatin did not modulate this signaling cascade by itself. In the *in vivo* situation, key steps in the activation cascade of NF-κB, including nuclear translocation of NF-κB subunits, IκB phosphorylation and IκB kinase, are all remarkably enhanced in *Leishmania*-infected mice by cystatin. Understanding the molecular mechanisms through which cystatin modulates macrophage effector responses will contribute to better define its potential for macrophage-associated diseases, in general. In our indirect therapeutic approaches on comprehensive understanding of cyclic nucleotide signaling in the establishment of *Leishmania* infection in macrophages, we earlier showed the importance of increased intracellular cAMP response in the life cycle and infectivity of *Leishmania* parasite. We are now trying to decipher the role of specific phosphodiesterase isoforms in the regulation of intracellular cAMP response.

Future plans include (i) detailed molecular characterization of phosphodiesterases for comprehensive cyclic nucleotide signaling in the infectivity of parasites, (ii) studies on dysfunction of macrophage signal transduction mechanisms due to Leishmania infection and the role of arginase. (iii) in vivo effects of immunomodulators of natural origin regarding organ specificity, pharmacokinetics as well as various upstream signaling pathways for NF-κB activation leading to up-regulation of iNOS and Th1 cytokines.

Dr. (Mrs.) Chitra Mandal and group

Impact of Glycosylation of Biomoleculs in health and disease

Sialic acids and its derivatives are found in nearly all higher animals studied and in certain bacteria and have been recognized to play a pivotal role in modulating various biological and pathological processes such as cell-cell and virus-cell adhesion, signalling, differentiation, immune reactions including apoptosis and malignancy. The main attention of my laboratory is focused on identification of modified sialylated structures, the understanding the importance of modulation of sialylation, its biological role and their utility as potential disease-associated biomarkers for monitoring patients with leukemia and visceral leishmaniasis. The following projects are ongoing to address the above points.

(1) Sialic acids in Visceral Leishmaniasis (VL)

We have earlier established an enhanced presence of 9-*O*-acetylated sialoglycoconjugate *(9-O*-AcSG) on erythrocyte of patients with VL and developed a user friendly, simple blood based assay for the

diagnosis by detecting disease specific antigen. These 9-*O*-AcSG triggers the alternate complement pathway in VL.

Over expression of 9-*O*-AcSGPs on peripheral blood mononuclear cells (PBMC) of these patients ($PBMC_{VL}$) has also been found. Recently we have demonstrated the contributory role of these sialoglycotopes on $PBMC_{VL}$ as immunomodulatory determinants. Sensitized $PBMC_{VL}$ showed a mixed T_H1/T_H2 cellular response with a predominance of the T_H1 response, indicating the ability of 9-*O*-AcSGPs in modulating the host cell towards a favorable response. Interestingly, humoral and cellular response showed a good correlation. Further high levels of anti-9-*O*-AcSGPs antibodies in the order of distribution IgM>IgG1=IgG3>IgG4>IgG2>IgE could be explained by the preponderance of a mixed T_H1/T_H2 response. A good correlation of enhanced 9-*O*-AcSGPs with both cell mediated and humoral response was observed. Therefore, it may be concluded that sensitization of 9-*O*-AcSGPs on $PBMC_{VL}$ may provide a basis for the modulation of the host's immune response by their controlled expression leading towards a beneficial immune response influencing the disease pathology.

Additionally, we have demonstrated the increased presence of 9-*O-AcSA* on promastigotes of virulent *Leishmania donovani* as compared to avirulent UR6 and their subsequent role in entry within macrophages.

Antibodies directed against these sialoglycotope are important source of classical complement activator even under normal physiological conditions suggesting their role in conferring host protection against parasite infection.

Future plan:

- Analysis of a few affinity purified sialoglycans from erythrocytes and PBMC of VL patients and parasites through proteomic approaches
- Biological significance of differentially expressed identified sialoglycans
- Investigation of differential glycosylation pattern on different clinical isolates

(2) Sialate-O-acetyltransferase (SOAT) in lymphoblasts of childhood Acute Lymphoblastic leukaemia (ALL)

Earlier studies have established an enhanced presence of leukaemia-associated 9-*O*-acetylated sialoglycoproteins ($Neu5,9Ac_2\text{-}GP_{ALL}$) and gangliosides (9-OAcGD3) on lymphoblasts of ALL but not in corresponding cells of healthy children or in patients with other haematological disorders. The high level of $Neu5,9Ac_2\text{-}GP_{ALL}$ and antibodies against $Neu5,9Ac_2\text{-}GP_{ALL}$, characteristics of this disease, help these lymphoblasts to evade apoptosis. The cell surface $Neu5,9Ac_2\text{-}GP_{ALL}$ and anti-$Neu5,9Ac_2\text{-}GP_{ALL}$ antibodies have been used for monitoring the disease status. Therefore, it is necessary to get more information about the enzymes responsible for regulation of the expression of *O*-acetylated sialoglycotopes.

Recently, we have observed 24.34 fold enhanced sialate-*O*-acetyltransferase (sialate-*O*AT) activity in lymphoblasts of bone marrow (BM) and peripheral blood (PB) of B- and T-ALL patients at diagnosis as compared to normal healthy donors. V_{max} of the enzymatic reaction was 14.27 fold higher than

normal. The enzyme sialate-*O*AT transfers acetyl group only to sialic acid as evidenced by various approaches. A positive correlation was observed between sialate-*O*AT activity and the Neu5,9Ac_2-GPs_{ALL}^+ cells found in patients. Sialate-*O*AT increased at presentation of disease, decreased with clinical remission and sharply increased in patients that relapsed as monitored by a newly developed ELISA. This information adds considerable knowledge to our understanding of the *O*-acetylation of sialic acids in animals and human in general and not only in leukaemia. It may lead to the identification of a novel drug target.

Future plan:

- Exploration of other enzymes responsible for modulation of sialylation in leukaemia
- Identification of a few affinity purified sialoglycans from lymphoblasts through proteomic approaches
- Search for new anti-leukemic compounds and identification of targets
- Factors responsible for mobilization and maturation of hematopoietic stem cells
- Identify and characterize stem cells for their potential application.

(3) Investigation of human C-reactive protein (CRP)

CRP is a clinically important acute phase protein whose level increases upto 1000 folds in acute inflammatory conditions. We have demonstrated, for the first time, that human CRP is glycosylated and existence of disease-associated molecular variants. We have also identified a new ligand, Protein A and thus establishing an extended definition of CRP. Recent study unraveled the mechanism for destruction of red blood cells through CRP-complement-cascade and their potential pathological implications has been shown in plasmodium falciparum malaria.

Future plan:

- Binding of CRPs to microbes and parasites and their biological implication
- Development of monoclonal antibodies against disease-associated epitopes of CRP.

Dr. Syamal Roy and group

Kinetic parameters of peptide-MHC complex formation in Leishmania infection

The protozoan parasite *Leishmania donovani* replicates within the macrophage of the mammalian host. These heavily parasitized macrophages display increase in membrane fluidity coupled with defective T-cell stimulating ability. These defects can be eliminated by liposome delivery of cholesterol. Hence we studied the kinetic parameters of peptide-MHC complex formation in normal versus infected macrophage membrane. To address the above question macrophage membranes were prepared from normal and LD infected macrophage membranes of BALB/C mice and immobilized onto L1 chip. Using immunodominant IA^d restricted peptide (lambda repressor peptide sequence ,12-26 LEDARRLKAIYEKKK) the kinetic parameters were analyzed. It was observed that k_a is essentially identical where as there was a significant difference in k_d values (varied between 4e-8 to 6.7e-9 in normal and between 3.4e-6 to 3.9e-6 in infected membrane) and K_D values which indicates the affinity of peptide to MHC molecule to form peptide-MHC complex (varied between 1.1e-12 to 1.1e-13 for

normal and between 1.4e-9 to 1.3e-10 for infected). This observation tends to indicate that the dissociation of peptide from the peptide–MHC complex is much faster compared to the normal counterpart. Furthermore, $t_{1/2}$ for of the peptide-MHC complex in the normal and infected macrophage membrane was 28 hours and 4.9 hours respectively. Thus dissociation of the peptide-MHC complex may be a cause of defective cellular immunity in leishmaniasis. Studies are underway to understand the cause of rapid dissociation of peptide–MHC complex and its impact on cell mediated immune response in Leishmaniasis.

Micro RNA (miR122) in Leishmania donovani infection

There is a significant decrease in membrane cholesterol coupled with defective T-cell stimulating ability of *Leishmania donovani* infected macrophages and this defect can be corrected by liposomal delivery of cholesterol. Oddly enough, there is also significant decrease in serum cholesterol level as a function of splenic parasite load in Kala azar patients. Thus serum cholesterol may be used as a surrogate marker of cellular cholesterol as these two are in dynamic equilibrium. Since cholesterol homeostasis is governed to a great extent by the miR122, we endeavored to study the status of miR122 under parasitized condition and compared the results to those in uninfected control by northern blot and also by real time RT-PCR. Preliminary results showed that there is a two fold reduction in miR122 in liver under parasitized condition.

Viral vector (vaccinia) as a delivery vehicle of host protective leishmanial antigen KMP-11 (kinetoplastid membrane protein-11)

Vaccinia viruses are now-a-days commonly used as a vector for the expression of genes in mammalian cells. As a vector, vaccinia virus has a number of useful characteristics, including a capacity that permits cloning large fragments of foreign DNA, a wide host range, a relatively high level of protein synthesis and “appropriate” transport, secretion, processing and posttranslational modifications as dictated by the primary structure of protein and cell type used. We are using vaccinia expression system for an effective delivery of KMP-11 gene, which can lead to the generation of an effective immue response against KMP-11. Our laboratory had earlier shown that KMP-11 is an effective candidate for developing a vaccine experimental infection. It gives protection in both hamster and murine models. We have now sub-cloned the KMP-11 gene in a vaccinia transfer vector pSC65 so that it is flanked by DNA from a non-essential region of the vaccinia genome. These recombinant plasmids will then be transfected into cells that have been infected with wild-type vaccinia virus. The homologous recombinant between the vaccinia and plasmid DNA generates recombinant virus. This recombinant virus (with KMP-11 gene) will be used as a vaccine candidate in visceral leishmaniasis

Dr. Santu Bandopadhyay and group

Role of reactive oxygen species in chlorogenic acid (Chl)-induced preferential apoptosis of Bcr-Abl+ CML cells

We report that Chlorogenic acid (Chl) induces an early accumulation of intracellular reactive oxygen species (ROS) and that promotion of cell death by Chl is initiated by generation of ROS. Even though Chl has been shown to cause apoptosis in CML cells, the hierarchy of events leading to cell death particularly to those related to MAPK signaling, mitochondrial injury, and generation of ROS is not clearly defined. Chl resulted in an oxidative stress and redox-mediated downregulation of Bcr-Abl

phosphorylation. We further showed that the ROS-induced death of Bcr-Abl$^+$ CML cells was mediated partially by caspase-3, 9, 8 and the mitochondrial pathway. Antioxidant NAC attenuated the Chl-induced oxidative stress in CML cells and prevented the degradation of Bcr-Abl, caspase activation and cell death. The ability of Chl induced ROS to effectively kill Bcr-Abl $^+$ CML cells was further confirmed using primary leukemia cells isolated from CML patients as well as in nude mice bearing K562 xenografts. Collectively, our results provide a new insight that Chl is a promising compound capable of killing CML cells through a ROS-mediated mechanism.

Dr. (Mrs.) Nahid Ali and group

Complete cure of experimental visceral leishmaniasis with Amphotericin B in stearylamine-bearing cationic liposomes involves down-regulation of IL-10 and favorable T cell responses

Current drugs for the treatment of VL suffer from problems of drug resistance, relapse, specific toxicities, or multiple parenteral administrations of long durations. There is an urgent need to develop new therapies for safe and cost-effective treatment of kala-azar patients. In this study, we evaluated a new therapeutic approach based on combination of a low dose of amphotericin B (AmB) in association with suboptimum dose of stearylamine (SA)-bearing cationic liposomes, itself having leishmanicidal activity. We demonstrate that a single-shot therapy with this formulation caused clearance of parasites from liver and spleen below the level of detection in the selected piece of organs of BALB/c mice (Fig. 1). The combination was superior to free AmB and AmBisome for therapy, as well as for prevention of relapse and reinfection (Fig. 2). Besides having better killing activity, AmB in SA liposomes, in contrast to AmBisome, maintained the immunomodulatory effect of free AmB on CD4$^+$ and CD8$^+$ T cells for IFN-γ production (Fig. 3), at the same time reducing the toxic effects of the drug, reflected through decline in TNF-α. In addition, IL-10 was down-regulated to almost negligible levels, most efficiently through therapy with SA-bearing cationic liposomes-AmB (Fig. 4). This IL-10-deficient environment of IFN-γ-secreting T cells probably up-regulated the enhanced IL-12 and NO production observed in splenic culture supernatants of these mice, correlating with prolonged disease suppression better than free AmB and AmBisome. The ability of the formulation to elicit protective immunity was reconfirmed in a prophylactic model. Our results emphasize the requirement of effective immune stimulation, additionally, by antileishmanials for persistent disease protection, demonstrated by this liposomal AmB formulation.

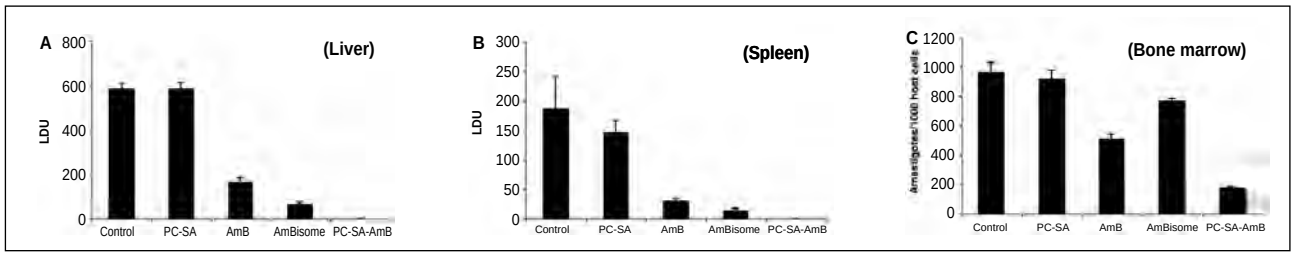


Fig. 1 : Complete cure is induced by PC-SA-associated AmB treatment in spleen and liver of established *L. donovani* infection in BALB/c mice. Effect of PC-SA (7:0.9, 20.3 mg/mouse)-associated AmB (3.5 mg/ kg) was compared with identical dose (3.5 mg/kg) of AmBisome, drug-free PC-SA (20.3 mg/mouse) liposomes, and free AmB (2.5 mg/kg)-treated 8-wk-infected mice. Untreated, infected mice were considered as controls. *A–C*, Hepatic (*A*) and splenic (*B*) parasite burden were determined by stamp-smear method and expressed as LDU, and bone marrow parasite load (*C*) was determined in cell smear prepared from femur bone marrow and expressed as amastigotes/1000 bone marrow nuclei. Data represent the mean ± SE for five animals per group. Results are one representative of four experiments.

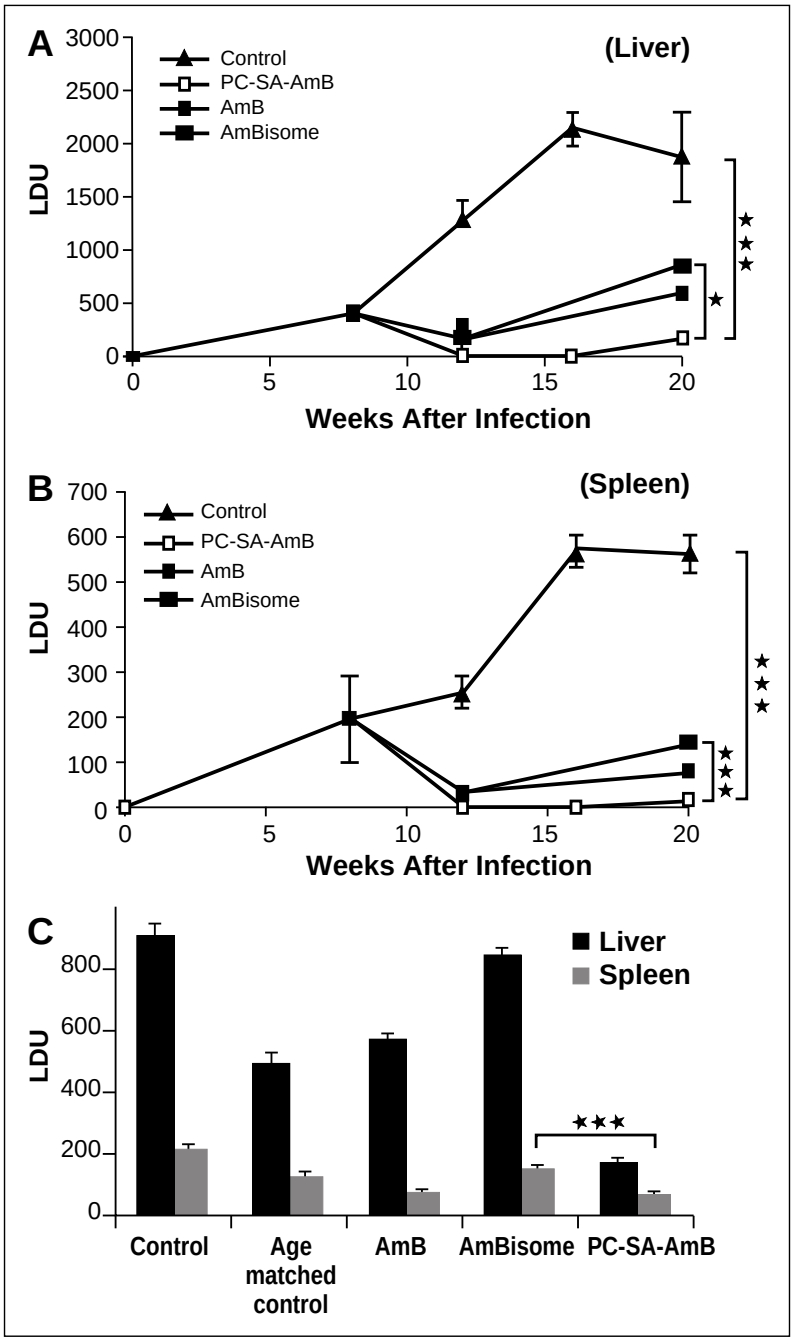


Fig. 2 : Protective effect of a single-dose treatment with PC-SA associated AmB on disease relapse and reinfection with *L. donovani*. *A and B, L. donovani*-infected BALB/c mice received a single-shot indicated treatment (8 wk postinfection): Animals were sacrificed every 4 wk up to 20 wk of postinfection and compared with untreated, infected controls at corresponding time points. Hepatic (*A*) and splenic (*B*) parasite burden were expressed as LDU. *C*, Reinfection of BALB/c mice with *L. donovani*, previously treated with curative doses of PC-SA-associated AmB. Cured mice (PC-SA-associated AmB, free AmB, and AmBisome treated) and naive age-matched BALB/c mice (Control 2) were i.v. administered with 2×10^7 amastigotes of *L. donovani* through tail vein. Untreated, infected control mice were not reinfected (Control 1). The progress of infection was determined in liver and spleen after 8 wk of reinfection and expressed as LDU. Data represent the mean ± SE for five animals per group. Data were tested by ANOVA. Differences between mean were assessed for statistical significance by Tukey's test (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$).

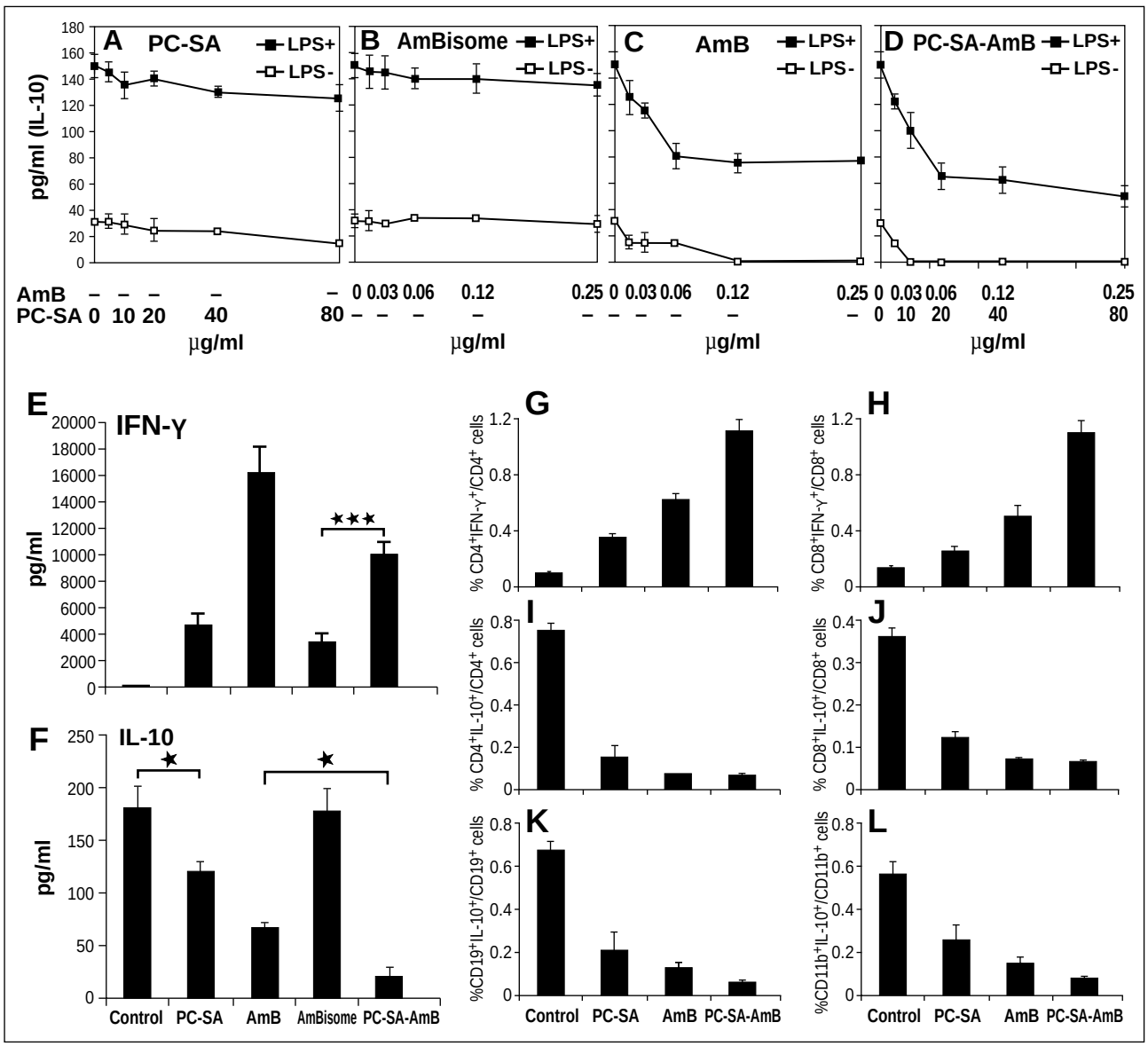


Fig. 3 : Immunomodulatory effect of PC-SA-AmB on splenocytes of normal mice in vitro and in vivo. *A–D*, Splenocytes (2.5 x 10^5cells/well) of normal healthy mice were incubated with various concentrations of PC-SA (*A*), AmBisome (*B*), free AmB (*C*), and PC-SA-AmB (*D*) with or without LPS (2.5 µg/ml) for 48 h at 37°C in 95% humidified air with 5% CO_2. IL-10 was measured by ELISA from supernatants. Each symbol represents mean cytokine level (± SEM) at each dose of the drugs (n = 3). *E* and *F*, Normal mice were treated once with PC-SA (20.3 mg/mouse), AmB (2.5 mg/kg body weight), AmBisome (3.5 mg/kg body weight), and PC-SA-associated AmB (20.3 mg/mouse and 3.5 mg/kg body weight, respectively). Spleen cells of differently treated animals were isolated 10 days after treatment, plated aseptically (2.5 x 10^5 cells/well), and stimulated with Con A (2.5 µg/ml) or LPS (2.5 µg/ml) for 48 h. Levels of Con A-specific IFN-γ and LPS-specific IL-10 were determined by ELISA. Data represent the mean ± SE for five animals per group. Data were tested by ANOVA. Differences between mean were assessed for statistical significance by Tukey's test (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). *G–L*, Splenocytes of PC-SA-, AmB-, and PC-SA-AmB-treated (at the doses mentioned above) and control mice were stimulated with Con A (2.5 µg/ml) or LPS (2.5 µg/ml). Surface phenotyping and intracellular staining were performed, as described in *Materials and Methods*, and cells were examined by flow cytometry. Mean frequencies of IFN- γ^+ $CD4^+$ cells per total $CD4^+$ cells and IFN- γ^+ $CD8^+$ cells per total $CD8^+$ cells (Con A specific) and IL-10^+ $CD4^+$, IL-10^+ $CD8^+$, IL-10^+ $CD19^+$, and IL-10^+ $CD11b^+$ cells per total respective cell types (LPS specific) in each group of untreated and differently treated (n = 3) BALB/c mice have been presented. Data represent the mean ± SE for three animals per group.

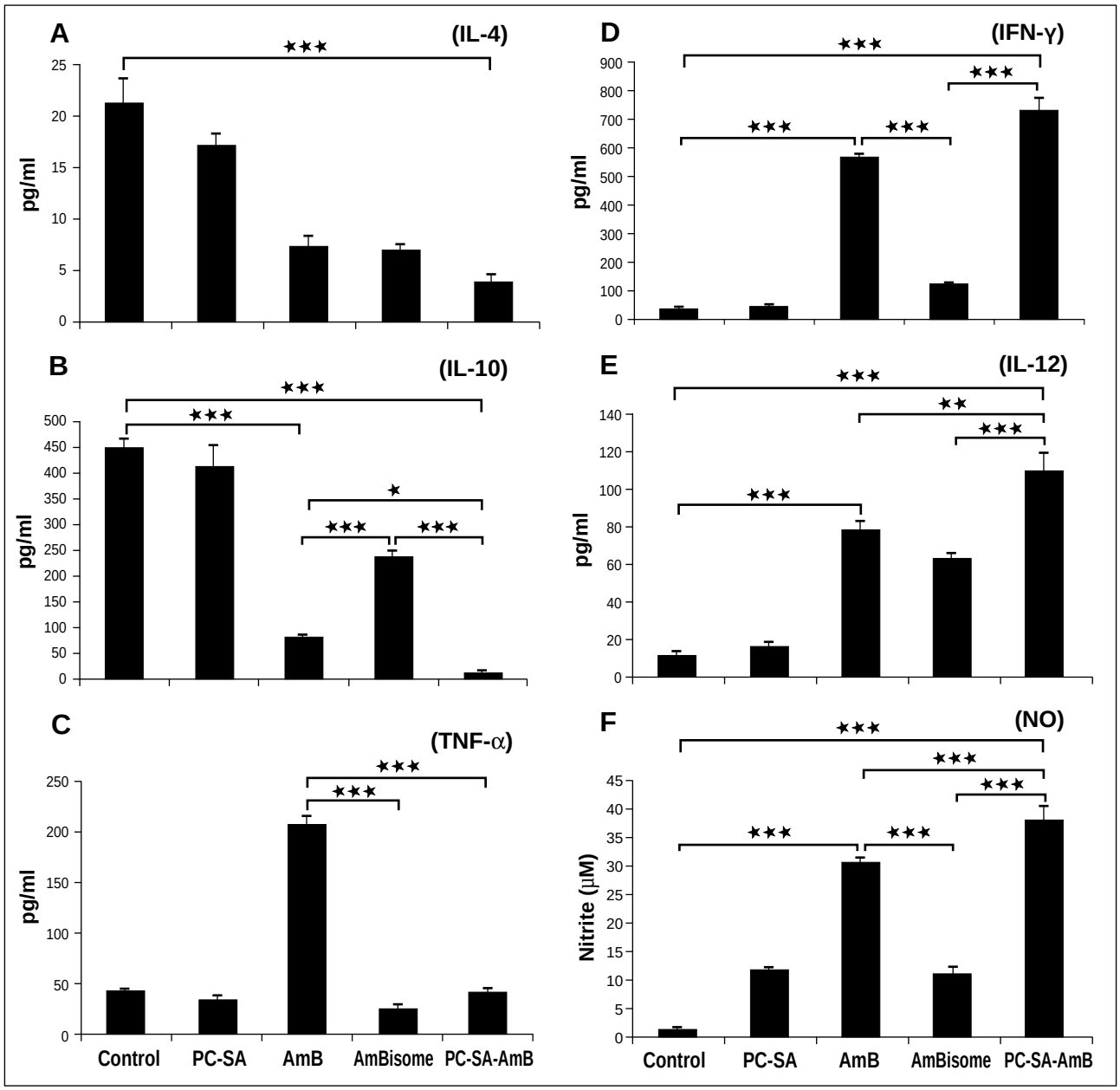


Fig. 4 : LAg-specific cytokine and NO levels in differently treated, infected mice. Spleen cells of indicated treated animals were isolated 4 wk of posttreatment, plated aseptically (2 x 10^5 cells/well), and stimulated with LAg at 10 μg/ml for 48 h. IL-4 (*A*), IL-10 (*B*), TNF-α (*C*), IFN-γ (*D*), IL-12 (*E*), and NO (*F*) in spleen cell culture supernatants of indicated treatment groups were determined by ELISA and Greiss assay method, respectively. Data represent the mean ± SE for five animals per group. Data were tested by ANOVA. Differences between mean were assessed for statistical significance by Tukey's test (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$).

Dr. (Mrs.) Rukhsana Chowdhury and group

Mechanism of modulation of virulence regulatory processes by environmental conditions

Unsaturated fatty acids present in the intestine exert multiple effects on virulence gene expression and also toxin in Vibrio cholerae. A mutation has been constructed in the fadD gene that is involved

in converting fatty acids to fatty acyl-CoA and simultaneous uptake into the cytosol. The fadD mutant exhibited decreased expression of virulence factors due to repression of a virulence transcriptional activator TcpP. The role of cellular cAMP level in modulating tcP expression in the fadD mutant is being investigated.

Competitive exclusion of classical biotype by El Tor biotype of V. cholerae

Vibrio cholerae strains of the O1 serogroup that typically cause epidemic cholera can be classified into two biotypes, classical and El Tor. The El Tor biotype emerged in 1961 and subsequently displaced the classical biotype as a cause of cholera throughout the world. In this study we demonstrate that when strains of the El Tor and classical biotypes were cocultured in standard LB medium, the El Tor strain clearly had a competitive growth advantage over the classical biotype starting from the late stationary phase and could eventually take over the population. The classical biotype produces extracellular protease(s) in the stationary phase and the amount of amino acids and small peptides in the late stationary and death phase culture filtrates of the classical biotype was higher than that in the corresponding culture filtrates of the El tor biotype. The El Tor biotype cells could utilize the amino acids and peptides more efficiently than the classical biotype under the alkaline pH of the stationary phase cultures but not in media buffered to neutral pH. The growth advantage of the El tor biotype was also observed in rabbit intestine.

Helicobacter pylori: Host-pathogen interaction

Although many studies have described the effects of a variety of environmental parameters on the expression of the virulence genes of *H. pylori*, the effect of contact with host cells has not been investigated. As this is of primary importance in host-pathogen interaction leading to disease, expression of the virulence genes *cagA, vacA, ureA, babA* etc was examined in *H. pylori* following adherence to the gastric epithelial cell line AGS. The results obtained indicated that the virulence genes were induced to different extents in cell associated bacteria. The induction was not due to host cell components secreted from AGS but requires direct contact of the bacteria with the host cells.

Helicobacter pylori: The Coccoid form

H. pylori has the interesting ability to convert from spiral to coccoid forms in the stationary phase and can also under a variety of stress conditions, for example, aeration, temperature and exposure to antibiotics. Coccoid *Helicobacter* cells could represent a viable-but-not-culturable state that is more resistant to environmental stresses than actively proliferating cells, and could thereby facilitate transmission to new hosts, or might mediate relapsing infection after incomplete eradication. The transition from spiral to coccoid form is being investigated by proteome analysis of the two forms. The appearance of several distinct protein species in coccoid and disappearance of other proteins have been demonstrated. These include outer membrane proteins like Omp2, Omp4, Omp20 and other proteins like aminopeptidase a/i.

Dr. Rupak Bhadra and group

Vibrio cholerae is a major human pathogen causing frequent diarrhoeal outbreaks in developing countries including India. So far no safe and effective immunoprophylactic measures against these

pathogens are available for public heath. The situation is further complicated by frequent emergence of new pathogenic clones with multiple drug resistance. In this regard recent spread of the hybrid *V. cholerae* El Tor strains carrying classical type CTX phages in Africa and Indian Subcontinent is noteworthy. However, recent progress in bacterial genomics and proteomics has dramatically altered the study of bacterial pathogenesis and designing of experiments for complete understanding the virulence mechanism, growth, survival and persistence of the pathogens in various environmental niches. As a result new genes and regulatory circuits of the above pathogens are identified. It is also necessary to understand the role played by various mobile genetic elements in the evolution of new pathogenic clones. Different physico-chemical stress signals including nutrition deprivation received by these pathogens in environmental reservoirs as well as under in vivo situations are quite dissimilar and probably play critical roles in adaptation through genetic mutation and help a pathogen to evolve further.

Evolution of hybrid Vibrio cholerae O1 biotype El Tor

The cholera toxin (CT) is a critical virulence-determining factor of epidemic *Vibrio cholerae* strains. The *ctxAB* operon coding for CT is carried by a filamentous phage, called CTXΦ. The classical biotype of *V. cholerae* O1 is the sixth pandemic strain, which was replaced completely by the current seventh pandemic El Tor biotype strains. One of the important differences between the two biotypes is that slight but specific differences in *ctxB* gene sequences; classical and El Tor strains carry $ctxB_{\text{class}}$ and $ctxB_{\text{ElTor}}$ alleles, respectively. Recently, an unusual strain of *Vibrio cholerae* O1 biotype El Tor carrying multiple tandem copies of classical CTX prophage caused a massive cholera epidemic in Mozambique in 2004. Thus, the evolution of the hybrid El Tor strain is a mystery. Furthermore, the location of the classical CTX prophage in the genome of the Mozambique strain was unknown. To determine this, pulsed field gel electrophoresis (PFGE) of the whole genome along with Southern hybridization experiments indicated that the classical CTX prophage present in the Mozambique strain is located in the small chromosome and the large chromosome does not carry any prophage. To determine the CTX prophage integration site in the small chromosome of Mozambique strain, the 5'and 3' junctions of the prophage and small chromosome were cloned and sequenced. Sequence analysis revealed that the CTX prophage was integrated in the conserved *dif* site of the replication terminus region of the strain. Interesting, while using an O1 El Tor isolate VC44 as a control, which carries tandem copies of CTX prophage in its small chromosome like the Mozambique strain, it was unexpectedly detected that the strain VC44 also carries $ctxB_{\text{class}}$ allele. Since the strain VC44 was isolated in Kolkata, India just prior to O139 Bengal outbreak in 1992, it seems that the hybrid El Tor strains were prevalent in India much before the emergence of Mozambique strain and supports the view that the latter strain has most probably originated from a VC44-like strain. Further genetic and molecular studies are underway to elucidate the evolution of hybrid *V. cholerae* O1 El Tor strains.

Molecular basis of survival of V. cholerae under nutritional stress

During the study period we have constructed several *relA* and *spoT* deletion mutants of *V. cholerae*. Our mutational analysis suggested that the *spoT* gene is essential in *V. cholerae* under $relA^+$ genetic background. Interestingly, the *V. cholerae* Δ*relA* Δ*spoT* strains still accumulated (p)ppGpp molecules under glucose or fatty acid starved condition, which raises the probability that there could be an alternative source of (p)ppGpp production in *V. cholerae* besides RelA and SpoT. Unlike *E. coli relA*

spoT mutant [ppGpp$^{(0)}$ strain], the *V. cholerae relA spoT* mutants showed certain unusual phenotypes, which are (a) resistance towards 3-amino-1,2,4-triazole (AT); (b) growth in nutrient poor M9 minimal medium; (c) ability to stringently regulate cellular rRNA accumulation under glucose starvation and (d) initial growth defect in nutrient rich medium. Since these phenotypes of Δ*relA* Δ*spoT* mutants could be reverted back to Δ*relA* phenotypes by providing SpoT in trans, it appears that the *spoT* gene function is crucial in *V. cholerae*. Currently studies are also going on to identify the genetic source of (p)ppGpp in Δ*relA* Δ*spoT* strains of *V. cholerae*. We have also dissected the SpoT function in *V. cholerae* and our preliminary results suggest that the ACT domain of the protein is critical for its hydrolase function. Stringent response in bacteria is also regulated by a factor, called DksA (product of the gene *dksA*). We have generated *dksA* mutant of *V. cholerae* and characterization of the mutant phenotypes are in progress. Preliminary studies indicate that DksA may be involved in regulation of motility of *V. cholerae* apart from its normal function related to stringent response. Role of stringent response genes *relA*, *spoT* and *dksA* will be further explored for their involvement, if any, in quorum sensing, biofilm formation, long-term starvation survival and relation with stationary phase sigma factor gene (*rpoS*) expression. We are also working on the essential GTP binding protein *cgtA* and previously we showed that like *spoT* the *cgtA* gene is also essential in *V. cholerae*. We have deleted the chromosomal *cgtA* gene of V. cholerae by providing CgtA in trans through an inducible promoter. Further studies are going on to understand the role C-terminal domain of the CgtA protein. Apart from these studies we are also trying to understand the role(s) of nutritional/metabolic differences between biotypes, classical and El Tor, in the evolution of epidemic clones of *V. cholerae*.

Mrs. Neeta V. M. Khalkho and group

With a view to study the Static or Dynamic nature of universal minicircle sequence binding proteins UMSBP1 and UMSBP2 from *L. donovani*, and to see if their status changes at different cell cycle stages, we cloned UMSBP1 and UMSBP2 from *L. donovani* in *Leishmania* transfection vector pXG-GFP+ strain B2863, with GFP tagged at C-terminal end of UMSBP1 and UMSBP2. They were transfected in *L. donovani* AG83 cells. Cells were selected under drug pressure of 200 μM with G418 at 22°C. Cells, so grown, were fixed for florescence microscopic study. Study revealed that UMSBP1 and UMSBP2, due to GFP tagging, become so big in size that they could not passively transport them inside the Kinetoplast. Thus, instead of being localized in the kinetoplast, they were present in the cytoplasm and visible with Green florescence under Florescence microscope. UMSBP from *Crithidia fasiculata* was reported to lack N-terminal mitochondrial-targeting sequence (Shomai *et al.*, JCB, 2001, .153, 725-731). It may be passively transported into kinetoplast due to its small size, which is further strengthened by the above observation. To study whether UMSBP1 and UMSBP2 are cooperative or competitive in nature, we have cloned Antisense UMSBP1 in pLEW82v4, a *Leishmania* transfection vector. It was then transfected in *L. tarentole (Lt.*T_7*.*T_R*).* When such construct was induced for down regulation of UMSBP1, it was observed that there is a 2 Fold Expression of UMSBP1 compared to uninduced cells. Change in fold Expression of UMSBP2 was negligible when compared between induced and uninduced cells. This result can be explained by the hypothesis that the UMSBP1 acts as a cis-acting element. In our previous study of Stage Specific Expression of UMSBP1 and UMSBP2, we have observed that UMSBP1 maintains itself at a much higher level than the UMSBP2 in promastigotes than in amastigotes. Here, when we induce a cell for Anti–UMSBP1, instead of down regulation, there is a 2 Fold up regulation. This probably indicates that a forced down regulation is

counter acted by fast processing of UMSBP1 to overcome the depleted level of UMSBP1 in the cell. The UMSBP2 expression level remains unaltered in induced cell. Thus, this result helps us to conclude that UMSBP1 and UMSBP2 are stage specific and differentially expressed.

Dr. (Mrs.) Tripti De and group

Beta 1-4 Galactosyltransferase Expressing Live Attenuated Parasites as Vaccine for Visceral Leishmaniasis

As compared to cutaneous leishmaniasis, vaccination against visceral leishmaniasis (VL) has received limited attention. In this study, we demonstrate for the first time that an UDP-Galactose:N-acetylglucosamine β1-4 galactosyltransferase (Gen Bank Accession No. EF159943) expressing attenuated *LD* clonal population (A-LD) is able to confer protection against the experimental challenge with the virulent *LD* AG83 parasite. A-LD was also effective in established leishmania infection. The vaccinated animals showed both cell mediated (*in vitro* T-cell proliferation, and DTH response) and humoral responses (Th1 type). These results demonstrate the potential of the attenuated clones as an immunotherapeutic and immunoprophylactic agent against visceral leishmaniasis.

Complete protection against experimental visceral leishmaniasis with complete soluble antigen from β1-4 Galactosyltransferase expressing attenuated Leishmania donovani promastigotes involves Th1-immunity and down-regulation of IL-10

Compared with cutaneous leishmaniasis, vaccination against visceral leishmaniasis has received limited attention. Most available drugs are toxic, and relapse after cure remains a chronic problem. Growing limitations in available chemotherapeutic strategies due to emerging resistant strains and lack of an effective vaccine strategy against visceral leishmaniasis deepens the crisis. Complete soluble antigen (CSA), from a β1-4 galactosyltransferase expressing attenuated *Leishmania donovani* parasite, induced protection against subsequent challenge and during active infections. CSA immunization was effective against both pentavalent antimony sensitive and resistant strains of *L. donovani*. Majority (~85%) of the immunized animals showed sterile protection. Resolution of the disease required the presence of T cells, and the recovered animals remained immune to re-challenge. Control of the parasites was dependent on type 1 $CD4^+$ helper cells, which evolved in the presence of IL-12 and activated macrophages through the production of IFN-γ. Immunity was adoptively transferable and was dependent on both $CD4^+$ and $CD8^+$ cells. CSA immunization led to enhanced IFN-γ production, while suppressing the IL-10 production. However, CSA immunization did not abrogate IL-4 production. Earlier studies have established that the resolution of hepatic parasite burden is associated with granuloma formation, with associated immune cell recruitment at parasitized focus. Consistent with IL-10's recognized effects, initial suppression of Th1-cell-dependent events was associated with a rapid intracellular parasite replication and granuloma assembly at 4 wk p.i. However, at 8 wk p.i., when infection was more restrained, with accompanied iNOS, IL-12, IFN-γ and TNF-α expressions, IL-10's direct macrophage de-activating effects were less prominent, and this was reflected in the involuted granuloma. The low IFN-γ and TNF-α expression at this time point resulted in a moderate iNOS expression, and this probably prevented the mounting of NO induction. On the other hand, IL-12 and IFN-γ produced on CSA immunization initiates and/or drives the basic Th1 responses to result in a well-formed granuloma surrounding a parasite-free Kupffer cell. Our results accentuate the need

to establish a favorable cellular immunity while intervening with the development of Th2 cells during leishmania infection.

Dr. Uday Bandopadhyay and group

Malarial infection develops mitochondrial pathology and mitochondrial oxidative stress to promote hepatocyte apoptosis

Activation of mitochondrial pathway of apoptosis by oxidative stress has been implicated for hepatocyte apoptosis during malaria. Since mitochondria are the source and target of reactive oxygen species (ROS), we have investigated whether hepatocyte apoptosis is linked with mitochondrial pathology and mitochondrial ROS generation during malaria. Malarial infection induces mitochondrial pathology by inhibiting mitochondrial respiration, dehydrogenases and transmembrane potential and damaging ultrastructure as evident from transmission electron microscopic studies. Mitochondrial GSH depletion and formation of protein carbonyl indicate that mitochondrial pathology is associated with mitochondrial oxidative stress. Fluorescence imaging of hepatocyte documents intramitochondrial superoxide anion ($O_2^{\cdot -}$) generation during malaria. $O_2^{\cdot -}$ inactivates mitochondrial aconitase to release iron from iron-sulfur cluster, which forms hydroxyl radical ($^{\cdot}OH$) interacting with H_2O_2 produced concurrently. Malarial infection inactivates mitochondrial aconitase and carbonylation of aconitase is evident from westernimmunoblotting. The release of iron has been documented by fluorescence imaging of hepatocyte using Phen Green SK and mitochondrial $^{\cdot}OH$ generation has been confirmed. During malaria, the depletion of cardiolipin and mitochondrial permeability transition pore formation favor cytochorome c release to activate caspase-9. Interestingly, mitochondrial $^{\cdot}OH$ generation is correlated with the activation of both caspase-9 and caspase-3 with the progress of malarial infection indicating the critical role of $^{\cdot}OH$.

Lansoprazole protects and heals gastric mucosa from NSAID–induced gastropathy by inhibiting mitochondrial as well as Fas-mediated death pathways with concurrent induction of mucosal cell renewal

We have investigated the mechanism of antiapoptotic and cell renewal effects of lansoprazole, a proton pump inhibitor, to protect and heal gastric mucosal injury *in vivo* induced by indomethacin, a non-steroidal anti-inflammatory drug (NSAID). Lansoprazole prevents indomethacin-induced gastric damage by blocking activation of mitochondrial and Fas pathways of apoptosis. Lansoprazole prevents indomethacin-induced upregulation of proapoptotic Bax and Bak and downregulation of antiapoptotic Bcl-2 and BclxL to maintain the normal proapoptotic/antiapoptotic ratio thereby arrests indomethacin-induced mitochondrial translocation of Bax and collapse of mitochondrial membrane potential followed by cytochrome c release and caspase-9 activation. Lansoprazole also inhibits indomethacin-induced Fas-mediated mucosal cell death by down-regulating Fas or FasL expression and inhibiting caspase-8 activation. Lansoprazole favors mucosal cell renewal simultaneously by stimulating gene expression of prosurvival PCNA, survivin, EGF and bFGF. The up-regulation of Flt-1 further indicates that lansoprazole activates VEGF-mediated controlled angiogenesis to repair gastric mucosa. Lansoprazole also stimulates the healing of already formed ulcer induced by indomethacin. Time-course study of healing indicates that it switches off mitochondrial death pathway completely but not the Fas pathway. However, lansoprazole heals mucosal lesions almost completely after overcoming the persisting Fas

pathway probably by favoring the prosurvival genes expression. This study thus provides the detailed mechanism of antiapoptotic and pro-survival effects of lansoprazole for offering gastroprotection against indomethacin-induced gastropathy.

Melatonin reduces indomethacin-induced gastric mucosal cell apoptosis by preventing mitochondrial oxidative stress and the activation of mitochondrial pathway of apoptosis

Augmentation of gastric mucosal cell apoptosis due to development of oxidative stress is one of the main pathogenic events in the development of non-steroidal anti-inflammatory drug (NSAID)-induced gastropathy. Identification of a non-toxic, anti-apoptotic molecule is warranted for therapy against NSAID-induced gastropathy. The objective of the present study was to define the mechanism of the anti-apoptotic effect of melatonin, a non-toxic molecule which scavenges reactive oxygen species. Using an array of experimental approaches, we have shown that melatonin prevents the development of mitochondrial oxidative stress and activation of mitochondrial pathway of apoptosis induced by indomethacin (a NSAID) in the gastric mucosa. Melatonin inhibits the important steps of indomethacin-induced activation of mitochondrial pathway of apoptosis such as up-regulation of the expression of Bax and Bak, and the down-regulation of Bcl-2 and BclxL. Melatonin prevents indomethacin-induced mitochondrial translocation of Bax and prevents the collapse of mitochondrial membrane potential. Moreover, melatonin reduces indomethacin-mediated activation of caspase-9 and caspase-3 by blocking the release of cytochrome c and finally rescues gastric mucosal cells from indomethacin-induced apoptosis as measured by the TUNEL assay. Histological studies of gastric mucosa further document that melatonin almost completely protects against gastric damage induced by indomethacin. Thus, melatonin has significant anti-apoptotic effects to protect gastric mucosa from NSAID-induced apoptosis and gastropathy, which makes its use as potential therapy against gastric damage during NSAID-treatment.

Dr. (Mrs.) Malini Sen and group

Research Interest:

(i) Elucidating the role of Wnt Induced Secreted Protein -3 (WISP3) in maintenance of cartilage integrity; and (ii) Elucidating the role of Wnt Signaling in inflammation in arthritis.

Dr. (Mrs.) Mridula Misra and group

Labeling and Biological Evaluation of Dihydropyrimidinones for Organ Imaging

Due to wide range of pharmacological and biological activities of Dihydropyrimidinones, the ^{99m}Tc labeling of these compounds has been very important for biological studies. DHPM was synthesized by published one-pot cyclocondensation method and labeled with ^{99m}Tc using stannous chloride reduction method. The pH of the ^{99m}Tc -DHPM complex was maintained 7.4. Radiochemical purity of ^{99m}Tc -DHPM was determined by ITLC (95%) and HPLC. Lipophilicity (1.4) of the complex was determined by solvent extraction in chloroform and serum protein binding (13%) was studied at different time points by amicon filtration method. Biodistribution studies were performed with ^{99m}Tc -DHPM complexes in Female Sprague Dawley rats (n-10) bodyweight 280–320g. Biodistribution studies of ^{99m}Tc -DHPM in rats showed major uptake in lung followed by liver, spleen, kidney, blood,

heart, urine, stomach, intestines and brain. The highest uptake in lungs in comparison to other organ and rising accumulation with respect to time up to 30 minutes were also observed. After 30 minutes lung uptake is decreasing in comparison to other organ. Scintigraphic imaging studies were also performed for 1 hr by intravenous injection (5 mci, 0.5ml) of 99mTc-DHPM in rabbits under SPECT Gamma Camera at Regional Radiation Medicine Centre (VECC), Kolkata. For Scintigraphic imaging studies dynamic images were obtained for 36 minutes showed highest activity of 99mTc-DHPM in lung (Fig. 5 & Fig. 6).

This ^{99m}Tc -DHPM radiopharmaceutical may be used as a lung imaging agent and could be used for evaluation of pathological conditions of lung.

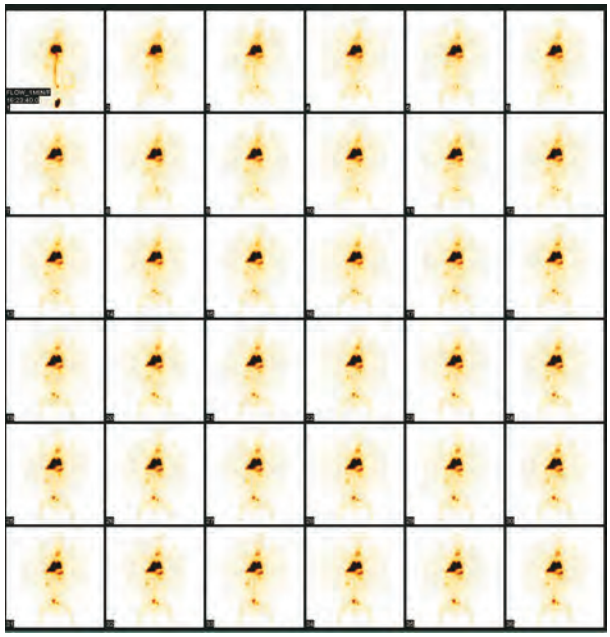


Fig. 5.

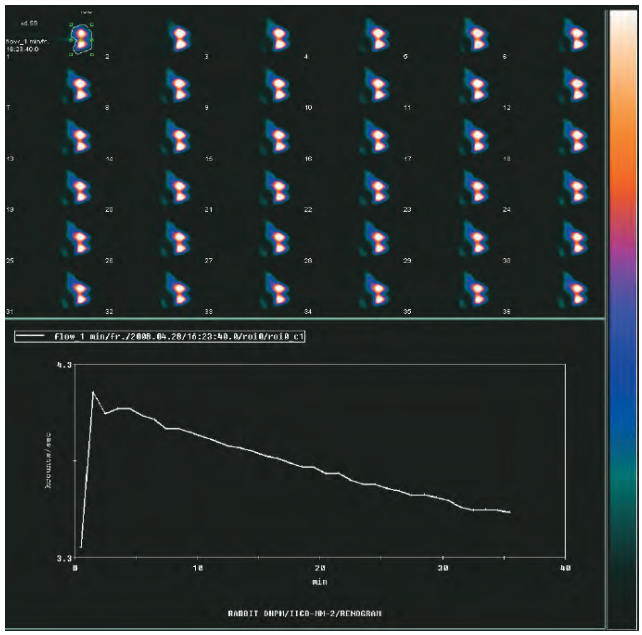


Fig. 6.

Fig. 5. Whole body Scintigraphic Images of ^{99m}Tc –DHPM in rabbit

Fig. 6. Histogram showing lung uptake of ^{99m}Tc –DHPM in rabbit

Dr. Mita Chatterjee Debnath and group

Preparation, characterization and biodistribution study of 99mTc-tricarbonyl-ciprofloxacin in staphylococcus aureus infected rat model

Infection is a major cause of mortality and morbidity not only in the developing countries but globally. Diagnosis of deep seated infection, septic arthritis, fever of unknown origin, osteo myelitis etc. become a challenging problem to clinicians. Timely diagnosis of patient with suspected bacterial infection is very much crucial to provide adequate treatment. Various non invasive imaging techniques such as x-rays, computed tomography (CT), magnetic resonance imaging(MRI), and ultrsonography might be helpful but are not specific for infection detection. Nuclear medicine technique with the help of

appropriate radiopharmaceutical accumulating in the infected foci could enable the detection of infected site by scintigraphic procedure and have a major impact on the clinical management of patients with suspected bacterial infection.

At present *fac*[^{99m}Tc(CO)$_3$ (H$_2$O)$_3$]$^+$ core has been widely used for radiolabelling of different types of bioactive molecules. This prompted us to redirect some of our effort to applying the tricarbonyl core approach to the goal of improving the performance of $(TcO)^{3+}$ in infection imaging. Fluoroquinolone antibiotic, ciprofloxacin was radiolabelled at pH 6.0 with freshly prepared Tc(I) tricarbonyl precursor. ^{99m}Tc(CO)$_3$-Ciprofloxacin was then characterized by TLC using acetone and CH$_3$CN : H$_2$O (1:1 v/v) as developing solvent and by reverse phase HPLC, where C-18 column was eluted with a gradient mixture of H$_2$O containing 0.1% TFA (solvent A) and methanol containing 0.1% TFA (solvent B). Elution was done at linear gradient with 90% A/10% B to 10% A/90% B from 0 to 20 min (Fig 1). The radiochemical purity was >96%. The biodistribution studies (4hr) were performed in balb/c mice, resulted urinary excretion of about 35%, hepatobiliary excretion of about 16% and blood activity was 2.5% of the injected dose . Infection was induced in right thigh muscle of Sprague Dawley rat (180-200gm) with *s. aureus* (5x 10^8 cfu). After 22hr when the swelling of inoculated muscle was apparent ^{99m}Tc-tricarbonyl ciprofloxacin (259 – 370 KBq) was injected and scintigraphic studies were performed under gamma camera showing definite uptake in infected thigh in comparison to that of normal thigh. (Fig. 2). The above method of radiolabelling with tricarbonyl precursor will also be extended for chelation of other fluoroquinolones as well as some antiprotozoal drugs like different nitrofuryl carbazones and thiosemicarbazones. This study will help us in uderstanding the pharmacokinetics of a series of antimicrobial agents with different spectrum of activity. In addition this study may lead to the development of a novel infection imaging agent having ability to localize in wide variety of deep seated bacterial infection.

Technical Staff

Mr. T. K. Chakraborty, Mr. Rabindra Nath Mandi, Mrs. Arti Khetrapal, Mr. Asish Mallick, Mr. Kshudiram Naskar, Mr. Anirban Manna, Dr. Kalidas Paul, Mr. Sandip Chakraborty, Mr. Pratap C. Koyal.

Pool Officers, RAs, Research Fellows etc.

Mr. Agneyo Ganguly, Mr. Somdeb Bose Dasgupta, Mr. Amit Roy, Mrs. Bijoylaxmi Banerjee, Mr. Souvik Sengupta, Mr. Sayan Chowdhury, Dr. Anindita Bhattacharya, Mr. Arijit Bhattacharya, Mr. Susanta Kar, Ms. Arunima Biswas, Ms. Gunjan Sharma, Mr. Writoban BasuBall, Mr. Supriya Srivastava, Mr. Suschandra Chowdhury, Mr. Angana Ghosal, Mr. Chandan Mandal, Mr. Sajal Samanta, Mr. Biswajit Khatua, Mr. Anjan Talukder, Miss Ranjita Das, Dr. Bikramjit Roychaudhuri, Ms. Subha Sen, Mr. Rajan Guha, Mr. Ranjan Dhar, Ms. June Ghosh, Mrs. Moumita Ghosh, Ms. Rupkatha Mukhyapadhyay, Mr. Shantanava Das, Mr. Budhaditya Mukherjee, Dr. Arun Kumar Haldar, Dr. Monidipa Ghosh Ray, Mr. Nabendu Biswas, Ms. Sudipta Bhowmick, Ms. Smriti Mondal, Mr. Saumyabrata Mazumdar, Ms. Amrita Das, Mr. Mithun Maji, Dr. Tanusree Das, Mr. Amit De, Ms. Epshita Chatterjee, Mr. Amit K. Baidya, Ms. Subhra Pradhan, Mr. Raghawan, Mr. Debarshi Sengupta, Mr. Bhabatosh Das, Ms. Sangita Shah, Mr. Ritesh Ranjan Pal, Mr. Kalpataru Halder, Mr. Stayabrata Bag, Mr. Joubert Banjop Kharlyngdoh, Mr. Siddhartha Kumar Bhaumik, Mr. Manoj Kumar

Singh, Mr. Subir Karmakar, Mr. Sourav Chackraborty, Mr. Chinmoy Pal, Mr. Manish Goyal, Mr. Sumanta Dey, Mr. Samik Bindu, Dr. (Mrs.) Kakali De, Ms. Suparna Ghosh, Ms. Susmita Chandra, Mr. Kamal Krishna Halder**,** Mr. Arup Panda , Mr. R Srinivas Rao, Mr. Debdut Naskar, Mr. Supratim Mandal, Mr. George Maiti.

Names of Project Assistants

Mrs. Rita Maity, Mr. Saptrashi Roy, Mr. Kaushik Bhattacharya, Mr. Sayantani Sarkar, Mr. Arup Bag, Avik Acharya Chowdhury**,** Mr. Jaydeep Chowdhuri, Mr. Surjendu Bikash Debnath, Ms. Roma Sinha, Mr. Pradyot Bhattacharya**,** Ms. Manjarika De, Ms. Srijani Ray, Mr. Athar Alam**,** Mohd Shameel Iqbal.

Summer Trainees

Ms. Kamala Devi, Oscar Vassallo, Ms. Tanwee Das, Ms. Sudeshna Banerjee, Ms. Debosmita Roy, Mr. Arghya Kusum Medda, Ms. Subhalina Roy, Debapriya Basu, Titil Ghosh, Milan Patra.

Administrative Staff

Mrs. Moumita Majumdar, Mr. Dipak Guin, Mr. Asim Roy.

Lab Assistant

Mr. Narendra Pradhan, Mr. Biswajit Mandal, Mrs. Seema Halder.

Biosafety Laboratory

A state-of-the-art Biosafety Level-3 facility is present to work with highly pathogenic bacteria and viruses. The BSL-3 labs are fitted with double door entries, ante-rooms, complete air purifying systems and Class II biosafety cabinets

CELL BIOLOGY & PHYSIOLOGY

Drs. K. P. Mohanakumar, Sumantra Das, Syed N. Kabir, Smritinath Chakraborty, Tuli Biswas, Arun Bandyopadhyay, Tushar Chakraborty, Sandhya R. Dungdung, Sib Sankar Roy, Padma Das, Mrinal Kanti Ghosh

Preamble

The Division is formed with a team of cell biologists and physiologists with a common goal of understanding the molecular basis of pathophysiology of a number of metabolic and degenerative diseases. The group's interests fall under the areas of cardiac hypertrophy, diabetes, drug addiction, neurodegenerative diseases, utero-ovarian dysfunction and responses to pathogens in hematopoietic system. A recent addition to these areas is stem cell biology in relation to carcinogenesis, corneal limbal cell culture in the laboratory with an aim to use in humans, and stem cell differentiation to neurons and their transplantation in animal models of neurodegenerative diseases. Significant contributions have been made in normal physiological functions of hormone-receptor mediated gene expression, bioenergetics of ion transport regulation, neural development, mitochondrial functions, and signal transduction events. As expected the members of the division also actively participate in regular teaching in neighboring Universities, graduate training program leading to PhD, and summer training programs. Regular biweekly seminars on the latest developments in the field, strong inter-institutional multidisciplinary collaborations, and regular organizations of workshops and symposia in the area of cellular physiology provide the graduate students of the division a lot of experience and exposure. This division has a number of cellular and animals models of various human diseases, and welcomes any cooperative collaborative program of mutual interest.

NEUROSCIENCE

Dr. K. P. Mohanakumar and group

The role played by mitochondrial dysfunction in the pathophysiology of Parkinson's disease (PD) has been investigated in animal and cybrid models of the disease, as well as patient samples from an Indian population. In our continuing search for effective neuroprotective strategies for PD, we have investigated the possible role of nitric oxide as a neuroprotectant. We have also demonstrated that taurine, one of the most abundant amino acids in the central nervous system and slated to be of therapeutic relevance in PD, failed to protect against 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP)-induced parkinsonism.

NADH coenzyme Q dehydrogenase activity is reduced in platelets of Parkinson's disease patients from an India population

The observation of decline in mitochondrial electron transport chain function, specifically at NADH coenzyme Q dehydrogenase (complex I), in patients with Parkinson's disease (PD) has been widely reported. In the present study we have investigated whether a defect in mitochondrial function is present in the platelets of PD patients from an Indian population. We found that the mitochondrial complex I activity in the platelets of PD patients is lower than that in healthy age- and gender-matched controls, while the succinate dehydrogenase (complex II) activity was similar in all the groups.

Furthermore, there was no change in either of the activities in patients with Parkinson plus syndrome or atypical Parkinsonism. This is the first report indicating a decline in mitochondrial function in the platelets of PD patients from the Indian population, offering further support to the role of a mitochondrial defect in PD. In the light of these findings, the results of our study further contribute to the increasing evidence of mitochondrial dysfunction playing a major role in the disease mechanism of PD (Fig. 1).

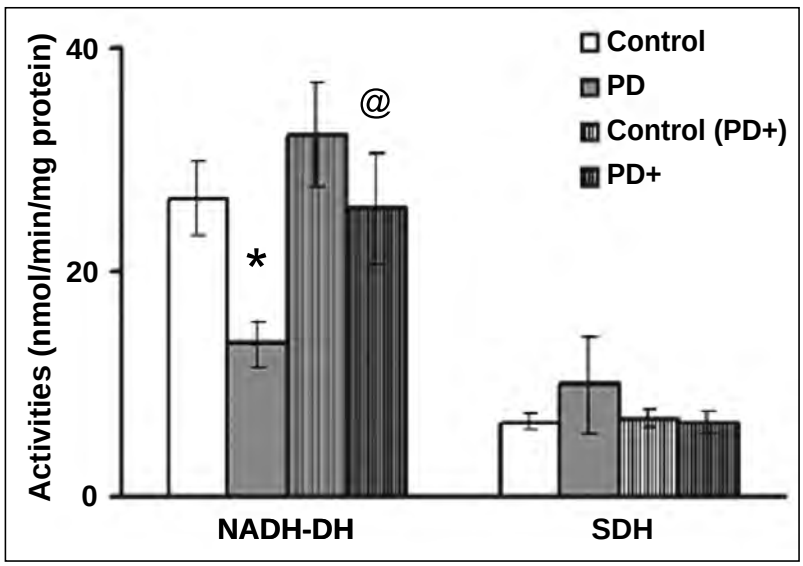


Fig. 1 : NADH dehydrogenase (NADH-DH) and succinate dehydrogenase (SDH) activities in platelets. Activities of NADH-DH and SDH were assayed in platelet homogenates from PD patients (n=10) versus age-matched controls (n=30), and Parkinson plus patients (PD^+, n=12) compared to age-matched controls (n=19). Specific activities are expressed as nmol substrate oxidized/min/mg protein for NADH-DH, and nmol of DCIP reduced/min/mg protein for SDH. Values are mean ± SEM. *$p \leq 0.005$ as compared to the respective control, and @ $p \leq 0.025$ as compared to the PD group by Student's t-test.

Chronic, sub-acute rotenone treatment mimics changes of early Parkinson's disease in differentiated human SH-SY5Y neural cells

PD demonstrates a brain-wide pathology that begins pre-clinically with alpha-synuclein (ASYN) aggregates ("Lewy neurites") in processes of gut enteric and vagal motor neurons. Rostral progression into substantia nigra with death of dopamine neurons produces the motor impairment phenotype that yields a clinical diagnosis. The vast majority of PD occurs sporadically, and current models of sporadic Parkinson's disease (sPD) can utilize directly infused or systemic neurotoxins. We developed a differentiation protocol for human SH-SY5Y neuroblastoma that yielded non-dividing dopaminergic neural cells with long processes that we then exposed to 50 nM rotenone, a complex I inhibitor used in PD models. After 21 days of rotenone, ~60% of cells died (Fig. 2). Their processes retracted and accumulated ASYN and ubiquitin aggregates that blocked organelle transport. Mitochondrial movement velocities were reduced by 8 days of rotenone and continued to decline over time. Subacute rotenone treatment of differentiated SH-SY5Y neuroblastoma cells caused process retraction and partial death over several weeks, slowed mitochondrial movement in processes and appeared to reproduce the Lewy neuritic changes of early PD pathology (Fig. 3) but did not cause Lewy body inclusions. This study revealed that rotenone-

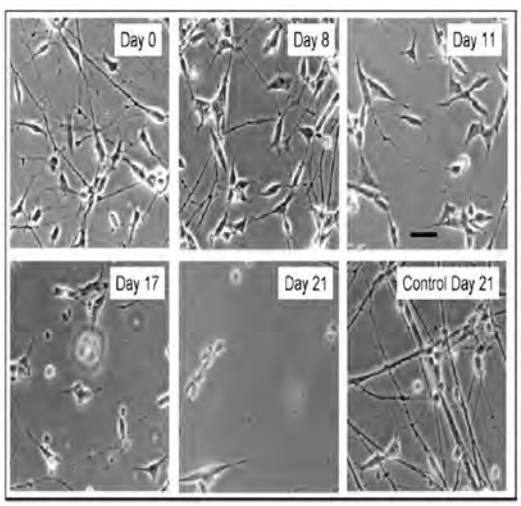


Fig. 2 : Phase contrast images of differentiated SH-SY5Y cells chronically exposed to 50 nM rotenone.

SH-SY5Y model in a differentiated human neural cell mimics changes of early Parkinson's disease and may be useful for screening therapeutics for neuroprotection in that disease stage.

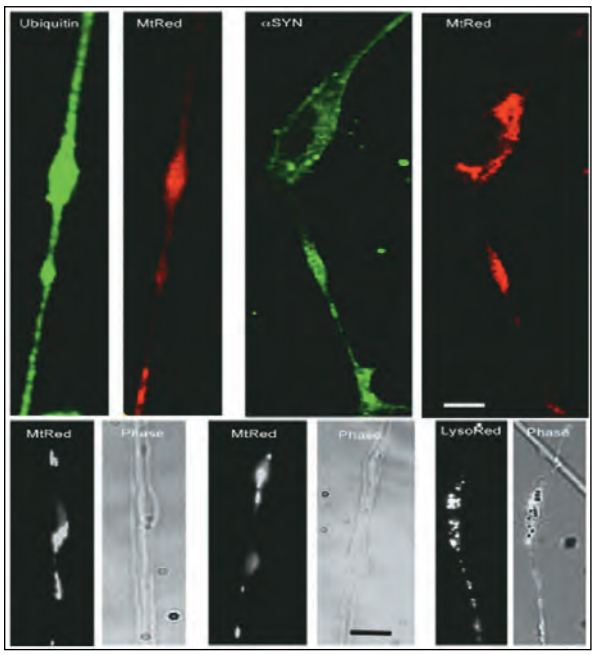


Fig. 3 : Lewy neurites in processes of differentiated SH-SY5Y neural cells after incubation with 50 nM rotenone for 7 days. MtRed = MitoTracker Red; α SYN = alpha synuclein; Phase = phase contrast microscopy; LysoRed = LysoTracker Red.

Relationships among molecular genetic and respiratory properties of Parkinson's disease cybrid cells show similarities to Parkinson's brain tissues

We have studied sporadic Parkinson's disease (sPD) from expression of patient mitochondrial DNA (mtDNA) in neural cells devoid of their own mtDNA, the "cybrid" model. In spite of reproducing several properties of sPD brain, it remains unclear whether sPD cybrid cells reflect more complex sPD brain bioenergetic pathophysiology. We characterized and correlated respiration of intact sPD cybrid cells with electron transport chain (ETC) protein assembly, complex I gene expression and ETC protein levels in sPD brain. We also assayed expression for multiple ETC genes coded by mtDNA and nuclear DNA (nDNA) in sPD cybrid cells and brain. sPD cybrid cells have reduced levels of mtDNA genes, variable compensatory normalization of mitochondrial gene expression and show robust correlations with mitochondrial ETC gene expression in sPD brains. Relationships among ETC protein levels predict impaired complex I-mediated respiration in sPD brain. That sPD cybrid cells and sPD brain samples show much correlated regulation of nDNA and mtDNA ETC transcriptomes suggests similar bioenergetic physiologies.

Evidence for hydroxyl radical scavenging action of nitric oxide donors in the protection against 1-methyl-4-phenylpyridinium-induced parkinsonism in rats

Evidences for hydroxyl radical (•OH) scavenging action of nitric oxide (NO•), and subsequent dopaminergic neuroprotection in a hemiparkinsonian rat model has been provided. Reactive oxygen species are strongly implicated in the nigrostriatal dopaminergic neurotoxicity caused by the parkinsonian neurotoxin, 1-methyl-4-phenylpyridinium (MPP^+). Since the role of this free radical as a neurotoxicant or neuroprotectant is debatable, we investigated the effects of some of the NO• donors such as S-nitroso-N-acetylpenicillamine (SNAP), 3-morpholinosydnonimine hydrochloride (SIN-1), sodium nitroprusside (SNP) and nitroglycerin (NG) on in vitro •OH generation in a Fenton-like reaction involving ferrous citrate, as well as in MPP^+-induced •OH production in the mitochondria. We also tested whether co-administration of NO• donor and MPP^+ could protect against MPP^+-induced dopaminergic neurotoxicity in rats. While NG, SNAP and SIN-1 attenuated MPP^+-induced •OH generation in the mitochondria, and in a Fenton-like reaction, SNP caused up to 18-fold increase in •OH production in the latter reaction (Fig. 4). Striatal dopaminergic depletion following intranigral infusion of MPP^+ in rats was significantly attenuated by NG, SNAP and SIN-1, but not by SNP.

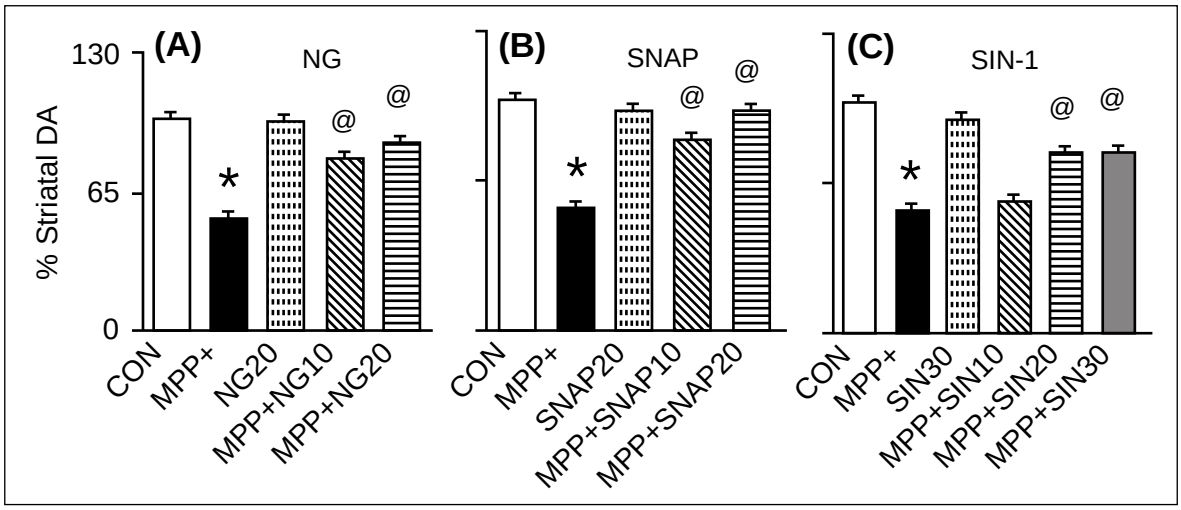


Fig. 4 : *In vivo* effects of NO· donors (NG, SNAP, SIN-1) on MPP^+- induced dopamine (DA) depletion in the rat striatum. MPP^+ (32 nmol in 1µl) and/or $NO^•$ donors (doses in nmol in 1µl, as given in X-axis) were infused into the right substantia nigra pars compacta. Left SN received saline in the same volume. NG was infused immediately after opening the vial. Solutions of SNAP and SIN-1 were prepared immediately before infusion. As a control to the neuroprotective studies, a group of animals received $NO^•$ donor solutions (in the highest dose) that have been kept open for 48 h at room temperature along with MPP^+. The control value of striatal DA was 57.29 ± 3.31 pmol/mg tissue. Co-infusion of fresh NG, SNAP and SIN-1 with MPP^+ significantly attenuated striatal DA depletion caused by MPP^+. The results are given as Mean ± SEM (n = 8 in each group). Statistically significant as compared to control (*), or as compared to MPP^+ effect (@), $p \leq 0.05$.

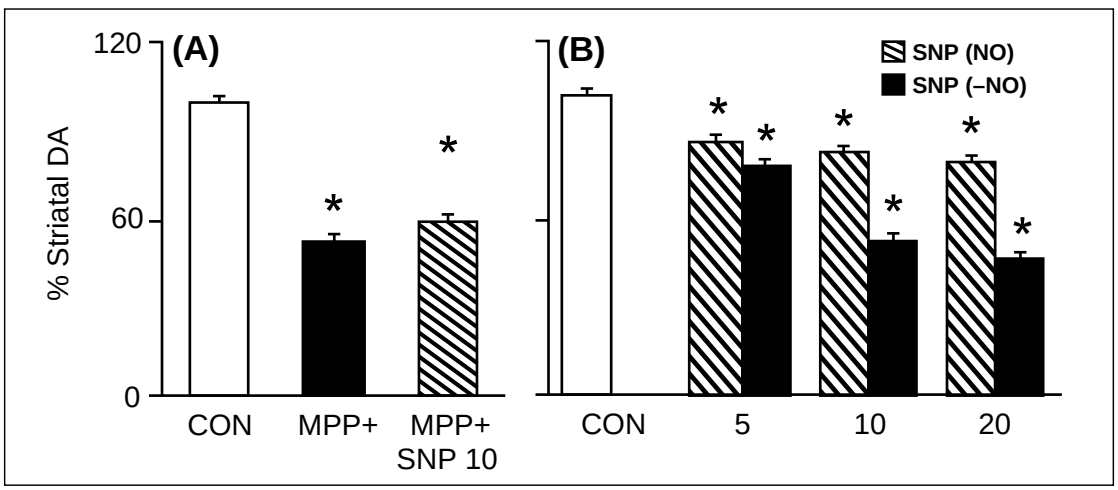


Fig. 5 : *In vivo* effects of SNP, an NO· donor on MPP^+-induced dopamine (DA) depletion in the striatum. (A) Animals were infused intranigrally with 1 µl of MPP^+ (32 nmol) alone or along with freshly prepared SNP (10 nmol in 1µl). Ipsi- and contra-lateral striata were dissected out and DA levels were measured at 72 h employing HPLC electrochemistry. SNP failed to render protection against MPP^+-induced DA toxicity. (B) Solutions of SNP were freshly prepared [SNP (NO)] or the solution was kept open for 48 h [SNP (–NO)] at room temperature. SNP with or without NO• were infused into the nigral region and the striatal DA levels were assayed at 72 h. Infusion of fresh SNP at all doses caused a small but significant reductions in striatal DA levels. More severe dose-dependent striatal DA depletion was obtained with SNP without $NO^•$. Statistically significant as compared to control (*). $p \leq 0.05$.

Solutions of NG, SNAP and SIN-1, exposed to air for 48 h to remove NO•, when administered similarly failed to attenuate MPP^+-induced neurotoxicity *in vivo*. Conversely, long-time air-exposed SNP solution when administered in rats intranigrally, caused a dose-dependent depletion of the striatal dopamine (Fig. 5). These results confirm the involvement of •OH in the nigrostriatal degeneration caused by MPP^+, indicate the •OH scavenging ability of NO•, and demonstrate protection by NO• donors against MPP^+-induced dopaminergic neurotoxicity in rats.

In vitro and in vivo evidences that antioxidant action contributes to the neuroprotective effects of the neuronal nitric oxide synthase and monoamine oxidase-B inhibitor, 7-nitroindazole

The neuronal nitric oxide synthase (nNOS) inhibitor, 7-nitroindazole (7-NI) is neuroprotective against1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP)-induced parkinsonism. Monoamine oxidase (MAO)-B inhibitory action partially contributes to this effect. We tested the hypothesis that 7-NI could be a powerful •OH scavenger, and interferes with oxidative stress caused by MPTP. We measured •OH, reduced glutathione (GSH; Fig. 6), as well as superoxide dismutase (SOD) and catalase activities in the nucleus caudatus putamen and substantia nigra of Balb/c mice following MPTP and/or 7-NI administration. The nNOS inhibitor caused dose-dependent inhibition in the production of OH in (i) Fenton-like reaction employing ferrous citrate in a cell-free system in test tubes, (ii) in isolated mitochondrial preparation in presence of MPP^+, and (iii) in the striatum of mice systemically treated with MPTP (Fig. 7). An MPTP-induced depletion of GSH in both the nuclei was blocked by 7-NI, which was dose-dependent (10-50mg/kg) (Fig. 6), but independent of MAO-B inhibition. The nNOS-mediated recovery of GSH paralleled attenuation of MPTP-induced depletion of striatal dopamine. MPTP-induced increase in the activities of striatal or nigral SOD and catalase were significantly attenuated by 7-NI treatment. These results suggest potent antioxidant action of 7-NI in its neuroprotective effects against MPTP-induced neurotoxicity (Figs. 6-7).

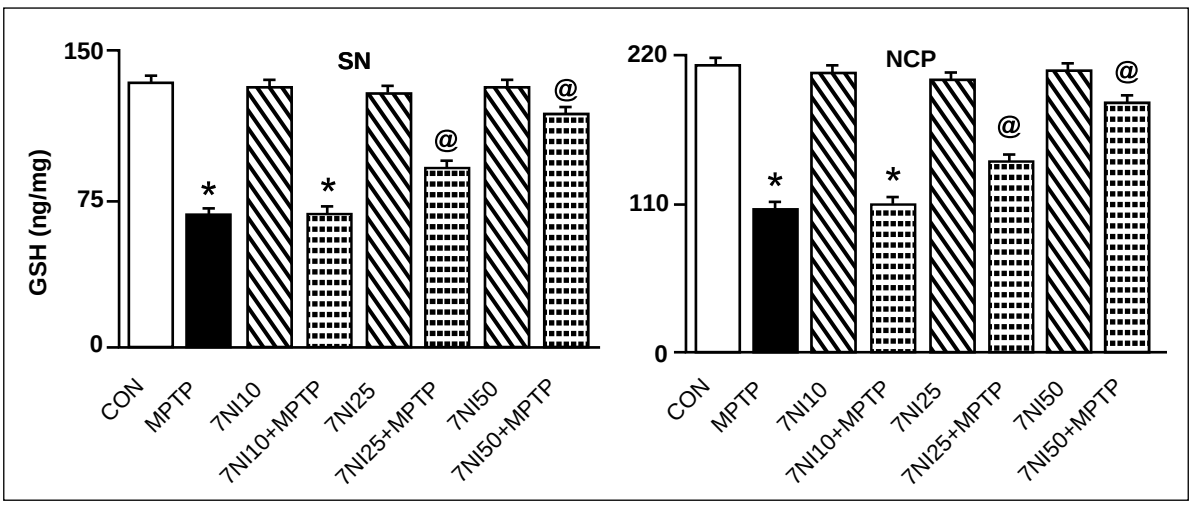


Fig. 6 : Efects of MPTP and/or 7-NI on GSH level in SN and NCP: mice were treated with MPTP (30 mg/kg, i.p.) twice 16 h apart and/or pretreatment with 7-NI (10, 25 and 50 mg/kg, i.p.) 30 min prior to MPTP. 7-NI injections were continued in four doses of every 10 h interval after last injection of MPTP. Animals were sacrificed on the 7th day and GSH was estimated in micropunched SN and NCP by a sensitive spectrofluorimetric procedure. Values are expressed as ng/mg tissue and represented as mean ± S.E.M. (n = 8), *p ≤ 0.05 as compared to control groups, (@) as compared to MPTP. Peanut oil treated animals served as controls.

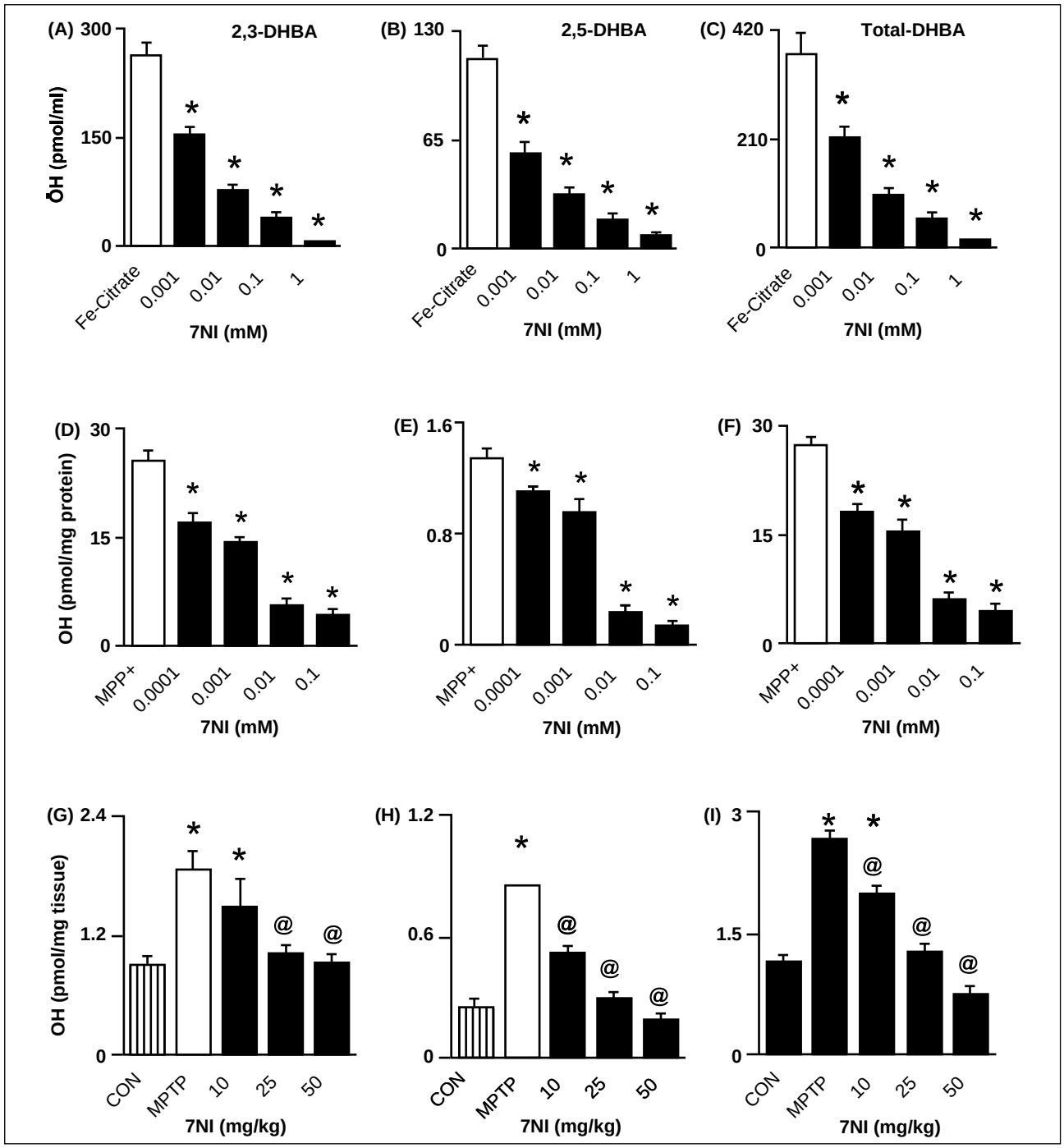


Fig. 7 : Effect of 7-NI on $Fe2^{+}$ citrate-, MPP^{+}-, and MPTP- induced .OH. (A–C) A cell-free system employing ferrous citrate (4.2 nmol) and sodium salicylate (1 mM) was used in this study for .OH generation by Fenton-like reaction. This cell-free system was incubated with 7-NI (10^{-6} to 10^{-3} M) at 32 ºC in plastic tubes under incandescent lamp for 30 min. Levels of 2,3- and 2,5-DHBA were measured by HPLC-electrochemistry. Results are expressed as pmol/ml and given as mean ± S.E.M. *p ≤0.05 compared to Fe^{2+} citrate (n = 4). (D–F) In vitro generation of 2,3- and 2,5-DHBA in mitochondria incubated with MPP^{+} (100 mM) for 30 min in presence of 7-NI (10^{-4} to 10^{-7} M). Data are expressed as pmol/mg protein and is depicted as mean ± S.E.M. *p _ 0.05 compared to MPP^{+} (n = 6). (G–I) In vivo .OH generation in Balb/c mice following systemic administration of MPTP (30 mg/kg) was assessed for 7-NI (10, 25 and 50 mg/kg) effects. SA (100 mg/kg) was administered 30 min after MPTP. Animals were sacrificed at 2 h after SA and 2,3- and 2,5-DHBA were measured in micropunched NCP employing HPLC electrochemistry. Results are pmol/mg tissue and are given in figure as mean ± S.E.M. *p ≤ 0.05 as compared to control, and (@) compared to MPTP (n = 6).

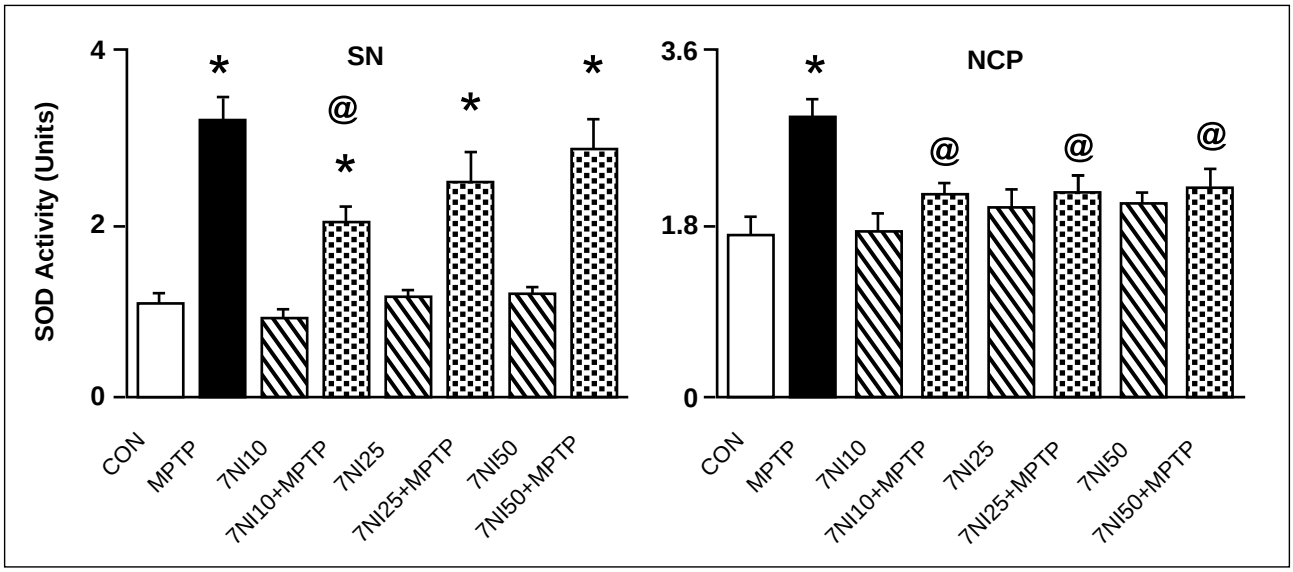


Fig. 8 : Effects of MPTP and or/7-NI on SOD activity. Balb/c mice were treated with MPTP (30 mg/kg twice, i.p.) 16 h apart and/or with 7-NI (10, 25 and 50 mg/kg, i.p.) 30 min prior to MPTP followed by four doses of 7-NI every 10 h intervals after last injection of MPTP. Animals were sacrificed on 7th day and superoxide dismutase (SOD) was analyzed employing pyrogallol oxidation method in cytosolic fraction of micropunched SN or NCP. One unit of the enzyme activity is defined as 50% inhibition/(min mg protein). Results given are mean ± S.E.M. (n = 6), *p ≤ 0.05 as compared to control, and (@) compared to MPTP treated group.

Taurine fails to protect against 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine-induced striatal dopamine depletion in mice

Taurine, a known antioxidant and neuroprotector has been investigated for its free radical scavenging action in vitro in isolated mitochondria, and tested whether it protects against 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP)-induced dopaminergic neurodegeneration in mice. Taurine (0.1-10 mM) did not affect 1-methyl-4-phenyl pyridinium-induced hydroxyl radical production in isolated mitochondria. Systemic administration of taurine (250 mg/kg, i.p.) caused a small, but significant loss of dopamine levels in the striatum of mice.Taurine failed to reverse MPTP-induced striatal dopamine depletion, but caused significant increase in dopamine turnover in these animals. In the light of the present study it may be suggested that consumption of taurine may neither help in scavenging of neurotoxic hydroxyl radicals in the brain mitochondria, nor would it help in blocking the process of neurodegeneration (Fig. 9).

Dr. Sumantra Das and group

Structure, function and altered function of astroglial cells

Our earlier studies had demonstrated a profound role of the β-adrenergic receptor (β-AR) system as a downstream regulator of thyroid hormone (TH) induced differentiation and maturation of astrocytes. Investigations revealed that TH regulated phospho β-arrestin levels, which could explain the increased affinity of β_2-AR in astrocytes exposed to TH. We, therefore, carried out β-arrestin gene knockdown studies in astrocytes which showed that TH-induced morphological maturation was further accelerated (Fig. 10).

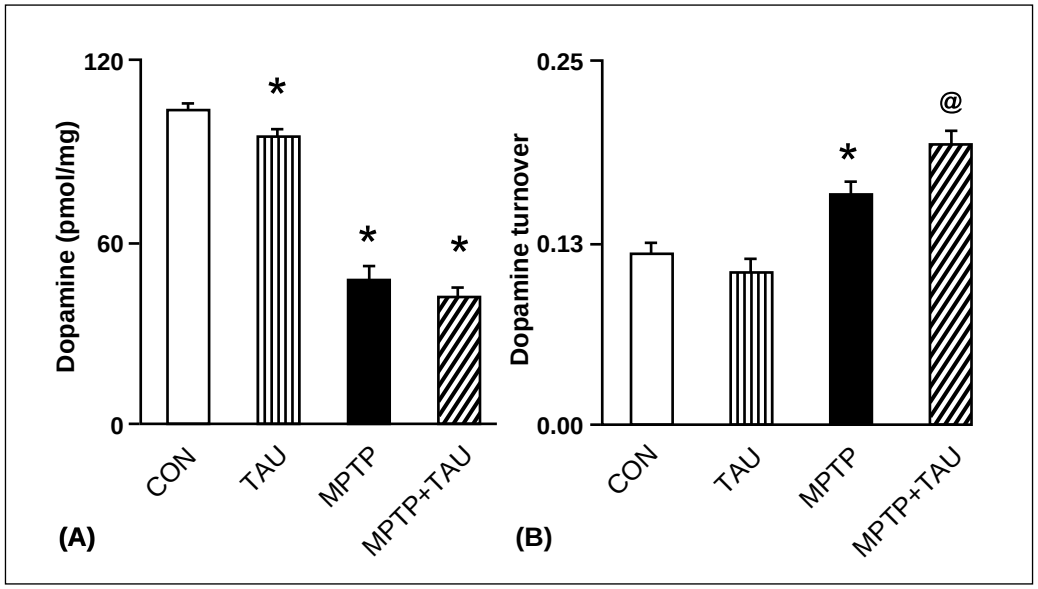


Fig. 9 : Taurine treatment reduces striatal dopamine levels. Mice were treated with MPTP (30 mg/kg, i.p.) and/or 0.9% saline twice, 16 h apart followed by 4 doses of either taurine (TAU; 250 mg/kg, i.p.) or saline in a span of two days. Animals were sacrificed on the fourth day and dopamine (DA), and its metabolites homovanillic acid (HVA) and 3,4-dihydroxyphenylacetic acid (DOPAC) were estimated in the microdissected striata by a sensitive HPLC-electrochemical procedure. **A** Levels of DA in the striatum of mice are given as pmol/mg tissue. **B** DA turnover, obtained as the ratio of the metabolites to the neurotransmitter [(HVA+DOPAC): DA]. The data are represented as mean ± SEM. *p≤ 0.001 as compared to control, @ p≤0.05 as compared to MPTP group. n = 6.

Thyroid hormone deficiency on stoichiometry of neurofilaments

It has been previously shown that hypothyroidism in the developing brain results in progressive intraneuronal accumulation of neurofilament (NF) proteins in the proximal hillock regions of axons, analogous to the pathological intraneuronal accumulation of NF in common neurodegenerative diseases like Alzheimer's disease, Parkinson's disease and Amyotrophic lateral sclerosis. A preferential decline in the expression of the light chain of NF occurs in all the three diseases leading to an absolute change in stoichiometry of the NF subunits. Using the developing hypothyroid rat cerebra as a model, a collaborative study was initiated with Dr. Pranab K. Sarkar, INSA Fellow to elucidate if age or hypothyroidism causes a change in the stoichiometry or molar ratio of the NF subunits which could be responsible for their aberrant intraneuronal accumulation. It was observed that in the normal cerebra, the expression of NFL and NFM were abundant during the first 2 weeks, corresponding to the onset of axonal outgrowth and synaptogenesis, whereas that of NFH was predominant during the second and third weeks corresponding to the period of maturation of synapses, axonal caliber and transport processes. These results show that consistent with the requirement for neuronal differentiation during synaptogenesis, the molar ratios NFH:NFM:NFL changed significantly from 1:3:9 at PND5 to 1:2:6 at PND25 (Fig. 11). Hypothyroidism caused a 40–60% decline in the expression of all three subunits. However, at all three ages examined, differences in the molar ratios of the NF subunits between normal and hypothyroid cerebra were insignificant suggesting that factors other than alteration in the stoichiometry of NF subunits are associated with their aberrant intraneuronal aggregation.

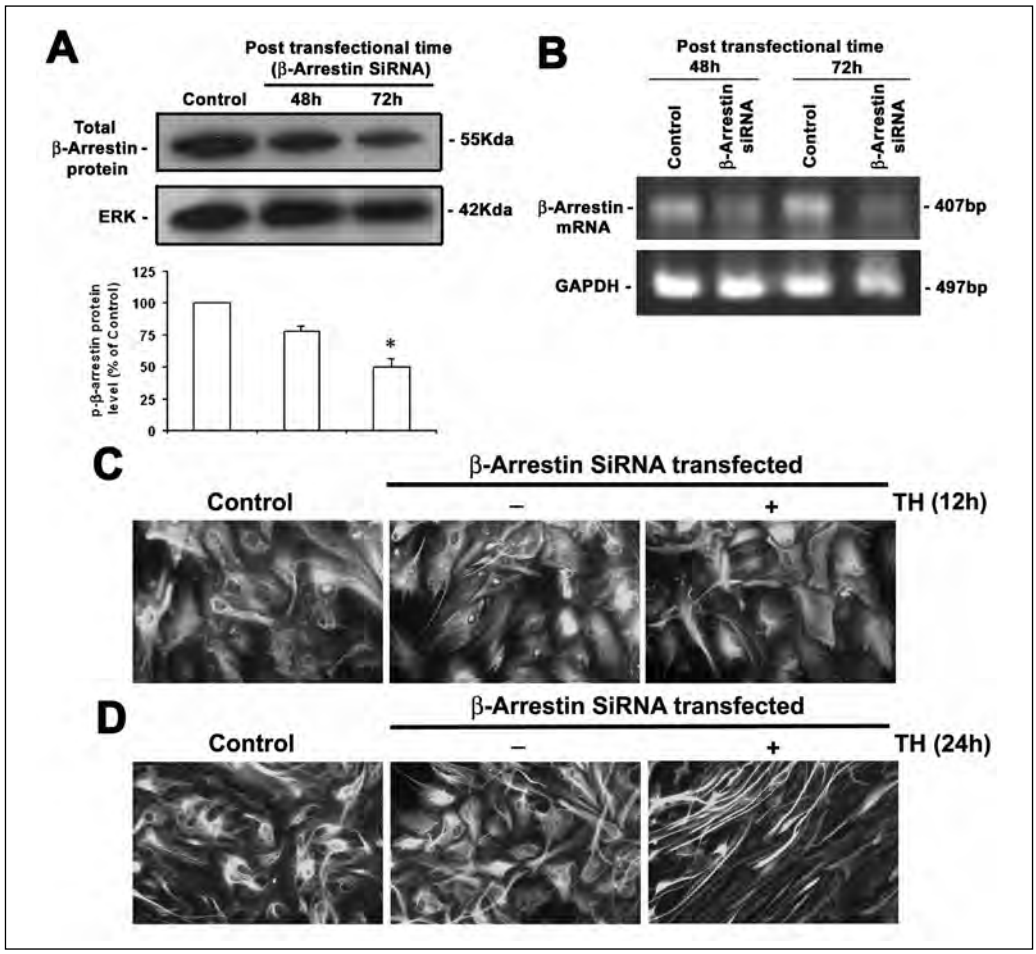


Fig. 10 : Effect of β-Arrestin gene knockdown on TH-induced astroglial morphology. 10-day-old hypothyroid astrocytes were transfected with recombinant pSIREN-RNAi vector containing siRNA oligonucleotide sequence for β-Arrestin. Proteins and RNA samples harvested from the cells 48 hr and 72 hr after transfection, were subjected to western blot analysis and semi-quantitative RT-PCR analysis. Representative western blots (A), using total β-Arrestin antibody and representative band images obtained by semi-quantitative RT-PCR (B). Densitometric analysis of the proteins are shown below the respective blots. *indicates $p < 0.001$ from non-silencing control. For morphologic study, transiently transfected astroglial cells were treated with vehicle or with TH (0.31 nM T_3 and 22 nM T_4) for 12 hr (C) and 24 hr (D) and immunofluorescence stained using anti-GFAP antibody. Scale bar represent 50 μm.

Newer approaches for the treatment of narcotic addiction

A series of substituted quinolines, synthesized by the Syntheic, Biophysical and Natural Product Chemistry group, have been found to have significant interaction at the μ-opioid receptor. A few of these also have activity at the μ-opioid receptor. The compounds were tested for their efficacy to antagonize naloxone precipitated withdrawal in morphine dependent mice. With a view to determine the opioid agonistic or antagonistic property of the test compounds, we have successfully developed a micro assay based on the principles that both κ- and μ-opioid receptor agonists and not antagonist's causes transient activation on pERK20 in cultured cells within a few minutes of application. Astrocyte

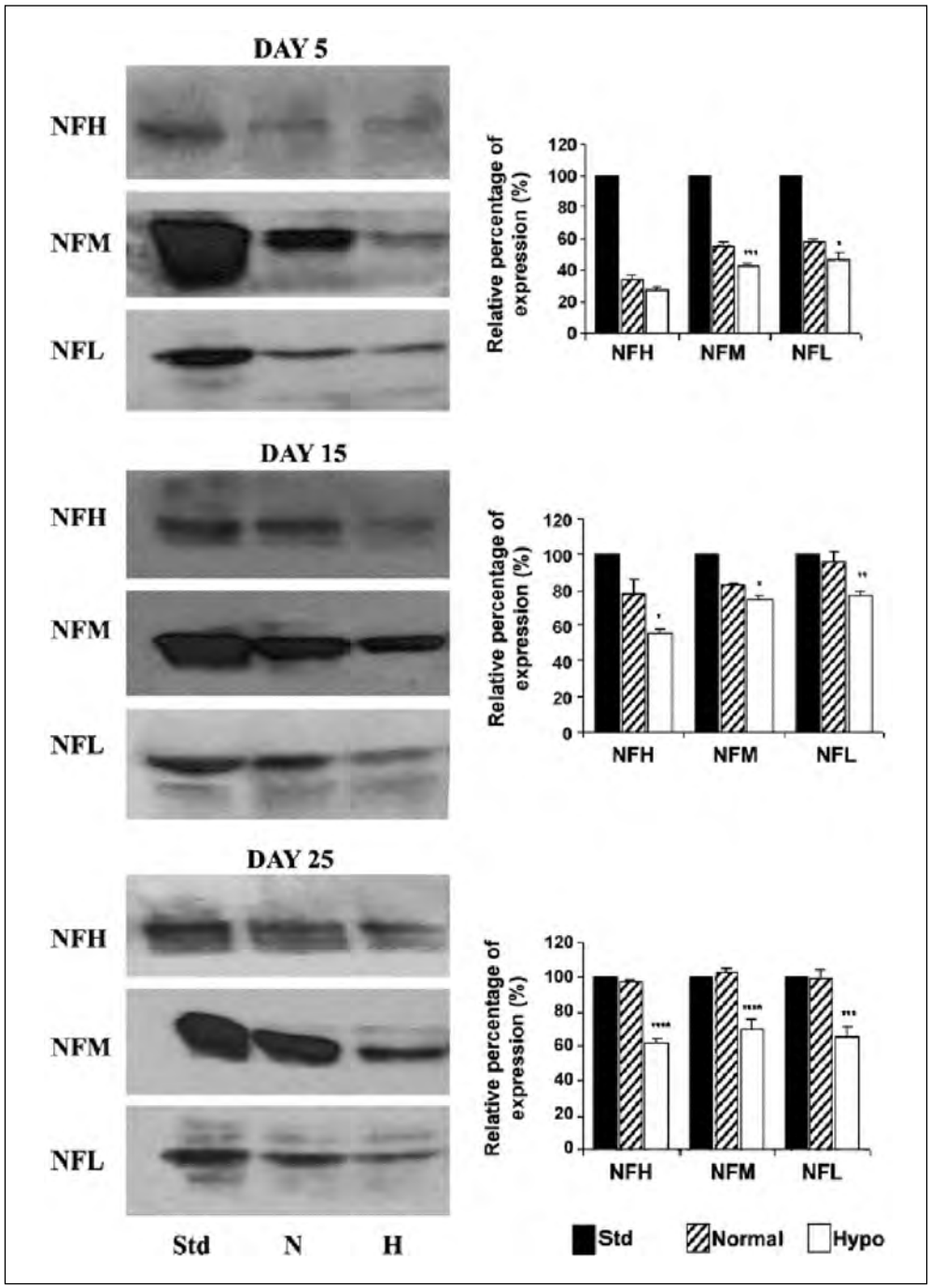


Fig. 11 : Comparison of the relative amounts of NF subunits in cytoskeletal preparations prepared from developing normal and hypothyroid rat cerebra by Western blot analysis and chemiluminescence assay. Left Panel: standard adult (15-week old) cytoskeletal protein samples (Std) was run simultaneously with each pair of normal (N) and hypothyroid (H) samples prepared from 5-day, 15-day and 25-day postnatal rat cerebra. The intensities of the chemiluminescent bands, as seen in a typical experiment, are shown. Right Panel: bar diagrams show the corresponding relative expression of the different NF subunits, calculated assuming the expression in the standard sample as 100. Data obtained from three independent experiments similar to that shown in the left panel were used for statistical analysis. Relative expression of the different NF subunits in preparations from normal and hypothyroid cytoskeletal preparations at PND5, PND15, and PND25 are shown. The p-values shown (*p < 0.05, **p < 0.025, ***p < 0.01, ****p < 0.005) are against age matched normal controls. Data represents mean _ S.E.M.

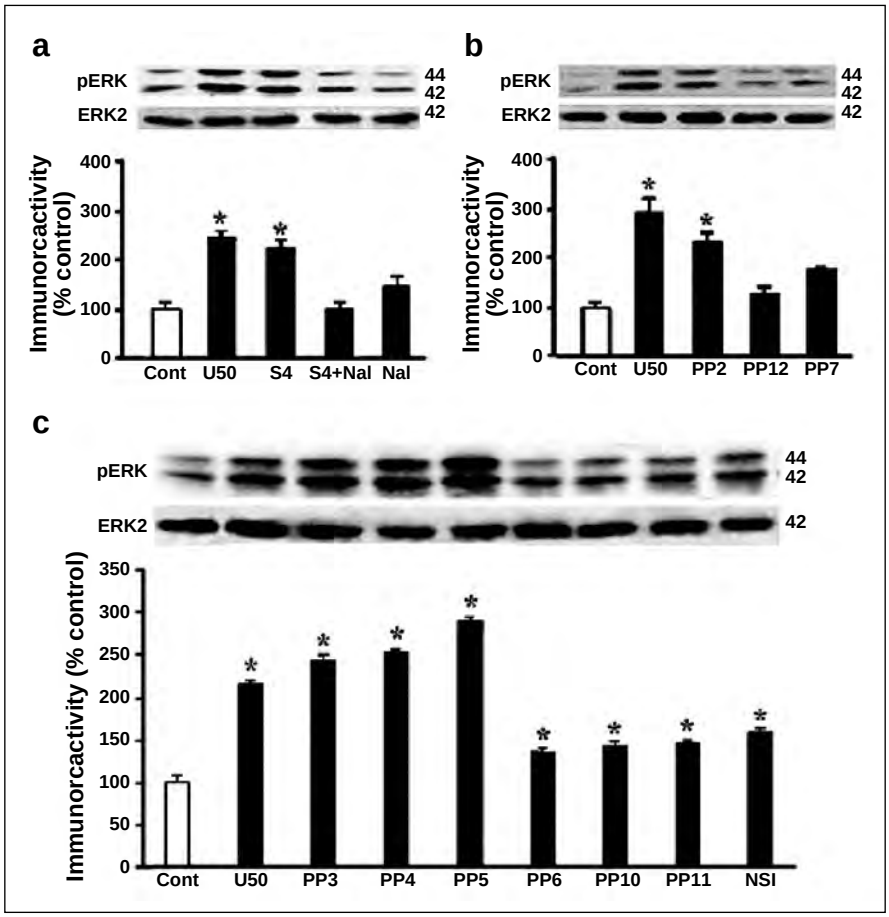


Fig. 12 : Effect of test compounds on induction of pERK activity in primary cultures of astrocytes. Ten-day-old cultures were serum starved for 48 h. The stimulatory effect of opioid agonist such as κ-opioid receptor agonist, U50488H (1 µlM) and the test compounds (40 µM) were evaluated by treating cells for 10 min with the drugs and quantitating pERK1/2 by western blot analysis. a) Shows stimulation of pERK by S4, which was antagonized by co-treatment with naloxone (10 µM). The effect of other test compounds shown in (c). *P <0.05 versus untreated control.

cultures were treated with the test compounds and pERK levels were estimated by western blotting analysis. It was observed that many of the test compounds were able to stimulate ERK phophorylation (Fig. 12).

Our group has actively participated in The Indian Genome Variation (IGV) Consortium, which was set up to build a resource for studying the distribution of genetic variation and its relationship to complex disease in the Indian population. We have been able to provide the distribution of SNPs of a number of candidate genes for addiction in 55 Indian populations representative of the ethnic, linguistic and geographic diversity of India.

A collaborative project with a psychiatric clinic, Baulmon, Kolkata and National Medical College, Kolkata is underway to carry out genetic epidemiological studies on opioid addiction by investigating the possible correlation of specific SNPs of certain candidate genes like µ-opioid receptor, κ- opioid receptor etc. with any feature of addiction.

Limbal stem cell culture

A collaborative project with Regional Institute of Ophthalmology, Kolkata was funded by the Department of Biotechnology, Government of India three years ago with the purpose of reconstructing damaged cornea in ocular surface disorders by transplantation of corneal epithelium from cultured limbal stem cells. Part of the project for establishing limbal cells from cadaver eyes on amniotic membrane was successfully implemented and reported to DBT task force. However, transplantation of the cells to patients is held up, awaiting DBT approval.

TOXICOLOGY

Dr. Tuli Biswas and group

Iron deprivation as an approach in the development of antileishmanial therapeutics

Iron (Fe) chelation has been proposed to be an useful tool for controlling visceral leishmaniasis (VL) under *in vitro* condition. Working in this direction, we have already reported the efficacy of quercetin (Qr), a falvonoid, as a chelator on the inhibition of Fe mediated proliferation of parasites in leishmanial infection under *in vivo* condition. Since serum albumin (SA) functions as the transport protein for Qr, depletion of SA in VL is likely to compromise the proficiency of Qr against this disease. Combination therapy with Qr and SA increased bio availability of the flavonoid in VL. This appeared to be the major advantage in favor of antileishmanial function of Qr. In an attempt to define the mechanism behind the inhibition of parasite proliferation by Fe chelation, we have measured the effect of Qr-SA on the activity of ribonucleotide reductase (RR), a Fe-dependent enzyme that catalyses the reduction of ribonucleotide to deoxyribonucleotide, the rate limiting step of DNA synthesis in an *in vivo* model. RR is a tetrameric protein composed of R_1 and R_2 subunits. R_2 subunit contains a di iron site that produces stable tyrosyl free radical essential for the enzyme activity. To determine the effect of Qr-SA on RR, we analyzed EPR signal of tyrosyl radical in the RR of amastigotes isolated from hamsters. Tyrosyl radical was measured from the peak to peak amplitude of EPR signal (Y). Fig. 13 shows about 65.5% quenching of the g = 2.009 feature of the signal after treatment with Qr-HSA (hamster serum albumin) in comparison to that exhibited by untreated infected counterparts. This may be related to the destabilization of tyrosyl radical in response to Fe chelation with Qr-HSA. Results indicate RR to be a target for Qr action with an implication for antileishmanial drug development based on interference with the iron metabolism of parasite under *in vivo* condition.

Studies on the mechanism of hemolysis in chronic arsenic toxicity

Arsenic (As) contamination has become an imperative threat to human health throughout the world. Chronic consumption of As contaminated drinking water is epidemiologically linked to many toxic effects including reduced lifespan of erythrocytes. A collaborative study with Dr. A. K. Giri of Human Genetics and Genomic Group has been undertaken with an objective to explore the mechanism of cell death in human erythrocytes during chronic As exposure. As toxicity decreases the flexibility of red cell membrane that makes them less deformable. This may be linked up with altered transbilayer lipid asymmetry and reorientation of endofacial aminophospholipids to the outer leaflet of the bilayer. Exposure of phosphatidylserine (PS) to the outer cell membrane was determined from annexinV binding with the help of FACS analysis. The binding increased significantly from the control level due to As exposure (Fig. 14A). PS exposure provides a signal for the recognition of these cells by the macrophage which stimulates eryptosis, an apoptotic process present in the erythrocytes. This was

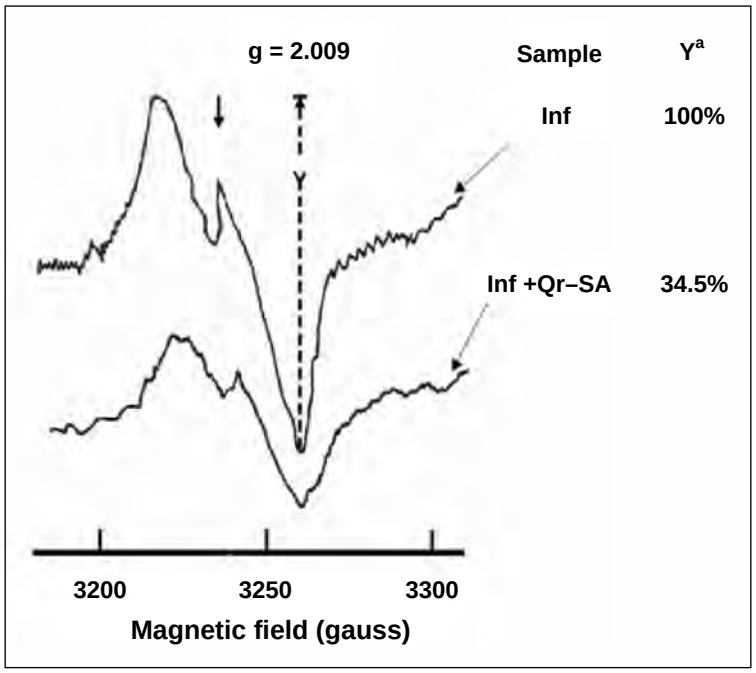


Fig. 13 : EPR signal of tyrosyl radical in RR of *L.donovani* amastigotes. EPR spectra of g=2.009 region, before after the treatment of infected hamsters with Qr-HSA.

accompanied by an alteration of cell volume as evident from the decrease of forward scatter (Fig. 14B), which indicates cell shrinkage, another characteristic of eryptosis. Results suggest the involvement of altered cell volume with the loss of membrane lipid asymmetry in the activation of death process in red cells during As exposure.

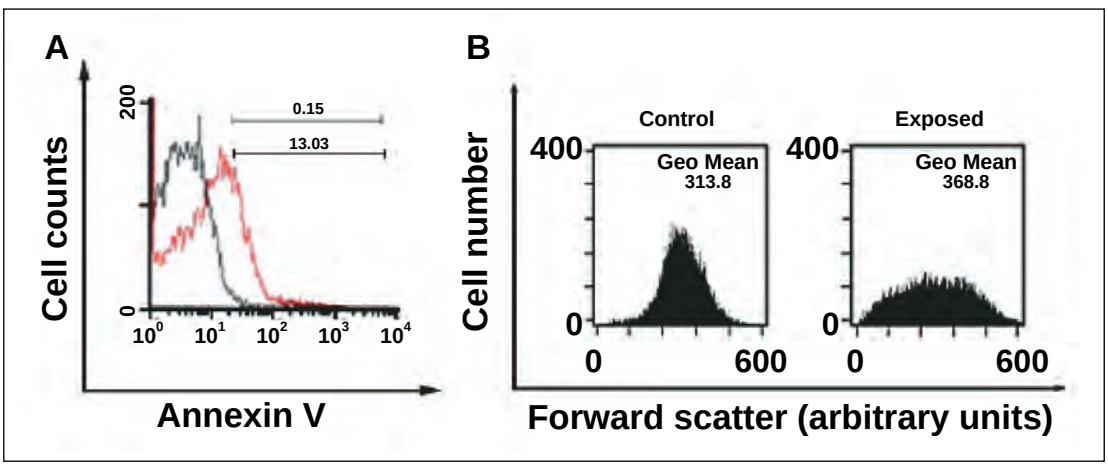


Fig. 14 : PS exposure at the erythrocyte surface and red cell shrinkage due to As toxicity. (A) Representative histogram of AnnexinV binding erythrocytes from control (black line) and exposed (red line) population. (B) Representative histogram of forward scatter of erythrocytes from control (left panel) and exposed (right panel) erythrocytes.

MOLECULAR ENDOCRINOLOGY

Dr. Arun Bandyopadhyay and group

Understanding molecular mechanism of dysfunction of hypertrophied Heart

PCR Array of Angiogenesis

The excess of glucocorticoid causes pathophysiolgical changes of the myocardium which might lead to slower heart beat, reduced cardiac output and dysfunction. The myocardial remodeling and fibrosis contributes significantly to cardiac dysfunction by altering cardiac contractility and ventricular pump function in diseased hearts. We have also developed a hypertrophy model in rat by administering dexamethasone, a synthetic analogue of glucocorticoid, for a period of 2-3 weeks.

Angiogenesis based pathway-focused gene expression profiling was performed using real-time PCR with cDNA samples from control and Dex treated hearts. The array showed the differential expression of 84 angiogenesis pathway specific genes, of which about 7 genes were significantly down regulated and 31 genes were significantly up regulated ($P< 0.05$). A large number of genes that encode ECM proteins displayed enhanced expression in Dex treated model relative to control rat heart tissue. In addition to several types of collagen, other proteins that are structural components of the ECM were transcriptionally elevated, including fibronectin, laminin etc. The increase in the level of proinflammatory cytokine TNF alpha was also found. The results exhibit the involvement of angiogenesis in Dex treated rat model.

Cluster Diagram. Clustered gene expression patterns were obtained for the relevant genes.Genes with similar expression patterns were clustered together and the clusters were arranged by nearest similarity to other clusters. The relative expression levels for each gene in the control vs Dex treated samples were plotted against each other in the Cluster diagram (Fig. 15).

Proteomic approach to study the differential protein expression in hypertrophied rat heart

Associated with technological progress in genomics and transcriptomics, advances in basic biology have led to a more complete and sophisticated understanding of interactions among genes and environment. Proteomics, presently the most advanced technology, is merely more than just generating lists of proteins that increase or decrease in expression as a cause or consequence of pathology. The goal is to characterize the information flow through the intercellular protein circuitry that communicates with the extracellular microenvironment and then ultimately to the serum/plasma macroenvironment.

Hyperthyroidism has long been known an important factor for eliciting a cardiac hypertrophic response culminating in heart failure. The T_3–altered genes encode various types of proteins related to metabolism, matrix and cytoskeletal structures, growth factors, transcription factors, Ca^{2+} channels etc. Currently in our laboratory, utilizing the proteomics-based knowledge we have found few proteins related to mitochondrial energetics and energy metabolism as well in our T3-induced hypertrophied heart model. The protein expression profiles of left ventricular myocardia in control and hyperthyroid rats after 15 days of T_3-treatment (7.5µ'b5g/100g body-weight of rat) were analyzed using 2-DE (2-Dimensional Electrophoresis) in combination with MALDI-TOF/TOF MS/MS.

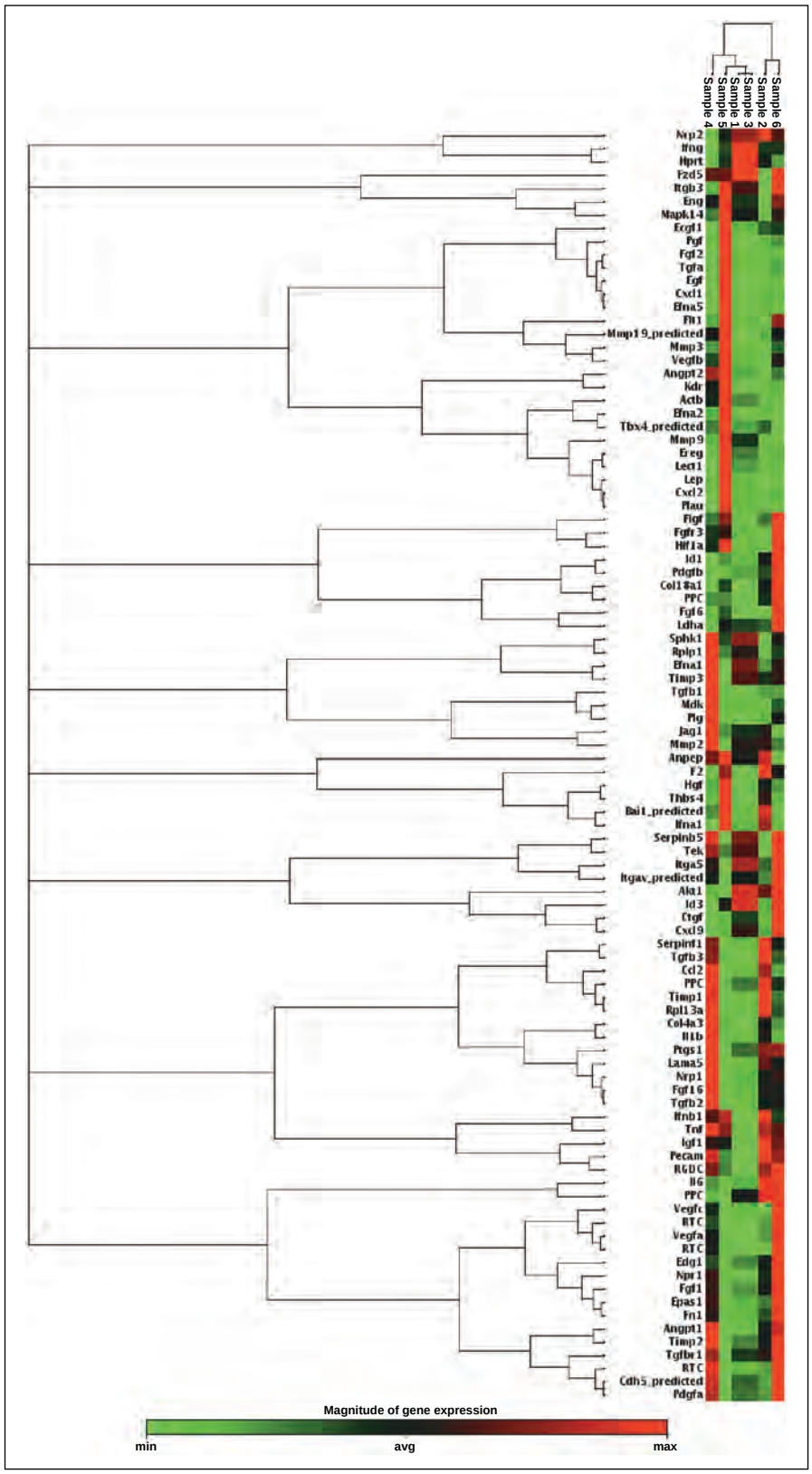


Fig. 15 : Representation of PCR array results as clusterdiagram

Comparing the 2-DE images between control and hypertrophied heart in rats, 20 spots were significantly modulated. These spots were cut out for identification by MALDI-TOF/TOF MS with PMF and/or MS/MS in combination with database searching. As a result, 9 were identified, of which 4 protein spots were found to be down-regulated and few were slightly-upregulated in hypertrophied heart. One or two were found to be uniquely expressed hypertrophied heart compared to control. Most of these proteins are known to be involved in mitochondrial energetics and energy metabolism. Although further investigations are necessary to find out the correlations of how these alterations in protein expressions are associated with the patho-physiological mechanisms of the cardiac dysfunction.

Dr. Sib Sankar Roy and group

To study the transcriptional network involving Pitx2 homeodomain transcription factor in gonadal development and function

Our previous data showed the expression of Pitx2, a homeodomain transcription factor in the ovary of rat and human. A cluster of gene that is probable target of Pitx2 has been identified by ChIP-chip method. The Pitx2-associated cofactors have also been identified in ovary and these factors are found important for regulation of expression of Pitx2 target genes in ovary. We earlier showed the involvement of different Pitx isoforms in ovarian function in adult rat. Here we show the temporal and spatial expression pattern and localization of Pitx2 throughout the embryonic development as well as in neonatal and adult gonads of both sexes. Pitx2's expression is found restricted to the embryonic testicular cords and ovarian primordial germ cell clusters, but higher expression level was observed in testis than in ovary. We have found the transcription factor GCMa expresses only in testis during gonadal development and interacts with Pitx2 in testis. GCMa plays essential role in development and maintenance of normal function of different tissues. The higher expression level of GCMa and Pitx2 in developing testis suggests their sex-specific activity. GCMa co-localizes with Pitx2 in testis during developmental stages and co-immunoprecipitation data suggests that the Pitx2 and GCMa interact with each other during gonadal development. Future study would reveal the possible transcriptional network involving Pitx2 that regulates the gonadal development and sex-specific regulation of expression of different genes; this information will help us understand the disorders associated with gonadal development in both sexes.

Molecular basis of hypothyroidism-associated ovarian disorders and the role of T3 and VEGF on expression of MMP genes

The involvement of thyroid hormone in the collagen metabolism and the role of lysyl hydroxylase (Plod2) in ovarian dysfunction has been shown by our laboartory. The involvement of MMPs and TIMPs has also been studied in the event of defect of collagen metabolism in hypothyroid condition. We have shown the regulation of Plod2 gene expression in ovary by Pitx2 homeodomain transcription factor and showed that it binds to bicoid element of Plod2 promoter and that it is an upstream activator of Plod2 gene by siRNA mediated gene knock down study. We have also identified other factors that are associated with Pitx2 and these are important for ovarian function and disorders.

MMPs are associated with maintenance of ovarian ECM and also their malfunction cause different

ovarian disorders. Some MMPs are found to be differentially expressed in ovarian cancer. Ets-related transcription factors including PEA3 regulate different MMP gene expression in many tissues. To know the mechanism of MMP gene expression in ovary we initiated our study to know the role of these factors. We have also investigated the role of different factors, like VEGF and thyroid hormone (T3) in regulating the Ets gene expression. Our data suggests that these factors influence the differential expression and nuclear translocation of Ets1 and Ets2 transcription factors in ovarian carcinoma cell line (Fig. 16). Hence, to understand the genetic, molecular and biochemical basis of hypothyroidism-associated reproductive disorders, our group has identified and characterized several significant factors. Future study will help us understand the molecular mechanism of these disorders.

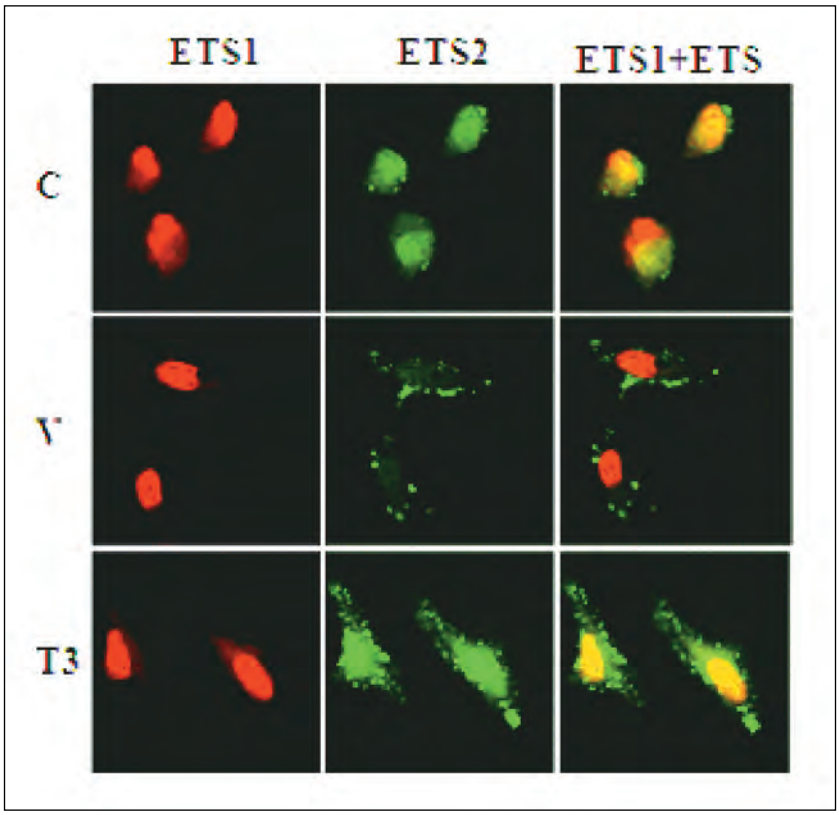


Fig. 16 : Role of VEGF (V) and thyroid hormone (T3) in expression and nuclear translocation of ETS1 and ETS2 transcription factors in Sk-Ov3 ovarian carcinoma cell lines with compare to control (C). ETS1 expression indicated as red fluorescence, ETS2 expression indicated as green fluorescence and the right panel the merged figure is shown, where expression of both factors are shown.

To study mitochondrial dysfunction in type 2 diabetes

The mechanism of insulin resistance followed by diabetes type 2 is not yet known. The role of mitochondria and mitochondrial proteins is very much important in causing diabetes type 2. In this regard the role of PGC1 α and uncoupling proteins (UCP-2 and -3) is also shown. Our objective was

to validate mitochondrial structural and functional disorders in diabetic model system and in insulin target cell lines. Standardization of the quantification of the membrane viscosity/fluidity of the isolated mitochondria from rat muscle tissue was done. The fluidity was shown to increase in the mitochondrial membrane of STZ-induced diabetic rat muscle. The mitochondrial membrane potential measurement has also been standardized and we found that the membrane potential was increased in high insulin and high glucose treatment in muscle cell line. We have also studied the expression profile of different genes in muscle and adipose tissues of diabetic model, those are either mitochondrial genes or their proteins act inside mitochondria.

We wanted to study the association of hypo-and hyperthyroidism with diabetes and the mechanism thereof. The clinical evidences suggest that hypothyroid patients have more risk from diabetes than that of normal healthy individuals. We have found that the mitochondrial membrane fluidity at hypothyroid condition as well as in diabetic condition is increased. The Mfn gene, which codes for an important protein for maintenance of mitochondrial structure and function, was down regulated in hypothyroid condition. ROS generation has also been shown to alter both in hypothyroid and in diabetic conditions. Therefore, it is possible that mitochondrial dysfunction as a whole is common consequence or cause of these two disorders. The work is in progress to find out other common factors that are linked with these two disorders.

REPRODUCTIVE BIOLOGY

Dr. Sandhya R. Dungdung and group

Purification and characterization of a sperm motility promoting protein from goat blood serum

A 66 kDa forward motility stimulating factor (FMSF) has been purified to apparent homogeneity from goat blood serum and some of its physical, biochemical and physiological characteristics have been established using the homologous sperm system. It is a heat-stable, Mg2+ -dependent, monomeric protein and enhanced markedly sperm forward motility. Antibody has been raised against the forward motility stimulating protein. ELISA results also revealed that it is present in testis in comparatively good amount although goat blood is the richest source from where it was purified. The observation that FMSF is present in testis and epididymal plasma, as determined by ELISA, suggests that the motility factor has a regulatory role on sperm physiology. Goat FMSF showed high degree of immunospecificity as evident from the Western Blotting test (Fig. 17). FMSF antibody at lower levels causes significant inhibition of sperm motility. Spermatozoa undergo head to head agglutination when treated with higher-level anti-sera against FMSF, demonstrating thereby the localization of the motility-promoter on the outer surface of sperm head. The data are compatible with the view that FMSF binds with its specific receptors localized on the sperm head surface, although it is not clear as to how the FMSF-receptor interaction triggers the flagellar motility. Further characterization of FMSF and finding its role in fertilization is under progress.

Sperm ecto-kinase and its protein substrate: novel regulators of membrane fusion during acrosome reaction.

Previously we have purified and characterized a unique plasma membrane-specific cyclic AMP-

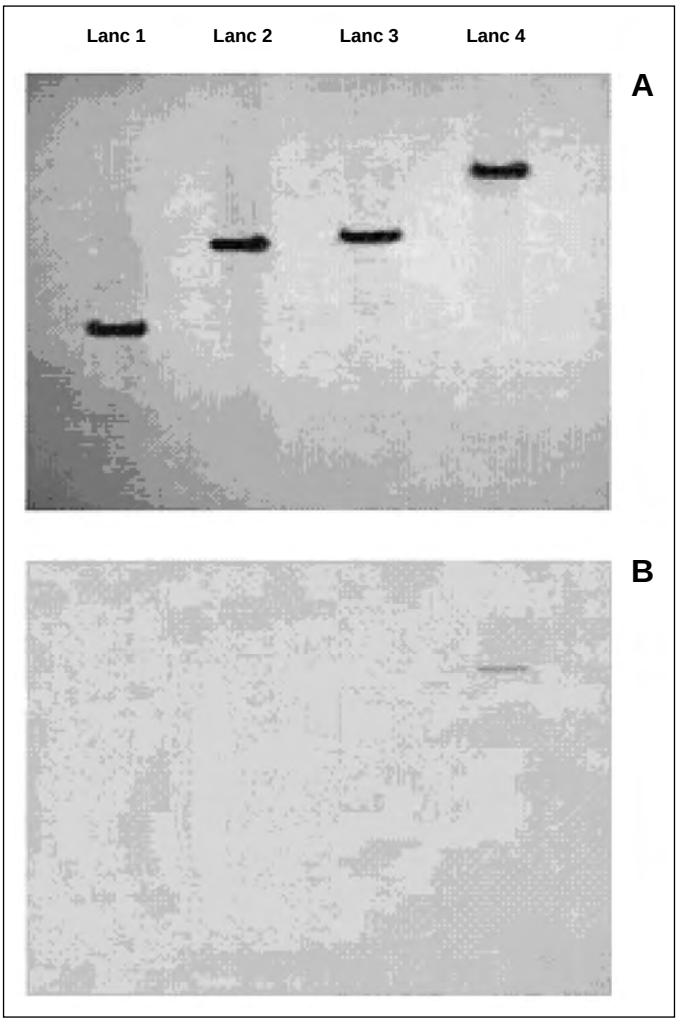


Fig. 17 : Determination of antibody specificity by Western Blotting. Lane 1: Casein, Lane 2: Ovalbumin, Lane 3: Fetuin, Lane 4: Goat FMSF. A: Polyacrlamide gel electrophoresis of proteins, B: Immunoblot on nitrocellulose paper.

independent ecto-protein kinase (ecto-CIK) as well as its ecto-phosphoprotein substrate (MPS) using caprine sperm model. This study reports for the first time the role of the sperm external surface protein phosphorylation system on sperm acrosome reaction, which is essential for fertilization. Calcium ionophore A 23187 has been used to trigger the sperm acrosome reaction *in vitro*. Treatment of sperm cells with CIK antibody (dil: 1:500) causes a significant decrease (approx 50%) in percentage of acrosome reacted sperm (Fig. 18). Onset of the acrosome reaction causes a remarkable increase in the rate of acrosin release from the cells in the medium. However, CIK antibody inhibits significantly (approx. 50%) the acrosin release. The level of membrane-bound MPS as estimated by ELISA and the degree of its phosphorylation catalysed by the endogenous ecto-CIK, increase significantly with the progress of the acrosome reaction. Both the parameters increase by approx 100% during the 20 min of the reaction. MPS antibody (1:100 dilution) markedly decreases (approx 75%) percentage of acrosome-reacted sperm. MPS antibody as well shows high efficacy to inhibit acrosin release from spermatozoa. The results demonstrate that the cell-surface protein kinase and its protein substrate are

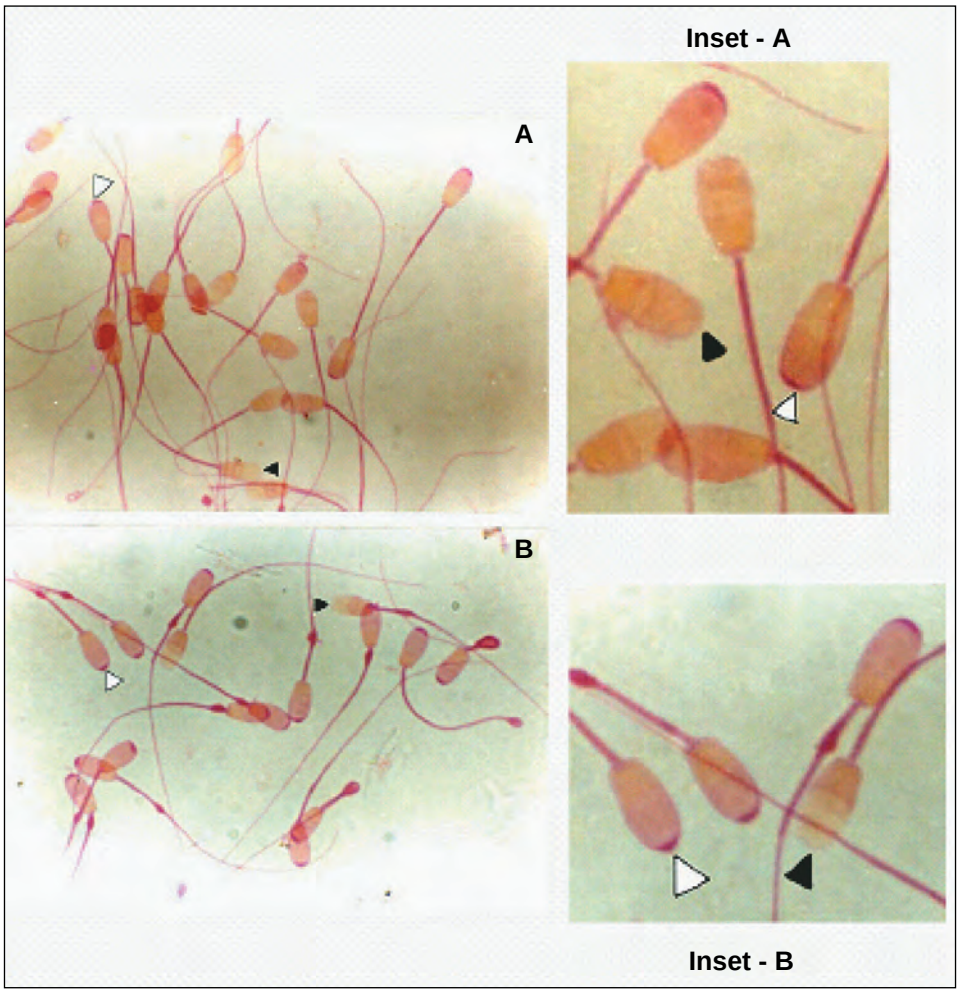


Fig 18 : Effect of ecto-CIK antibody on acrosome reaction of goat cauda spermatozoa as monitored by the Rose Bengal staining method.

essential for membrane fusion component of acrosome reaction. The data are consistent with the view that MPS regulates acrosomal membrane fusion with the overlying plasma membrane by the mechanism of its phosphorylation and dephosphorylation.

Acrosome reaction was carried out under the standard assay conditions and the cells after staining with Rose Bengal were observed under microscope at 1000x magnification (Fig. 18). (A) Sperm cells treated with preimmune sera. (B) Cells treated with ecto-CIK antibody. (s) represents acrosome reacted (acrosome not intact) sperm or (ŝ) represent acrosome un-reacted (acrosome intact). The "acrosome unreacted" cell has a well defined tiny colored spot on the tip of the sperm head whereas the "acrosome reacted" cell has no such colored spot . The insets showing sperm cells at higher magnification give clearer vision of the acrosome reacted and unreacted cells.

Further studies on upgrading the recently developed computerized spectrophotometric sperm motility analyzer and its application for assessing sperm fertility potential

The SPERMA, sperm motility analyzer, a unique computer based instrumental system has been

developed for the first time to determine sperm motility (velocity), using a spectrophotometer for clinical and biological applications. Now, a new project funded by DST is continuing in which the main purposes are to calibrate and standardize this unique instrumental system, SPERMA, and correlate the vertical motility parameters experimentally with fertilizing ability of the spermatozoa. The other purpose of this project is to upgrade the SPERMA by incorporating multi-cuvette (multi-sample) analysis of the spermatozoa sample in the present instrumental system to make it more useful and market friendly. The proposed instrumental upgradation will develop a simple but unique device for objective assessment of sperm motility. The work is under progress.

Dr. Syed N. Kabir and group

Physiological and pathophysiological aspects of female reproduction

Animal model for premature ovarian failure

We have been working on development of animal model for premature ovarian failure (POF) and exploring the impact of follicular quantum on follicular apoptosis. We have demonstrated earlier that embryonic galactosyltransferase (GalTase) plays important roles in the process of germ cell migration, and attenuation of embryonic GalTase activity restricts oogonial migration leading to development of ovary with deficient follicular reserve. Reduced follicular quantum, in turn, accelerates the rate of atresia in the remaining follicles. Expression of GDF-9, an oocyte-specific factor essential for early phase follicular maturation, along with its upstream transcriptional regulator, *NOBOX*, was significantly down regulated. Grafting of immature control rat ovary under the bursa of the follicle-deficient ovary reversed its expression of GDF9 and *NOBOX*, rescued it from undergoing accelerated rate of atresia, and the rat recovered from the adverse consequences of ovarian aging. We hypothesize that the balance between the pro-survival and pro-apoptotic factors involved in determining the rate of follicular atresia is perhaps under the upstream regulation of an as-yet unidentified ovarian milieu provided by the size of follicle pool; and the declining follicular reserve is perhaps the immediate thrust that increases the rate of follicle depletion during the final phase of ovarian life.

Search for spermicidal molecules of plant origin

Spermicidal and anti-HIV effects of Acaciaside-B-enriched fraction of the seeds of Acacia auriculiformis

The population explosion coupled with steer rise in the incidence of HIV infection through heterosexual contacts has regenerated our interest to develop topical microbicides with discerning spermicidal property that would prevent unwanted pregnancies and curb the rising HIV epidemic. We have demonstrated earlier that isolates of the extracts of *A. auriculiformis* seeds, Acaciaside-B (Ac-B) and an Ac-B-enriched fraction (Ac-B-en), offer spermicidal activity and attenuate HIV-1 transmission in vitro at significantly lower concentrations. Electron microscopic studies on human sperm demonstrated that Ac-B-en disintegrates plasma membrane and damages acrosomal cap to various degrees ranging from perforations and vesiculation to complete disintegration. Transmission electron microscopy further shows that along with dissolution of the acrosomal cap, there occurs expansion and separation of the plasma membrane from the nucleus (Fig. 19).

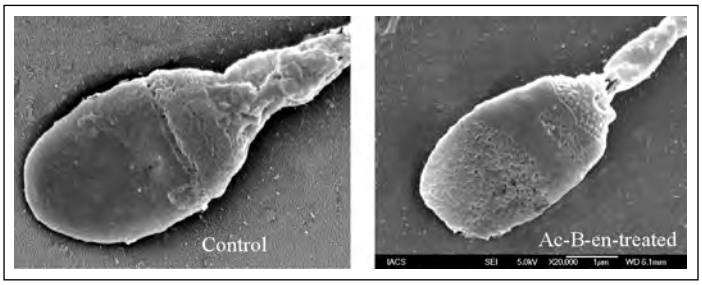


Fig. 19 : High resolution scanning electron micrographs showing dissolution of acrosomal cap under exposure to Ac-B-en at mean effective concentration.

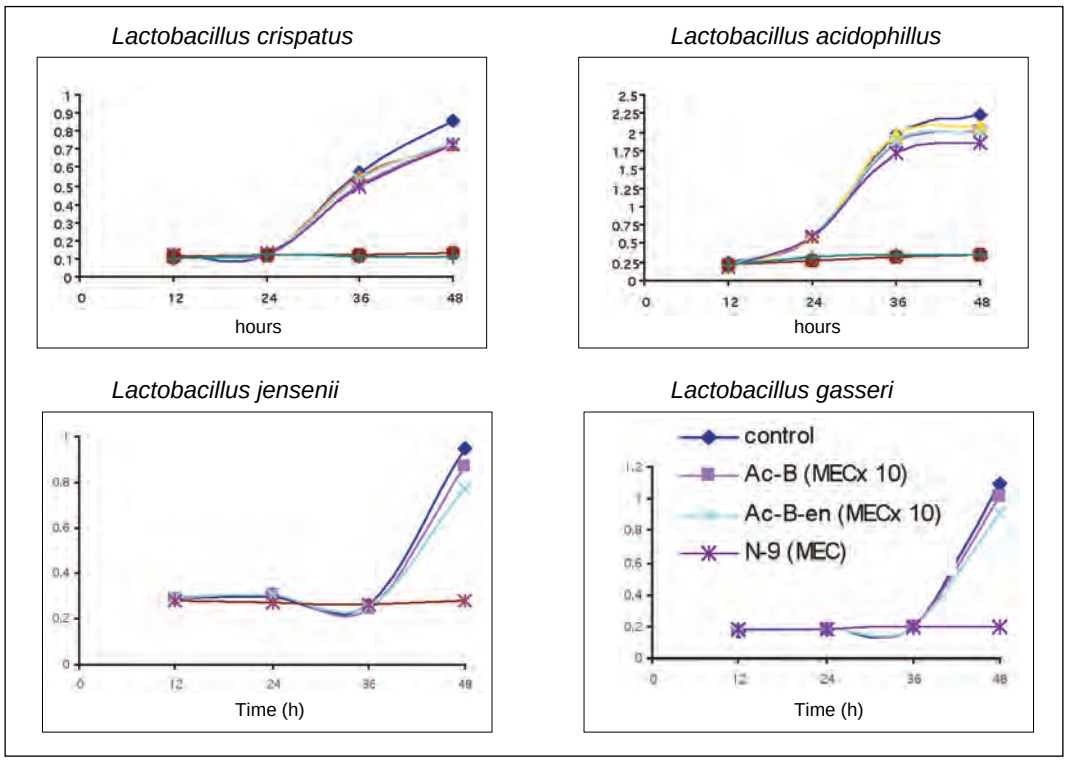


Fig. 20 : Optical density as the measure of turbidity denoting growth of Lactobacilli colonies during 48 hour of culture in the absence and presence of nonoxynol-9, Ac-B and Ac-B-en. As against a constant inhibition of bacterial growth by nonoxynil-9, neither Ac-B nor Ac-B-en shows any adverse impact.

We have earlier demonstrated that Ac-B-en exerts no detrimental effects on *Lactobacillus acidophilus* growth cultured *in vitro*. However, the *L. acidophilus* complex is highly heterogeneous and varies between geographically separated locations. To give more power to the prediction of safety covering different geographical locations, we evaluated the effects of Ac-B and Ac-B-en on 3 more sp/sub-sp of Lactobacilli including, *L. cryspatus, L. jensenii, and L. gassiri.* No adverse impact of Ac-B or Ac-B-en was evident until 10x mean effective concentration (MEC) (Fig. 20).

We evaluated the possibility of mutation via bacterial reverse mutation test using four different histidine-requiring strains of *Salmonella typhimurium* that detect point mutations involving subsititution, addition, or deletion of one or few DNA bp. Each of the four strains contains a different type of mutation in the histidine operon. *S. typhimurium* TA100 detects mutagens that cause bp ubstitutions at G-C pairs; TA 97a and TA 98 detect frameshift mutagens that damage the correct reading frame of histidine synthesis at G-C bp Since Ac-B-en increases lipid peroxidation and these strains may not detect the oxidizing mutagens, we also employed the strain TA102, which has A-T bp in the primary reversion site. The test was performed with or without metabolic activities by cofactor-supplemented post-mitochondrial fraction (S9). For all test strains, regardless of S9 activation, the number of revertant colonies in the presence of Ac-B-en at 100xMEC did not differ significantly from that in the corresponding negative control.

Intravaginally applied compounds come into contact with the epithelia of vaginal, ectocervical and uterine mucosae, causing a reaction leading to inflammation. Investigations are underway to characterize such immunoinflammatory reactions by the number, phenotype activation status, and the cytokines and other soluble factors released by them., The expression of NFκB, a transcription factor capable of transactivating cytokine and chemokine genes, in the epithelial cells of the cervicovaginal mucosa reflects the activation status of ensuing immunoinflammatory reaction. We observed that following 14 days of vaginal application of AC-B-en at MEC level had little or no influence on nuclear and cytoplasmic expression of NFκB, but at 10xMEC the epithelia showed a moderate increase in the expression level (Fig. 21).

Ac-B-en was evaluated in CEM-GFP cells infected with HIV-1 NL4-3 virus. It was shown to have potent anti-HIV property at an IC 50 dose of 0.035 mcg/ml, as against its CC50 (cytotoxicity) of 6.64 mcg/ml in CEM-GFP cell and 5.68 mcg/ml in human cervical cell line, ME 180, reflecting a wide range of safety (HIV part of the investigation was done in collaboration with Dr. D. Mitra, NCCS, Pune).

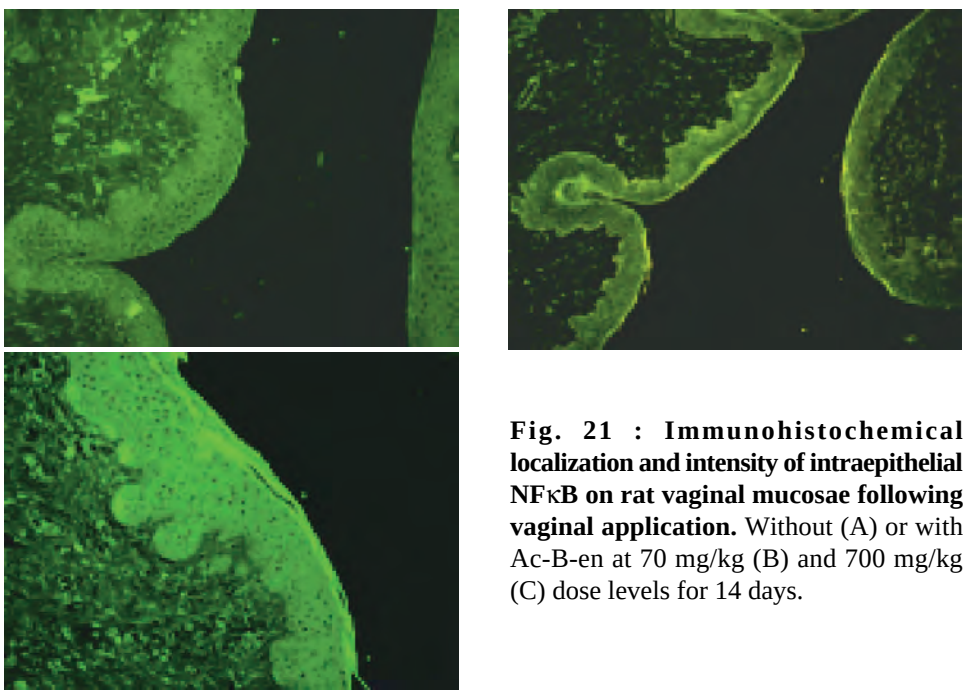


Fig. 21 : Immunohistochemical localization and intensity of intraepithelial NFκB on rat vaginal mucosae following vaginal application. Without (A) or with Ac-B-en at 70 mg/kg (B) and 700 mg/kg (C) dose levels for 14 days.

Dr Smritinath Chakraborty and group

Search for fertility regulating agents from natural resources or of synthetic origin

Spermicidal activity of oleanolic acid 3-β-D glucuronide (OAG), an active principle isolated from root extracts of *Sesbania sesban* was assessed to achieve an ideal contraceptive. Following modified Sander-Cramer criteria; the spermicidal activity of OAG was conducted analyzing motility and mortality by supra-vital staining, effect on membrane on hypo-osmotic swelling (HOS) and transmission electron microscopy (TEM) using highly motile rat sperms. Thiobarbituric acid (TBA) was used to assess membrane lipid per-oxidation (LPO). Compatibility of OAG with beneficial vaginal flora and irritability were evaluated *in in-vitro* Lactobacillus culture and hemolytic test using rat RBC. Contraceptive efficacy was measured by intra-vaginal application of OAG in rats followed by mating. The minimum effective concentration (MEC) of OAG that induced irreversible motility and loss of viability of rat sperm was 25βg/βdl. TEM and LPO revealed that OAG affected the sperm membrane. OAG declined fertility to zero and induced no adverse effects on Lactobacillus. OAG has substantial spermicidal potency that could be explored further.

Biocompatibility studies of polymer composites as replacement of bone

This is a collaborative work with Dr. S Pal, Bio-Science and Engineering Department, Jadavpur University, Kolkata-32. In continuation of earlier work on biocompatibility studies, hip-prosthesis made up of alumina reinforced ultra high molecular weight polyethylene (UMHP) coated with bio-glass was implanted/grafted *in vivo* in rabbit's hip-joint in bone replacement surgery and kept for two years. Movement of the rabbits was observed which was absolutely normal showing no symptoms of uneasiness. The prosthesis is working rightly; this can be validated further in bipedal animal (primate).

Search for controlling agent/s for breast tumors/cancers

The objective of the present study, a collaborative work with Dr P. Jaishankar, Chemistry Division. is identification and development of drug for breast cancer indigenously.

Breast cancer is the second most leading cause of cancer death. Study indicated that most early in the initiation stage breast carcinomas are dependent on estrogen. There after only fifty percent of them are dependent on estrogen for further growth. Specific anti-estrogens or estrogen agonist are useful for treatment of breast cancer or other diseases dependant sex hormone.

Diindolylmethane (DIM) initially isolated from natural sources and reported to have significant anti neoplastic effect. PH-DIM is a synthetic derivative of DIM. Earlier we have reported that PH-DIM reduced carcinogen induced rat tumor model in female Sprague-Dawley rats. The same experiment was repeated again. Estrogenic/anti-estrogenic action of PH-DIM was measured by immature rat uterine weight bio-assay method which still regarded as gold standard for estrogenic test. Uterine peroxidase was also measured. MTT assay was conducted using human breast cancer cell (MCF-7). Chroromosomal abnormalities are associated in initiation or progression with different types of cancers. So, preventive role of the compound was examined by analyzing the chroromosomal aberration in human lymphocyte culture co treated with the compound and a carcinogen.

Human breast cancer cell (MCF-7) proliferation was significantly inhibited by PH-DIM treatment. The compound reduced tumors volume significantly of carcinogen-induced mammary tumors model, result comply with earlier finding. Distinct decline of frequencies of chromosomal aberration occurred

when Ph DIM was co-treated with mitomycin C in human lymphocyte culture in comparison to treatment with mitomycin C alone. PHDIM reduced uterine weight when co-treated with estrogen and uterine peroxidase was also declined in immature female rat bioassay. The compound showed distinct anti-carcinogenic properties in different system and could be explored further for the development of anticancer drugs.

The task of karyotypic analysis of the different cell lines were carried out to validate the status of the cell lines. Karyotyping of eleven cell lines were conducted.

Active targeting of nanoparticles grafted with ligands to cells of the reticuloendothelial system by receptor-mediated endocytosis and their application against macrophage associated disorders

This is a DBT sponsored collaborative project with Sarsuna College. Sanchaita Lala (Sarsuna College), Smritinath Chakraborty, Nirup Bikash Mondal, Shampa Sarkar (IICB). We have constructed the mannose grafted PLGA (poly-DL-lactide-co-glycolide) nanoparticle. SEM studies reveal that mannose particles have tagged with PLGA. Characterization of size, its composition and crystallinity are underway (Fig. 22).

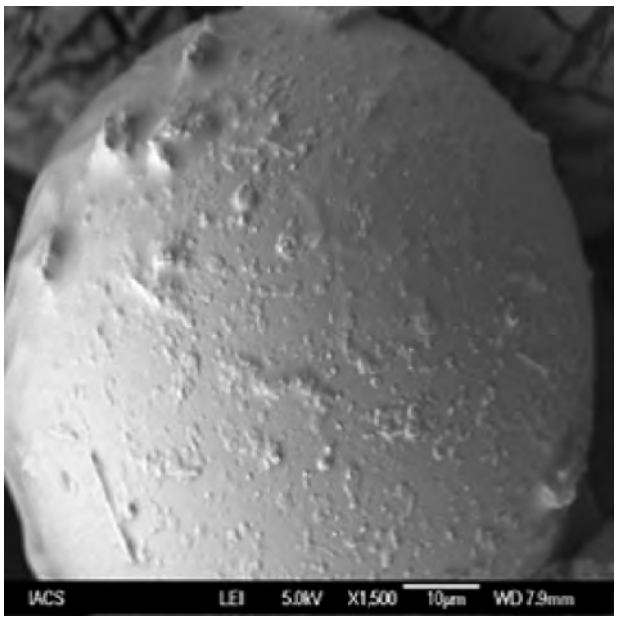


Fig. 22 : SEM picture of Mannose grafted to PLGA

Dr. Padma Das and group

Investigation of anti-cancer activity of the Andrographolide derivative

Andrographolide derivative possess a number of medicinal activities. Here we report that the active compound of Andrographolide derivative (BD43) induces apoptosis of several cancer cell lines *in vitro*. In our study we have found that growth of U937 cells was affected in the presence of Andrographolide derivative (BD43) with an IC_{50} of 5.4 μM after 48 h treatment. Following treatment of U937 cells with an IC_{50} dose of Andrographolide derivative (BD 43P) for 8 h, 12 h and 24 h, the

percentage of Annexin V-FITC binding increased. The addition of Andrographolide derivative (BD43) caused a loss of mitochondrial membrane potential. The increased proportion of cells in the sub G_0/G_1 phase corroborated that Andrographolide derivative (BD43) induced apoptosis in U937 cells. Collectively, Andrographolide derivative (BD43) induces apoptosis which was accompanied by loss of mitochondrial membrane potential, phosphotidyl serine externalization and cell cycle arrest at sub G_0/G_1 phase, which is considered as a hallmark of apoptosis.

Evaluation of the anti-cancer activity of Sesbania grandiflora

The study was carried out by biochemical observation of *Sesbania grandiflora* in human leukemic cell line U937. Bioassay guided separation was carried out to identify the fraction possessing the potential anti-cancer activity. Growth of U937 cells was affected in the presence of *Sesbania grandiflora* (SG) with an IC_{50} of 19.8 µg/ml after 48 h treatment. SG treatment resulted in a dose-dependent decrease in the viability of U937 cells which was associated with cell morphological changes and apoptotic cell death such as formation of apoptotic bodies and DNA fragmentation. Results indicated that the anti-proliferative effects of SG were associated with the induction of apoptotic cell death through loss of mitochondrial membrane potential, phosphotidyl serine externalization and cell cycle arrest at sub G_0/G_1 phase. Taken together, the overall results may be interpreted to mean a potent anticancer property of methanolic extract of *Sesbania grandiflora.* That may further be explored for its future pharmacological application.

Studies on the Berberine chloride induces a caspase-independent, apoptotic-like death in Leishmania donovani promastigotes

Berberine chloride, a quarternary isoquinoline alkaloid, is a promising anti-leishmanial compound, IC_{50} being 7.1 µM in L. donovani promastigotes. This leishmanicidal activity was initiated by its pro-oxidant effect, evidenced by enhanced generation of reactive oxygen intermediates that was accompanied by depletion of thiols; pre-incubation in N-acetyl cysteine, attenuated its cell viability, corroborating that generation of free radicals triggered its parasiticidal activity. Externalization of phosphatidylserine and elevation of intracellular calcium preceded depolarization of the mitochondrial membrane potential, which translated into an increase in the sub G_0/G_1 population and was accompanied by DNA laddering, hallmarks of apoptosis. Berberine chloride failed to induce caspase activity and anti-leishmanial activity in the presence of a pan caspase inhibitor, Z-Val-Ala-DL-Asp (methoxy)-fluoromethylketone remained unchanged, which indicated that the apoptosis was caspase independent. Collectively, the data indicates that Berberine chloride triggers an apoptosis-like death following enhanced generation of reactive oxygen species, thus meriting further pharmacological investigations.

GENE REGULATION & METAGENOMICS

Dr. Tushar Chakraborty and group

Characterization of metal microbiome through community analysis and metagenomics

Microorganisms in general have a vast capacity to interact with varieties of metals presented in almost any possible chemical form. They have developed elaborate strategies to do this. Activities are related

to protective function, metabolic utilization as well as in biogeochemical cycling. In contrast to the great amount of information concerning metal resistance, absorption and sequestration by individual model microorganism – little is known about the microbial communities associated with ores and metal rich environments and nature of their interactions.

We have carried out our study with ores from East Singbhum mines. These samples were rich in Cu, Ni, Zn, Co, Fe, S and U. We have also looked specifically into Chalcopyrites and acid mine drainage. Sampling were done in triplicates from different locations and total contents of metals were measured by atomic absorption spectrophotometry. The isolation of chemilithotrophic bacteria (Fig. 23), heterotrophic microorganisms, yeast and filamentous fungi and archaea were performed by previously reported methods. Conventional microbiological techniques are being carried out side by side with PCR based whole genome amplification and 16s rDNA phylogeny. Leaching and sequestration studies are also being carried out batch wise in shake-flask method. Relationship between biomass, pH, Redox value and leaching data are being collected to build a model which will predict switch from leaching to mineralization mode.

Microorganisms of 17 general and 278 species has been characterized with the help of 16s rDNA phylogeny. Preliminary analysis revealed 5 types of cohorts, defined by a characteristic core –group of microorganisms.

Finding common and unique features of human arsenic exposure and toxicity through genome wide methylation study

Cytosine-5 methylation at the CpG islands in the regulatory sequence of a gene is emerging as one of the key mechanisms of gene inactivation. DNA methylation/demethylation constitutes a major consequence in all biological processes involving transcription, differentiation, development, DNA repair, recombination, and chromosome organization. Perturbation of DNA methylation has been correlated with many cases of cancer incidence and progression. The hypothesis that arsenic perturbs DNA methylation has been tested successfully on tissue culture cells.

In the present work we have further tested the hypothesis on a subsection of the population tested earlier by isolating hypermethylated sequences from genomic DNA of arsenic exposed persons by methyl sensitive arbitrarily primed polymerase chain reaction (MS-AP-PCR). The fragments isolated has been cloned, sequenced. Analysed by bioinformatic tools indicate they are randomly situated in genes, pseudogenes, intergenic regions or repeat sequences. Southern hybridization of the fragments to amplified products from methyl sensitive restriction enzyme digested genomic DNA of persons exposed to arsenic in drinking water indicated that the sequences are indeed hypermethylated in the peripheral blood DNA of exposed persons Subjects of this study were a subset of our earlier study on arsenic induced DNA hypermethylation and are all residents of South & North 24 Parganas, West Bengal, India.

Criteria of diagnosis of arsenicosis and its severity are based on the established parameters. Participants have been divided into the four groups A, B, C, D according to the concentration of arsenic in their drinking water, i.e. <50, 51-250, 251-500, >500 (µg/L) respectively.We have also analysed the polymorphic status of each subject fallen in two groups, one having arsenic exposure with skin manifestations and the second is arsenic unexposed control group. Each of these two groups contain 30 samples. We have studied GSTMIand TI, Cyp 1A1, Cyp 2E, Cyp T/C and Cyp A/G polymorphism. Level of arsenic in water and urine was determined by atomic absorption spectrophotometer. Dna was extracted from whole blood by conventional chloroform extraction method using 0.01% sds &

proteinase K (0.1 mg/ml). Assuming no particular type of data distribution we have performed nonparametric Mann-Whitney U test to understand that if there any differences between Ppolymorphic variety and arsenic induced skin manifestations. We have found that in GSTMI and TI polymorphism the person with GSTMI null genotype shows a significantly ($p<0.05$) higher degree of skin manifestations in comparison to GSTMI wild type (Fig. 24).

This finding was also crosschecked by non parametric ANOVA which reveals that GSTMI null allele is positively correlated ($r=0.56$, $p<0.05$)with arsenic induced skin manifestations. The same result was obtained in case of Cyp A/G polymorphism. Cyp A allele having persons are statistically significantly ($r=0.59$, $p<0.05$) correlated with higher incidence of arsenic induced skin manifestations in comparison to Cyp G allele.

Exploitation of soil microorganisms for biodegradation of nanomaterials

Varieties of nanomaterials are being created in the laboratories today and they are being used in the industry or are being developed towards such use.One major concern regarding development and use of these novel materials are their toxicity and their environmental impacts. Nanomatrials are often found to be highly refractory towards biodegradation. We have developed a novel strategy to biodegrade organozeolite nanomaterials which forms stable nanostructures even in solution state. These unusual peptide-based organozeolites were previously shown to be refractory towards Proteinase K digestion. When we tested their impact on selected laboratory strains of *E Coli* and *Psedomonus species*, we found these materials to be detrimental to their growth. However, usng a novel selection strategy we have been able to select a group of soil microorganisms which can biodegrade and use these peptide based nanomaterials as carbon and nitrogen source (Fig. 25). Characterization of these groups of organisms are now underway.

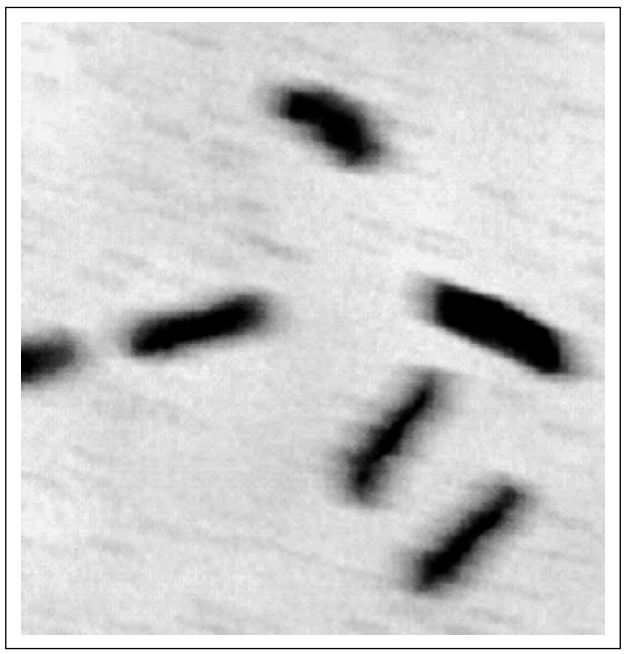


Fig. 23 : A major chemolithotrophic metal oxidizing bacterial strain isolated from metal ores. Low resolution TEM. The Bar is 1 micron

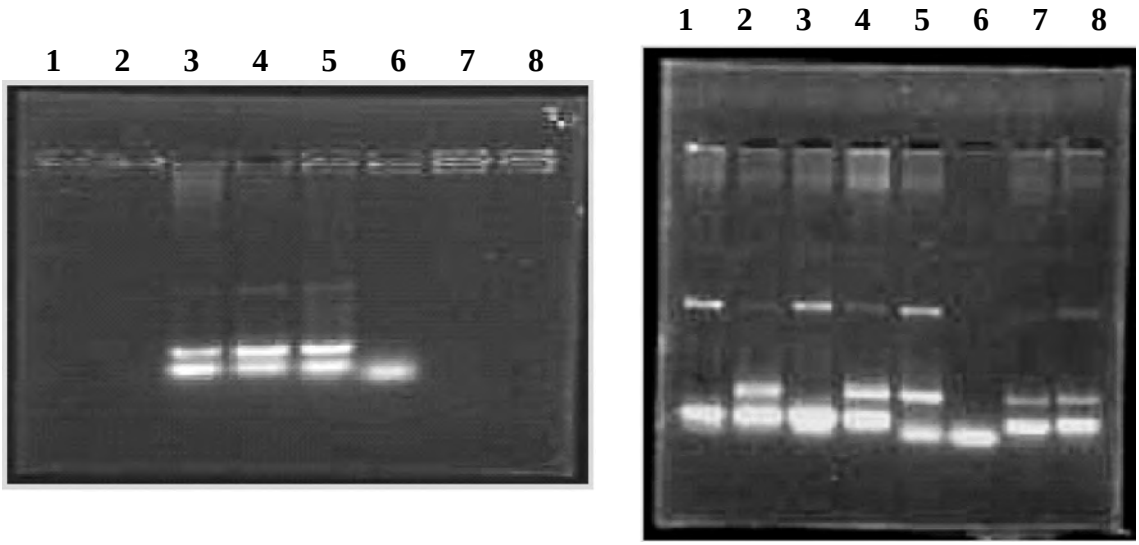


Fig. 24 : Analysis of GSTM1T1 polymorphism. By multiplex PCR the GST MI (as in A) and GST TI (as in B) status was analysed. Primer 619A & 619 B (â'89 globin gene) used to amplify 861bp internal control. Presence of either M allele confirmed by 230bp fragment. Presence of either T allele confirmed by 112 fragment. Lane 6 stands for primer Control

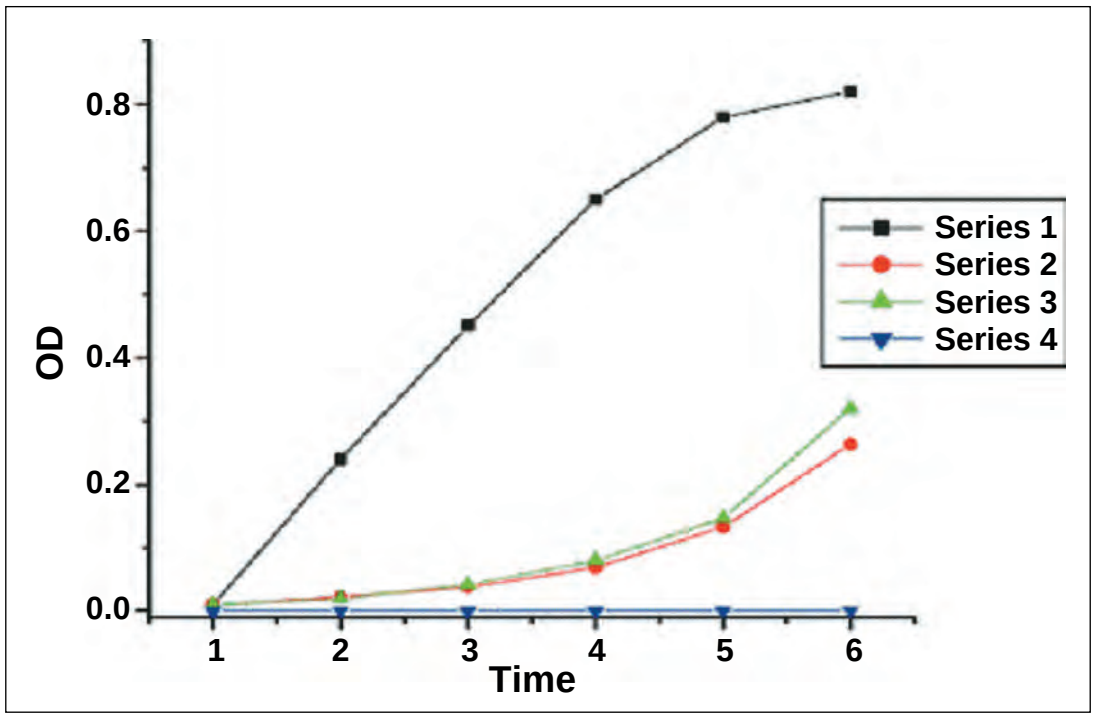


Fig. 25 : Biodegradation of a peptide based soluble nanoporous

Organozeolite by the soil microbial consortia. Series 1 represent a normal peptide as carbon and nitrogen source, where as 2& 3 represent two different organozeolite which supported subsistence growth of the selected microbial population. Series 4 represent medium without the organozeolite as negative control.

Dr. Mrinal K. Ghosh and group

Signal Transduction in Cancer & Stem Cells

Cancer is one of the major health issues in all developed countries and the molecular mechanisms that directly control the initiation and progression of cancer remains uncharacterized. Prostate cancer constitutes a crucial health issue for aging men. Whereas malignant gliomas, specifically Grade-IV glioma (GBM), the most common subtype of primary brain tumors, are aggressive, highly invasive and neurologically destructive tumors and is considered to be the deadliest form of human cancers. The global glioma researchers are focusing on different approaches of this devastating disease. The therapeutic intervention of GBM is very challenging and molecular targeted therapies are transforming the horizon of cancer treatment now-a-days.

Recent evidences suggest that solid tissue stem cells can acquire the property of cancer cells during proliferation without differentiation. The signaling pathway that is central to cell proliferation and differentiation during embryogenesis and in tissue stem cell maintenance, Wnt pathway, is now an emerging area of investigation in the etiology of cancer. Wnt-signaling controls proliferation and determination of stem cells during embryonic development and also responsible for maintaining normal tissue stem cells. β-catenin is one of the major molecular factor in this pathway to activate the early genes.

The focus of our study is to find out the molecular events involved in Wnt/β-catenin pathway which may converts stem cells to cancer cells and to dissect the signaling pathways involved in maintenance and alteration of stem cells to cancer cells. The possibility of this pathway being involved in de-differentiation process of differentiated adult tissue cells would also be investigated. β-catenin is the central player in Wnt canonical pathway and remains an indispensable area of further research. The stability of β-catenin and its role in the regulation of gene expression through TCF/LEF will also be studied. The understanding of the signaling mechanism involving Wnt proteins & β-catenin would provide critical target for therapeutic intervention of both prostate cancer and GBM. This study would provide an insight that will allow new therapeutic approaches using peptide based drugs for the prevention of cancer development.

Our research group is involved in studying the functional role of important molecular factors like Stat3, MAPK, Akt, and β-catenin. We will try to elucidate the molecular signaling pathways responsible for initiation and progression of both prostate cancer and Grade-IV glioma (GBM). This is very important because these proteins are highly oncogenic and involved as major players in most of the human cancer. This is to be done by studying the differential role of these molecular factors and their mechanism of activation in both prostate cancer and GBM. This would lead to the identification of potential targets for GBM and prostate cancer chemo-prevention.

Technical staff

Dr. Herambananda Ray, Dr. Shampa Sarkar, Mr. Swapan Kumar Mandal, Mr. P. C. Deuri.

RAs, Pool Officers, SRFs and JRFs

Ms. Tapashi Mandal, Mr. G. Kiran Kr. Naidu , Mr. Indranil Paul, Ms. Seemana Bhattacharya, Mr. Anirban Chatterjee, Ms. Shrabanti Kumar, Ms. Poornima Chandran, Ms. Piyali Das, Dr. Sudipta Saha, Dr. Sonali Ghosh, Dr. Kakali Dey (Dasgupta),, Mr. Sujoy Das, Mr. Deepak Kumar, Miss Abhi Das,

Ms. Debanjali Mitra, Mr. Shyam Sundar Nandi, Mr. Sudarshan Bhattacharya, Ms. Anindita Chakraborty, Mr. Kunal Basu, Ms. Moitri Basu, Ms. Priyanka De, Ms. Sumita Mishra, Ms. Sangeeta Maity, Mr. Vivek Chander, Mr. Priyam Banerjee, Mr. Debabrata Biswas, Mr. Kaustav Dutta Chowdhury, Mr. Dijendra Nath Roy, Mr. Samir Mandal,Ms Ms. Reena Haobam, Mr. Mritunjay Pandey, Ms Merina Varghese, Ms Sreetama Sen, Mr. Anupam Borah, Mr. Tathagata Sengupta, Ms. Debasmita Tripathy, Mr. Joy Chakraborty, Ms Ambili Appukuttan, Ms. Ayantika Pal, Mr. Tuhin Subhra Banerjee.

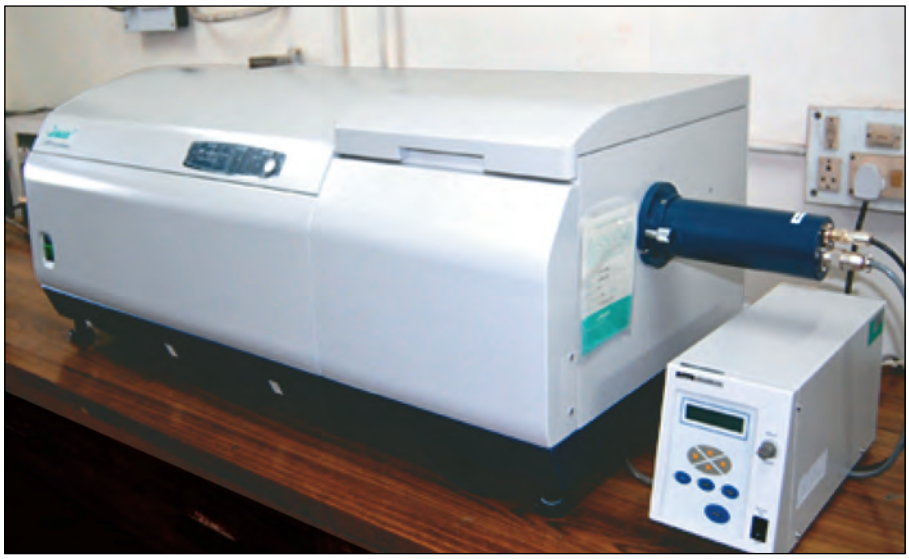
Project Assistants and Trainees

Dr. Anindita Joardar, Mr. Arijit Bhowmik**,** Mr. Syed Feroj Ahmed, Ms. Durba Pal, Ms. Sayani Banerjee, Mr. Saptarshi Dutta, Ms. Tanima Banerjee, Mr. Dipak Kar.

Surface Plasmon Resonance Analyzer

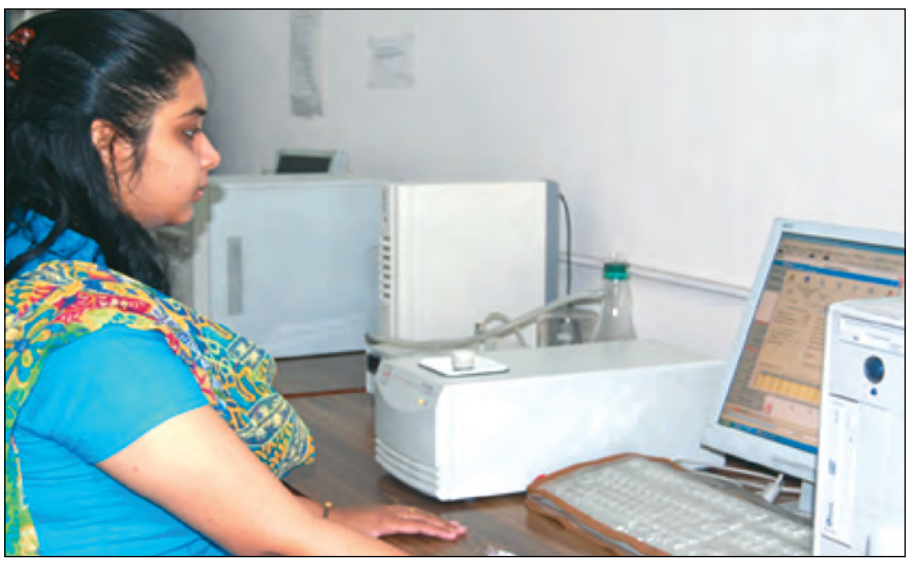
Biacore 3000 SPR system from GE healthcare equipped with analysis software for real-time measurements of protein-protein and protein-ligand interactions using microfluidics and Surface Plasmon Resonance (Centralized facility)

CD Spectropolarimeter



Jasco J815 Spectropolarimeter (commonly known as CD instrument or CD spectrometer), equipped with a Peltier thermoelectric type temperature control system and controlled by Jasco's Spectra Manager software

Microcalorimetry Facility



VP-Isothermal titration calorimeter and VP-Differential scanning calorimeter from Microcal USA to study the thermodynamics of protein:protein and protein:ligand interactions or to measure the thermal transitions

MOLECULAR & HUMAN GENETICS

Drs. Samit Adhya, Keya Chaudhury, Kunal Ray, Ashok Kumar Giri, Susanta Roychoudhury, Samir Kumar Dutta and Suvendra Nath Bhattacharyya

Brief Preamble:

The broad aims of the division are to understand the molecular genetic basis of diseases common in Indian populations, to study gene expression and function in pathogenic microorganisms, and to develop transgenic plants with improved characteristics.

The specific objectives are : to decipher the molecular basis of the genomic instabilities in head and neck cancer (HNSCC) and to identify the putative tumor suppressor genes involved in the development of this cancer: to identify susceptibility alleles in *Helicobacter pylori* associated gastroduodenal diseases: to study the molecular pathogenesis of oral submucous fibrosis: to understand the molecular genetics of haemophilia, glaucoma, Wilson disease, and oculo-cutaneous albinism: to assess the health effects, genetic damage and genetic variants in populations exposed to arsenic through drinking water in West Bengal: to test the antimutagenic and anticarcinogenic effects of black tea polyphenols theaflavins and thearubigins: to identify differentially expressed *V. cholerae* genes following infection to host and their role in pathogenesis, and to study the response of human intestinal epithelial cells to *V. cholerae* infection: to study the molecular basis of the import of nuclear-encoded tRNAs into the mitochondria of the kinetoplastid protozoon *Leishmania* using a combination of biochemical and reverse genetic approaches, to identify, isolate and modify genes from non-host plants involved in self-defence mechanisms against pests, and to transfer them as bio-pesticides to host plants.

Dr. Samit Adhya and group

Structure-function relationships in a bifunctional mitochondrial tRNA import factor from Leishmania tropica

Proteins that participate in the import of cytosolic tRNAs into mitochondria have been identified in several eukaryotic species, but the details of their interactions with tRNA and other proteins are unknown. In the kinetoplastid protozoon Leishmania tropica, multiple proteins are organized into a functional import complex. RIC8A, a tRNA-binding subunit of this complex, has a C-terminal domain that functions as subunit 6b of ubiquinol cytochrome c reductase (complex III). We show that the N-terminal domain, unique to kinetoplastid protozoa, is structurally similar to the appended S15/NS1 RNA-binding domain of aminoacyl tRNA synthetases, with a helix–turn–helix motif. Structure-guided mutagenesis coupled with in vitro assays showed that helix a1 contacts tRNA whereas helix a2 targets the protein for assembly into the import complex. Inducible expression of a helix 1-deleted variant in L. tropica resulted in formation of an inactive import complex, while the helix 2-deleted variant was unable to assemble in vivo. Moreover, a protein-interaction assay showed that the C-terminal domain makes allosteric contacts with import receptor RIC1 complexed with tRNA. These results help explain the origin of the bifunctionality of RIC8A, and the allosteric changes accompanying docking and release of tRNA during import.

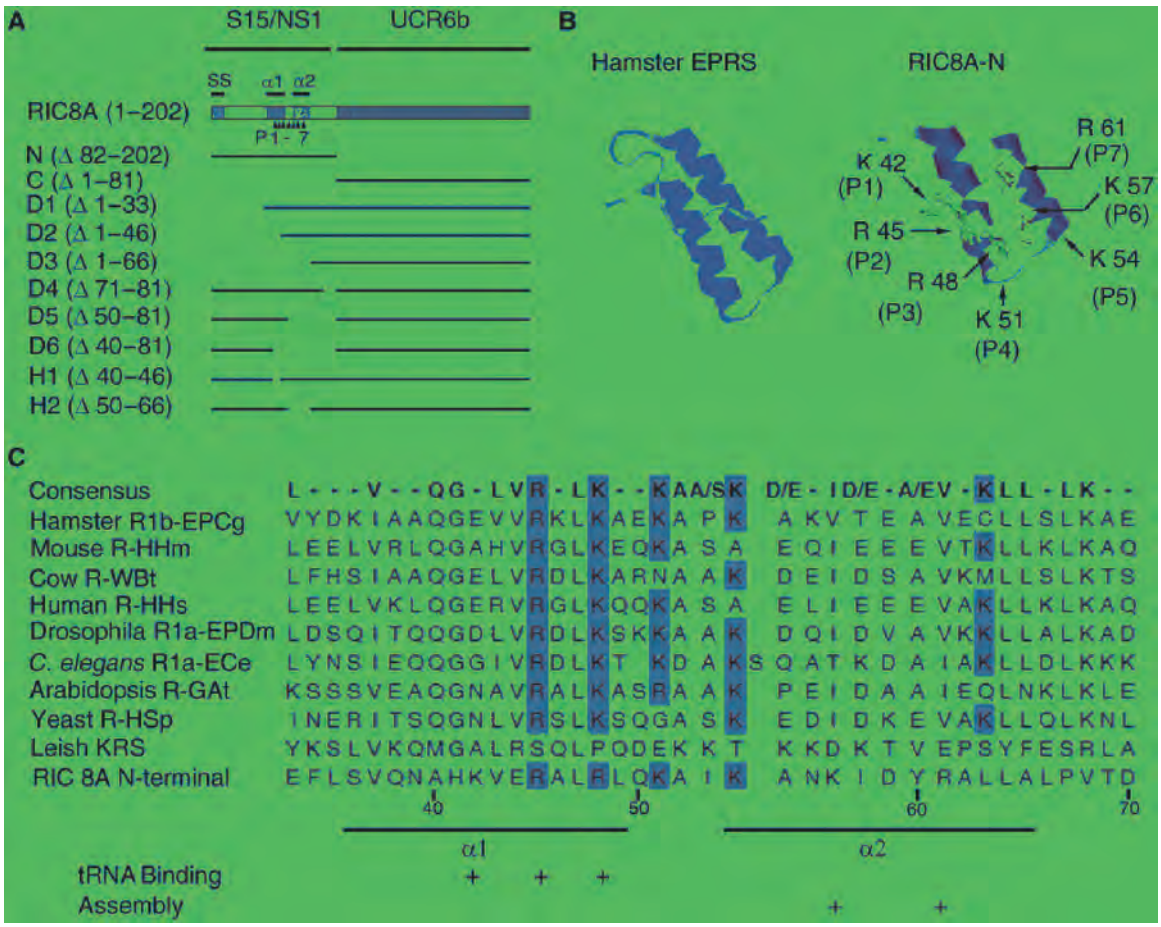


Fig. 1 : Domain structure and organization in RIC8A. (A) Domains and subdomains: ss, mitochondrial targeting sequence; α1, α2, the two helices of the S15/NS1-like domain. Positions of various deletions (D) and point mutations (P) are shown. (B) Homology model of RIC8A N-terminal domain (right) templated on the hamster GluProRS repeat R1. Side chains of residues altered to alanine are indicated (mutant numbers in parenthesis). (C) Sequence alignment of the α1–α2 region of RIC8A with the appended S15/NS1 domain of eukaryotic aaRS. Different residue types are shaded differently: pink, basic; blue, acidic; green, hydrophobic. Residues involved in tRNA binding, or assembly, are indicated by + signs.

Dr. Keya Chowdhury and group

Molecular analysis of human diseases

Vibrio cholerae, the etiological agent of cholera, leads to the induction of host cell nuclear responses and the activation of proinflammatory cytokines in the cultured intestinal epithelial cells. However, the host cell signaling pathway leading to proinflammatory response is not explored and the identity of the effector molecule(s) is largely unknown.

An engineered aflagellate V. cholerae flaA mutant (O395FLAN) resulted in highly reduced level of proinflammatory IL-1b expression in Int407. The crude flagellar protein of V. cholerae as well as recombinant FlaA induced IL-1b expression in Int407. Infection of Toll-like receptor 5 (TLR5) transfected HeLa cells with O395FLAN showed reduced expression of IL-1b compared to wild-type. Unlike wild-type V. cholerae, O395FLAN did not activate the NF-kB while the recombinant flagellin could activate NF-kB. Finally, the mitogen activated protein kinases (ERK1 and 2, p38) were

phosphorylated in wild-type and recombinant flagellin treated Int407 cells and inhibition of the p38 and ERK pathways significantly decreased the IL-1b response induced by wild-type V. cholerae as well as recombinant flagellin. Thus, our data clearly indicate that flagellin of V. cholerae could induce IL-1b expression by recognizing TLR5 that activate NF-kB and MAP kinase in Int407.

Our studies demonstrated that *V. cholerae* infection on intestinal epithelial cells results in the activation of extracellular signal regulated kinases1/2(ERK1/2) and p38 of the mitogen activated protein kinase (MAPK) family. *V. cholerae* induced intracellular pathways in Int407 cells leading to the activation of protein kinase A (PKA) and protein tyrosin kinase (PTK) in upstream of MAPK and nuclear factor-kappaB (NF-kB) pathway. Inhibitor study of Ca2+ and phospholipase-gamma (PLC-γ) pathway suggested the possible involvement of Ca2+ signaling in the *V. cholerae* pathogenesis. *V. cholerae* culture supernatants as also insertion mutants of *ctxA*, *toxR* and *toxT* genes modulate the activation of MAPK and NF-kB signaling pathways. MAPK and NF-kB signaling pathway activation were also modulated by adherence and motility of *V. cholerae*. Studies with inhibitor of NF-kB, MAPK, PTK, PKA, PKC, Ca2+ and PLC pathways showed differential cytokine secretion in Int407 following *V. cholerae* infection. Therefore *V. cholerae* mediated induction of nuclear responses through signal transduction pathway and subsequent activation of proinflammatory cytokines in Int407 modulated by *V. cholerae* secretory factors, virulence, adhesion/motility which might explain some of its reactogenic mechanisms (Fig. 2).

Identification of a novel RTX-like toxin in Vibrio cholerae: A gene cluster containing two genes in tandem has been identified in *Vibrio cholerae* ElTor N16961. Each has more than one cadherin domain and is homologous to the RTX toxin family and was common in various V. cholerae strains. Insertional mutagenesis demonstrated that each gene has a role in Hep-2 cell rounding, hemolytic activity towards human and sheep RBCs and biofilm formation. The mutants showed reduced adherence to intestinal epithelial cells as well as reduction of in vivo colonization in suckling mice. These two genes thus code for RTX-like toxins in V. cholerae and are associated with the pathogenecity of this organism.Using the programs developed in our laboratory for identification of Genomic Islands as well as Repeat Search, a gene cluster containing two genes in tandem has been identified in *V. cholerae* ElTor N16961, which were thought to code for some new toxin in this organism. Each of these genes possessed more than one cadherin domain, was homologous to RTX toxin family and was common in various *V.cholerae* strains. Insertional mutagenesis demonstrated that each gene has a role in Hep-2 cell rounding, hemolytic activity towards human and sheep RBCs and biofilm formation. The mutants showed reduced adherence to intestinal epithelial cells as well as reduction of *in vivo* colonization in suckling mice. These two genes thus code for **novel** RTX-like toxins in *V. cholerae* and are associated with pathogenecity of this organism.

Arsenic induced apoptosis in malignant melanoma cells is enhanced by menadione: Arsenic is an environmental toxicant and a human carcinogen but paradoxically it has therapeutic effects too. I*n vitro* application of the soluble most toxic and naturally prevalent form of arsenic, sodium arsenite ($NaAsO_2$) results in a different outcome in human malignant melanoma cell A375. Interestingly, 2 µM $NaAsO_2$, the maximum dose that can be achieved in blood plasma, led to induction of apoptosis at 72 h of treatment, confirmed through Annexin V-PI dual staining and DNA content analysis. Increases in reactive oxygen species (ROS) production, loss of mitochondrial membrane potential, associated with an activation of caspases was found to be the critical mediators of apoptosis. However, to further stimulate the action of arsenic, pharmacological concentration of arsenic in combination with a widely known oxidant, menadione was explored in this study which synergistically sensitized

malignant melanoma cells to apoptosis. Menadione synergized $NaAsO_2$ to significantly increase ROS generation and facilitated alteration of mitochondrial membrane potential, cytochrome c release and anti-apoptotic protein Bcl-2 down-regulation and subsequent activation of caspase-9 and caspase-3 followed by poly-ADP-ribose polymerase-1 cleavage. Investigation of the signaling-pathway revealed significant suppression of AP-1 activity but not NF-κB upon $NaAsO_2$ and menadione application. An increase in p38 phosphorylation and p53 protein expression did also dictate the apoptotic response. Suppression of p38 activation with SB203580 and inhibition of p53 expression by siRNA attenuated apoptosis. Transfection of p53, in p53 null HCT cells augmented the apoptotic events. Moreover, the treatment also led to tumor size reduction in BALB/c mice developed by intra-dermal B16 mouse melanoma cell injection; although it had no detectable pro-proliferative or pro-apoptotic effect on non-tumor keratinocytes, normal fibroblasts or PBMC. Taken together, our data provides the first evidence of arsenic activity accentuation by menadione through modulation of specific signaling-pathways.

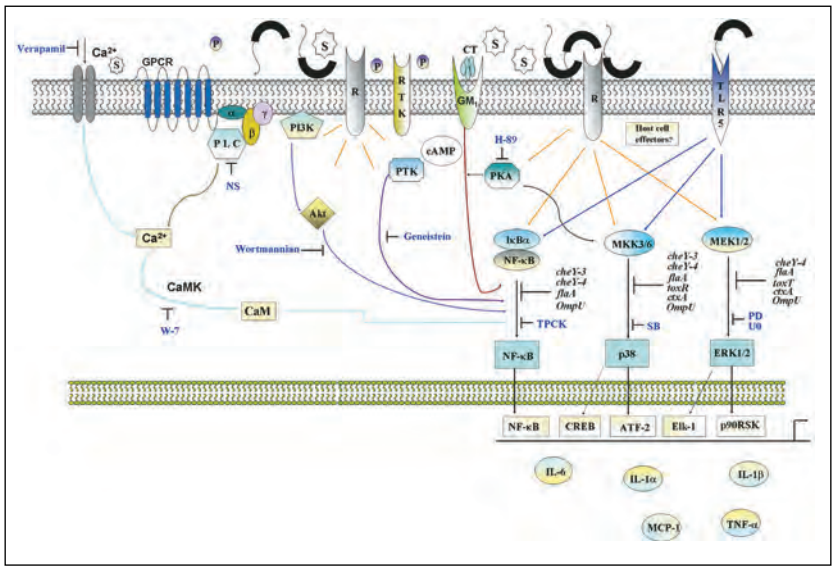


Fig. 2 : V. cholerae induces release of proinflammatory cytokines through NF-_B, MAPK, PTK, PKA, and Ca2+ mediated pathways. *V. cholerae* adheres to the intestinal epithelial cells and induces the proinflammatory response which is mediated by NF-_B, MAPK, PTK, PKA, Ca2+ as well as PLC. *V. cholerae* virulence factors (*toxR, toxT, ctxA, ompU*),adherence and motility (*cheY-3, cheY-4* and *flaA*) possibly modulate the intracellular pathways. U0, SB, PD and NS designate U0126, SB230985, PD098059 and neomycine sulphate respectively. The model is derived from this and previous study.

Biology of Oral Precancer: Oral submucous fibrosis (OSF) is a precancerous condition of the oral cavity and oropharynx and a significant number of such cases transform into oral squamous cell carcinoma (OSCC). Presently, diagnosis of OSF is done mainly through qualitative histopathological techniques and in the level of diagnostic molecular biology no specific genetic marker is evident. Keeping these facts in mind this study evaluates histopathological changes in the epithelium and subepithelial connective tissue of OSF through quantitative digital image analysis in respect to specific candidate features and analyses null mutations in the *GSTM1* and *GSTT1* by PCR amplification. The analysis revealed that there are subtle quantitative differences in the histological images of OSF

compared to NOM. The thickness of the epithelium and cell population in its different zones, radius of curvature of rete-ridges and connective tissue papillae were decreased but length of rete-ridges and connective tissue papillae, fibrocity and the number of cellular components (predominantly inflammatory cells) in the subepithelial connective tissue were increased in OSF. The PCR study revealed that there is no significant difference in the allelic variants in *GSTM1* between OSF and normal, while *GSTT1* null gene showed significantly higher frequencies in this precancerous condition. This study establishes a distinct quantitative difference between normal oral mucosa (NOM) and OSF in respect to their histological features and GST null gene frequencies.

Dr. Kunal Ray and group

Molecular Genetic Studies on Human Diseases

A few genetic diseases that are common in India are being studied. These are eye disorders (primary open angle glaucoma, POAG & oculocutaneous albinism, OCA), neurological disorders (Wilson disease & Parkinson's disease), and bleeding disorder (Haemophilia). The intent of the study is to understand the molecular basis of these diseases.

Eye Disorders : We are involved in molecular genetic studies on (a) glaucoma, which affects 67 million people worldwide and about 1.5 million people are blind due to glaucoma; and (b) Oculo-cutaneous albinism (OCA) represents a group of autosomal recessive disorders characterized by deficient synthesis of melanin pigment affecting skin, hair and eye. The defect in the eye is a developmental abnormality and is not curable. It is one of the major causes of childhood blindness in India. (a) Defects in *cytochrome P450 1B1* (*CYP1B1*) cause primary congenital glaucoma (PCG). However, defects in the gene have also been reported in primary open-angle glaucoma (POAG). Since POAG is primarily a complex disease, we examined the potential of coding single nucleotide polymorphisms (cSNPs) in the gene for association with the disease. For this purpose, five coding SNPs were genotyped in 264 unrelated POAG patients and 95 controls. In addition, 542 normal individuals selected from various ethnic groups representing the Indian population were also genotyped for these cSNPs. The c.1666G allele of the Leu432Val in *CYP1B1* showed a statistically significant higher representation among POAG patients compared to controls (p=0.0001; Odds ratio=6.027; 95% CI: 3.863–9.401) suggesting it to be a potential risk allele toward disease predisposition. Analysis of genotype frequencies of the polymorphism between the two groups demonstrated GG as a potential risk genotype (p=0.0001; Odds ratio=15.505; 95% CI: 5.529–43.474) for the disease. CYP1B1 Val432 was estimated to generate higher ROS in RPE cells compared to its allelic variant (Leu432; p=0.0245 for 15 min and p=0.0197 for 30 min). Comparison of haplotype diversities revealed CGGTA as the risk haplotype for the disease (p=0.0001, by Fisher's exact test). Our results suggests that higher ROS generation by Val432 in CYP1B1 might lead to apoptotic change that leads to glaucoma. Remarkable variation of the cSNPs observed among ethnic groups of India could provide insight for future epidemiological studies on POAG in these population groups (Bhattacharya et al, *Molecular Vision*, 14, 841-850, 2008).In another study we made a unique observation where POAG is not caused by a seemingly pathologic variant in *MYOC*, irrespective of homozygosity or heterozygosity, but manifested as a phenotype only when present in combination of two defective alleles in *CYP1B1*. We suggest, based on our observation that both *MYOC* and *CYP1B1* should be routinely screened for variants in POAG and PCG patients (Acharya *et al*, *Journal of Genetics*, 87:265-269, 2008). (b) Our OCA patient pool consists of 50 unrelated OCA pedigrees covering 17 ethnic groups of eastern and southern India. We identified mutations in two underlying genes (Tyrosinase, SLC45A2) in OCA patients and currently investigating the role of P-gene known to be one of the major locus for the disorder. Our observations

suggest that among Indian OCA patients Tyrosinase defect is responsible for the disorder in >50% cases. The molecular basis of the pathogenesis due to defect in this gene is being examined as a functional analysis of the mutant proteins.

Neurological Disorders: Among neurological disorders studies on Wilson's disease (WD), Parkinson's disease (PD) and dystonia is being carried out. The focus of the study is to identify the molecular basis of the disease among Indians. The studies are conducted in collaboration with Bangur Institute of Neurology & Psychiatry for clinical areas of the study. While our group is focused primarily on Wilson disease, studies on PD and dystonia are done with Prof. Jharna Ray (SN Pradhan Centre of Neurosciences, Calcutta University) who is the principle investigator for the latter two diseases. Wilson's disease is an inborn error of copper metabolism due to mutation in the copper-transporting gene *ATP7B* and characterized by excessive copper deposition predominantly in the liver and brain. WD can be thwarted if detected at a presymptomatic stage. We have over 200 unrelated patients in our cohort which initially contained patient samples largely from eastern India and some from western India. We are analyzing markers in the affected families and screening for ATP7B defects in the patients to identify the carriers of mutant allele and attempt genotype-phenotype correlation.

Bleeding disorder: Currently our lab is engaged in molecular genetic studies on Haemophilia. This X-linked disease is caused independently by defects in Factor VIII and Factor IX genes resulting in Haemophilia A and Haemophilia B, respectively. Usually females are carrier and males are affected with the disease. At present the most practical approach to contain haemophilia relates to strategies for carrier detection and prenatal diagnosis. We intended to carry structural analysis of factor IX protein variants to predict functional aberration causing haemophilia B. Factor IX (FIX) is a component protein of blood coagulation pathway, which activates factor X through interaction with factor VIII and Ca^{2+}. Defective FIX protein resulting from mutation in the corresponding gene causes an X-linked bleeding disorder known as haemophilia B. The aim of the present study was to speculate the potential detrimental effects of the FIX mutations upon the functionality of the protein, which could contribute to the comprehension of the mechanism underlying haemophilia B. In this report, we examined the effect of point mutation on the crystal structure of the native factor IX by measuring the change in the hydrogen-bonding pattern and electrostatic potential and explored the possibility of any correlation of the clinical severity of haemophilia B with the structural perturbation, by plotting the mutations of varying phenotype (severe and mild) on the crystal structure of FIX. Out of a total of 16 severe mutations 14 (88%) showed changes of hydrogen-bonding pattern to variable extent. Among the nine mild haemophilia B mutations, six (i.e. 66.66%) showed no change in hydrogenbonding pattern (Mukherjee *et al, Haemophilia*, 14:1076-1081, 2008). Our data suggest that there is a statistically significant correlation between the two groups of mutations as measured by change in the hydrogen-bonding pattern. Our study truly represents an initiation of an effort that would provide a framework for first evaluation of suspected mutations by in silico approaches, which might be further validated by other experimental techniques.

Genomic Variation in Indian Population in the disease associated genes: Analyses of frequency profiles of markers on disease or drug-response related genes in diverse populations are important for the dissection of common diseases. On that premise, Indian Genome Variation Consortium members including this group and others from IICB collectively reported the results of analyses of data on 405 SNPs from 75 such genes in 1871 individuals from diverse 55 endogamous Indian populations. These include 32 large (>10 million individuals) and 23 isolated populations, representing a large fraction of the people of India (*Journal of Genetics*, 87:3-20, 2008). High level of genetic divergence was observed between groups of populations that cluster largely on the basis of ethnicity and language.

Indian populations not only overlap with the diversity of HapMap populations, but also contain population groups that are genetically distinct. These data and results are useful for addressing stratification and study design issues in complex traits especially for heterogeneous populations. Our investigation on copy number variation (CNV) demonstrated that in genomic regions containing CNVs and/or segmental duplication, some of the highly heterozygous nucleotide variants (SNPs) stored in publicly available databases are likely to be erroneously recorded paralogous sequence variants (PSVs) and multi-site variants (MSVs) (Sengupta *et al, Journal of Genetics*, 87:95-97, 2008). Explicit knowledge regarding variation in copy number of the gene of interest in the study population is a prerequisite for accurate allelic information at the target SNP. These factors must be considered prior to the usage of specific SNPs as 'tools' to assess the contribution of genes in complex diseases, drug response, susceptibility of hosts to various pathogens and other related studies.

Dr. Suvendra Nath Bhattacharyya and group

Mechanism of miRNA mediated gene regulation in mammalian cells

MiRNAs are ~21-nt-long regulatory RNAs expressed in eukaryotes. Expression of many miRNAs are tissue or development stage specific and major changes in miRNA expression are observed in human pathologies. MiRNAs regulate gene expression post-transcriptionally, by imperfectly base-pairing to 3'UTR of mRNAs, what results in translational repression or mRNA degradation. Repressed mRNAs are localized to P-bodies, cellular structures involved in storage and degradation of mRNAs (Fig. 3). Present data provided evidence that P-bodies function in storage of miRNA-repressed mRNAs and demonstrated that miRNA-mediated repression is a reversible process. Deciphering the mechanism of miRNA-mediated gene regulation process in mammalian cells is one of the target of our research group.

This laboratory is investigating the mechanism of miRNA–mediated gene regulation process by extracellular factors in mammalian cells. The cellular microenvironment is composed of an intricate blend of extracellular matrix components and numerous neighboring cell types, and influences cellular behavior and gene expression profile *in vivo*. However, the effect of cellular microenvironment on post-transcriptional regulation of gene expression has never been addressed in detail in metazoa. Multidimensional cell culture systems and arrays of microenvironments are being used for identification

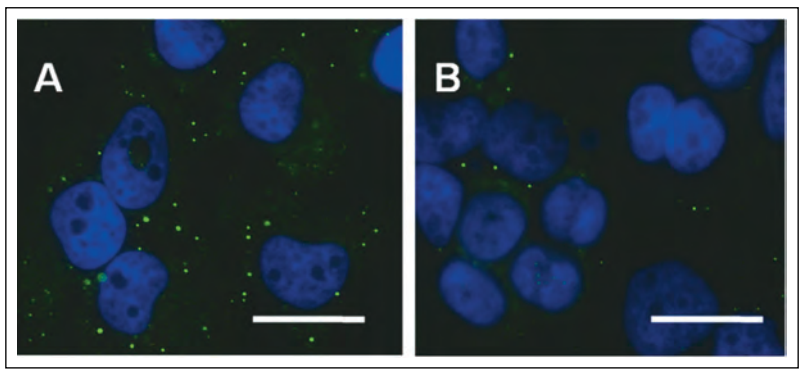


Fig. 3 : RNA processing body or P-Body number in HeLa cells gets reduced in cells from "confluent" (B) vs. sub-confluent (A) conditions. Antibody against RCK/p54, a component of mammalian P-bodies and Alexa 488 coupled anti-rabbit secondary antibody were used for immunofluorescence analysis White bars represent 10 μM.

of extracellular factors regulating miRNA-dependent and miRNA-independent post-transcriptional gene regulation machineries in mammalian cells. The miRNA-122, a liver specific mRNA has found to be upregulated in cells maintained at high cell density and cell-cell contact. Interestingly the upregulation of miRNA with cell density is a post-transcriptionally regulated process. Number of P-bodies also differs in cells with different cellular microenvironment.

Dr. Susanta Roychoudhury and group

Identification of susceptibility genes in the development of Leukoplakia and Oral Cancer

Genetic polymorphisms in genes controlling cellular processes such as cell cycle, DNA repair and apoptosis may modulate the risk for the development of cancer. Availability of large number of SNPs in the human genome allows us to find putative risk alleles in genes controlling these pathways for the development of cancer. We investigated the role of *p53* and its interacting genes *p73* and *MDM2* as well as several DNA repair genes in conferring risk to the development of oral cancer. Analysis of the SNP profile of these genes in several subpopulations in India revealed high levels of genetic divergence between groups of populations that cluster largely on the basis of ethnicity and language. Genetic association studies determined specific SNPs in *p53*, *p73* and *MDM2* genes conferring risks to the development of both oral cancer and its premalignant form leukoplakia, which is modulated by various environmental factors. Analysis of pair wise genotype combinations revealed increase in risk for specific *p73-MDM2* and *p73-p53* genotype combinations. The combined three loci analyses revealed that the presence of at least one risk allele at all three loci increases the risk of both leukoplakia and oral cancer. At present we are carrying out a high density SNP profiling of DNA repair genes to identify risk alleles for the oral cancer development.

Dr. Ashok K. Giri and group

Studies on Genetic Toxicology

Mechanism of anticancer activities of black tea polyphenols in human skin cancer cells: Studies on potent anticancerous effects of black tea polyphenols Theaflavins (TF) and Thearubigins (TR) are meager. This study aimed at evaluating the role of TF and TR as candidate anticancer agents. We also wanted to elucidate the underlying molecular mechanism of apoptosis induction by TF and TR *in vitro*, as also, the probable signaling cascade of chemoprevention induced by them in skin cancer cells. Our study appraised that both TF and TR could induce apoptosis in A375 (human malignant melanoma) cells through mitochondria mediated death cascade. In our system, Bax translocation to mitochondria persuaded depolarization of mitochondrial membrane potential, cytochrome *c* release in cytosol and induced activation of caspase-9, caspase-3 and PARP (poly (ADP-ribose) polymerase) cleavage. Our investigations showed that TF and TR augmented Bax/Bcl2 ratio, upregulated the expression of p53 as well as p21 and inhibited phosphorylation of the cell survival protein Akt. Furthermore, TF and TR elicited intracellular ROS (reactive oxygen species) generation in A375 cells. We also observed the role of three most important mitogen activated protein kinases (MAPK) viz. extracellular-signal regulated kinase (ERK), c-Jun N-terminal kinase (JNK) and p38 in TF and TR induced apoptosis. TF and TR treatment on A375 cells led to sustained activation of JNK and p38 MAPK but not ERK, suggesting that JNK and p38 are the effector molecules in these two polyphenols-induced cell-death. These observations raise speculations that TF as well as TR might exert chemopreventive effect through cell cycle arrest and induction of apoptogenic signals via mitochondrial death cascade in human skin cancer cells.

Assessment of health effects, genetic damage and genetic variants responsibility for arsenic susceptibility. Although a large number of individuals are exposed to arsenic through drinking water but only 15-20% individuals showed arsenic induced skin lesions. This indicates that genetic variants play an important role in arsenic susceptibility and carcinogenicity. Potential of allelic variants of various genes of arsenic toxicity pathway (PNP, As3MT, GSTO1 and GSTO2) and others (p53 and ERCC2) have been examined for association with the arsenic-induced skin lesions. Among the four candidate genes, PNP, As3MT, GSTO1 and GSTO2, we found that distribution of three exonic polymorphisms of PNP was associated with arsenicism. Genotype having the minor alleles was significantly overrepresented in the skin lesions group. The results of p53 polymorphism showed that arsenic induced keratosis has a significant association with the R/R and S/S allele. We wanted to see the chromosomal aberrations (CA) in the both R/R genotype group and compare with the other genotype i.e. R/P and P/P. A significant increase in the CA in the risk genotype (R/R) was observed. ERCC2 AA genotype was significantly over represented in the arsenic induced hyperkeratosis exhibiting group, indicating that it is strongly associated with the development of arsenic specific precancerous hyperkeratosis.

In order to probe into the mechanistic process of arsenic susceptibility, we employed Alkaline comet assay and Challenge assay in whole blood and chromosomal aberrations study in lymphocytes. Comet assay showed that in induction of DNA damage was similar in the exposed groups irrespective of the presence of arsenic-induced skin lesions, whereas, incidence of CA was significantly higher in the group with arsenic-induced skin lesions. To find out the DNA repair capacity in both hyperkeratotic and without skin lesion individuals challenge assay was performed. Challenge assay showed that upon induction of DNA damage, the repair capacity in the exposed individuals with premalignant hyperkeratosis is significantly less than that of individuals without skin lesion, although the basal level of DNA damage was similar in both. Thus the deficiency in DNA repair capacities in the hyperkeratotic individuals emerges as a prime contender for arsenic carcinogenicity.

Names of Technical staff

Bhaskar Basu, Tapas Choudhury, Mahua Bhattacharya.

Names of Pool Officers, RA etc.

Tapasi Das, Swati Bhowmick, Antara Banerjee, Anirban Ray, Pritha Ghosh.

Names of Project Assistants

Deblina Banerjee, Manshi Vishal,Abhisek Bhattacharyya, Tania Das, Arindam Datta, Rajat Pal, Manjari Kundu, Deblina Patra, Gunjan Dhar, Avirup Dutta, Sanjit Mukherjee

Names of Junior and Senior Research fellows

Biraj Mahato, Sandip Koley, Sukanta Jash, Atreyee Saha, Suddhasil Mookherjee, Mainak Sengupta, Maitreyee Mondal and Subhodip Chakraborty, Shashwata Mukherjee, Sharmistha Sengupta, Chaitali Mishra, Taraswi Banerjee, Dipanjana Datta De, Swati Bajaj, Somsubhra Nath, Pinaki Mondal, Sumana Bhattacharya Debrup Sen, Anup Majumder, June Ghosh, Souvik Ghosh, Mayukh Banerjee, Nilanjana Banerjee, Udayan Bhattacharya, Arghyashree Roychowdhury, Debashree Chatterjee, Pallashree Saha, Avirup Chakraborty, Samir Mandal, Bornita Das.

Analytical Ultracentrifuge

Beckman ProteomeLab XL-I analytical ultracentrifuge for sedimentation velocity and sedimentation equilibrium centrifugation experiments (Centralized facility)

Fluorescence Correlation Spectroscope

For Fluorescence Correlation Spectroscopy experiments ConfoCor 3 FCS system from Carl Zeiss

DRUG DEVELOPMENT, DIAGNOSTICS & BIOTECHNOLOGY

Drs. Tarun Kumar Dhar, Rajan Vedasiromoni, Anil Ghosh, Nirmalendu Das, Aparna Gomes, Pratap K. Das, Suman Khowala, Sharmila Chattopadhyay, Snehasikta Swarnakar

This group is involved in studies on bioactive compounds for improving health and quality of life, as also for promoting future economic growth through innovation in biotechnology. The major field of activity includes – therapeutics principles from medicinal plants and venums; mechanism of gastric ulceration; engineer plant genes for improved production of pharmaceuticals/nutraceuticales; immunodiagnostic strategies; analytical evaluation of herbal medicines; nanocapsulated drug delivery; molecular mechanisms of trehalose metabolism and microbial gycosidase enzymes.

Dr. J. Rajan Vedasiromoni, Dr. (Mrs.) Aparna Gomes and group

Development of drugs from plant materials, animal products and synthetic agents

The main objective is to identify and develop new antihyperglycemic, antineoplastic, prokinetic, anti-inflammatory and antioxidant agents.

Studies with Swietenia mahagoni leaves and seeds. Studies with aqueous methanolic extract of *Swietenia mahagoni* leaves was carried out giving special emphasis to study the anti-cancer activities in-vivo and in-vitro and identify the active ingredient(s) responsible for the activity and to make efforts to establish the chemical structure. The methanolic extract of seeds of *Swietenia mahagoni* Jacq. was also evaluated experimentally for in-vitro anti-leukemic activity.

The aqueous methanolic extract of *Swietenia mahagoni* leaves was evaluated experimentally for its in vitro anti-leukemic activity. It was found that the SMLE *(Swietenia mahagoni leaf extract)* inhibited cell growth and metabolic activity of U937, K562 and HL-60 cell lines in a concentration and time-dependent way. Morphological studies of the cells showed that the SMLE induces apoptotic changes in which membrane blebbing, chromatin condensation, nuclear fragmentation and formation of apoptotic bodies were observed. Flowcytometric analysis showed appreciable number of cells in early and late apoptotic stages. While U937 and K562 cell populations were arrested in the G2/M phase, the HL-60 cell population was arrested in G1 phase of cell cycle. SMSE induced apoptosis was mediated through mitochondrial intrinsic pathway involving the release of cytochrome c into the cytosol and activation of caspase-9 and caspase-3. Further study revealed that the aqueous methanolic leaf extract *Swietenia mahagoni* also produced significant anti-tumor effect in 3-methylcholanthrene (3MC) induced solid tumor model in mice. The tumor weight and biochemical parameters in serum and liver were measured. Tumor growth was markedly reduced in the SMLE and 5-FU treated mice as compared to that of the untreated control mice (Fig. 1). Biochemical parameters also suggested that SMLE treatment maintained a balance between free radical production and accumulation in treated mice as compared with untreated mice. The two flavonoids, catechin and quercetin-3-0-glucoside, isolated from Swietenia mahagoni leaves, also inhibited the growth and metabolic activity of U937, K562 and HL-60 leukemic cells significantly in a concentration-dependent manner. The two flavonoids, catechin and quercetin-3-0-glucoside may be responsible for its anti-cancer activity.

The methanolic extract of seeds of *Swietenia mahagoni* Jacq. was also evaluated experimentally for in vitro anti-leukemic activity. Swietenia mahagoni seed extract possessed anti-leukemic activity in U937, K562 cell lines. The apoptosis was confirmed by fluorescence and confocal microscopic studies in which chromatin condensation, nuclear fragmentation and formation of apoptotic bodies were observed.

Studies with Corchorus acutangulus Lam. The methanolic extract of aerial parts of Corchorus acutangulus Lam., a wild type of jute, was found to produce anti-inflammatory activity in rat. On the basis of correlation between inflammation and cancer, the MeOH extract and its fractions were evaluated for anti-leukemic activity in human leukemic cell lines U937, K562 and HL60. MeOH extract showed significant anti-leukemic activity and the BuOH fraction of MeOH extract was found to be the active fraction among the evaluated fractions (Figs. 2 A & B). Further work is progress to identify and isolate the active constituent responsible for the pharmacological effects of the extract.

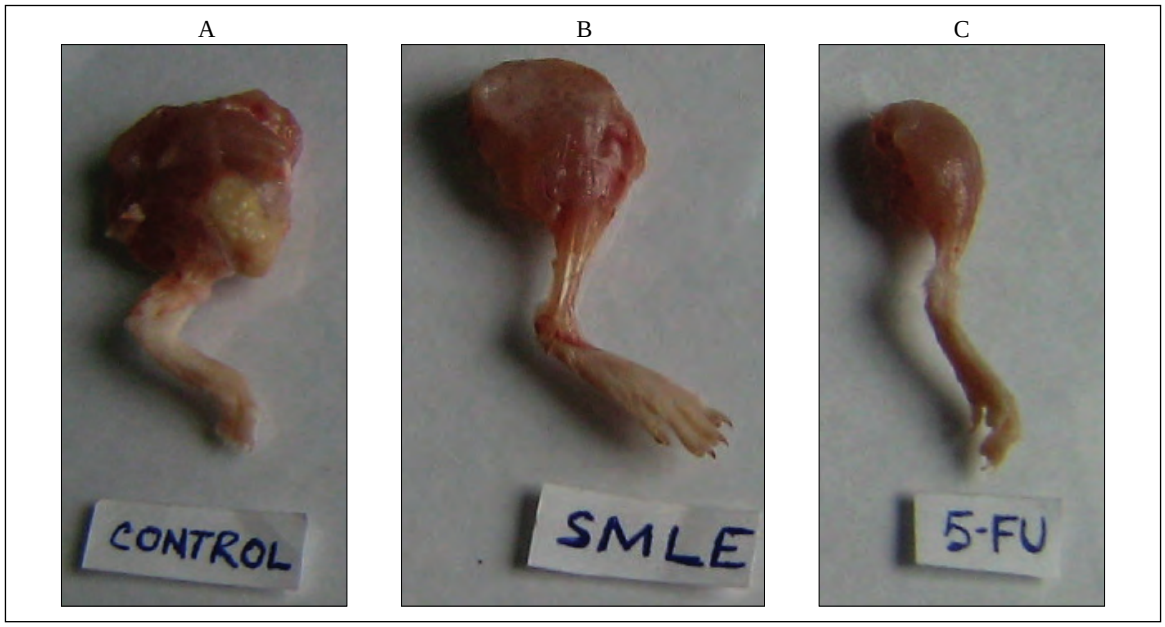


Fig. 1 : 3-MC induced solid tumor bearing, (A) untreated control, (B) SMLE (60 mg/kg) treated and (C) 5-FU (5 mg/kg) treated mouse. The solid tumors are dissected out from calf muscle of respective animals.

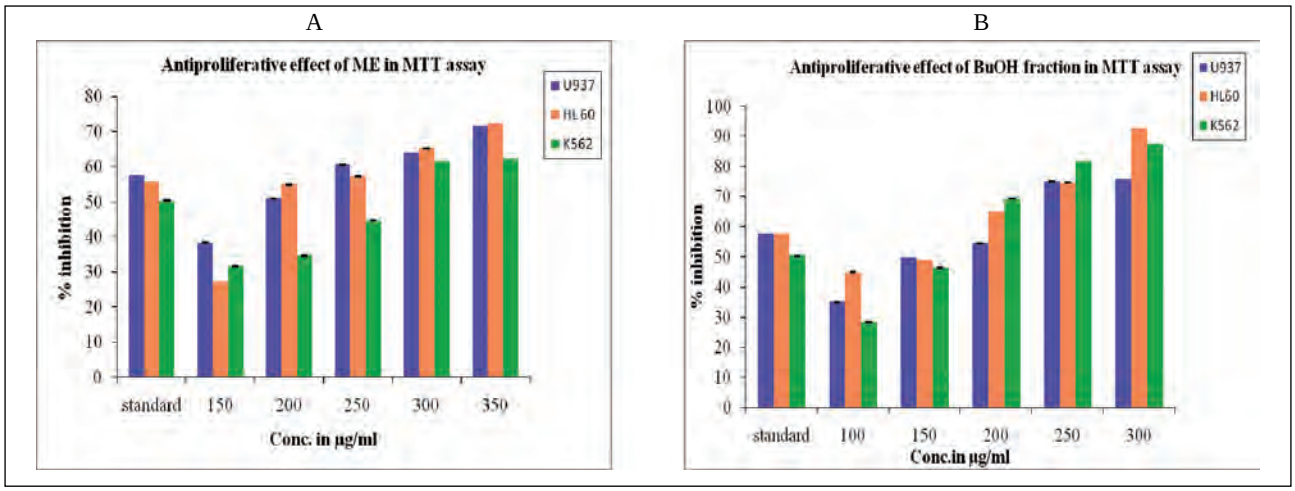


Fig. 2 : Antiproliferative effect of MeOH extract (A) and (B) BuOH fraction of MeOH extract of Corchorus acutangulus was observed on three leukemic cell lines (U937, K562, HL60) by MTT assay. Cells were treated with standard anti-leukemic drugs (Ara-C for U937, HL 60 and Gleevac for K562) and different doses of ME (in µg/ml). After incubation of 24 hours O.D was measured from which % inhibition was calculated in comparison of control (untreated cells)

Studies with fruit extract of Dillenia indica L. The methanoic extract of fruits of *Dillenia indica L.* was found to possess anti-leukemic activity in three leukemic cell lines U937, K562 and HL-60 and

the active constituent responsible for the activity was found to be betulinic acid which is present in reasonably good quantity in the methanol extract (ME) and its ethyl acetate fraction (EAF) with negligible amount in the n-butanol fraction (NBF). ME and EAF inhibited the growth and produced significant cytotoxicity of leukemic cell lines in a concentration-dependent manner. ME exerted 50% growth inhibition (IC_{50}) of U937, HL60 and K562 cell lines at concentrations of 328.80, 297.67 and 275.40 µg/ml respectively and that of EAF was 240, 211.80 and 241.96 µg/ml in U937, HL60 and K562 cell lines respectively. NBF did not produce significant effect in the concentration ranges of ME. The results suggested that EAF contains the active compound. Further study was carried out to observe morphological changes that occur on treatment with ME and EAF using fluorescence microscopy. ME and EAF induced cell death in U937, HL60 and K562 cell lines by inducing apoptosis. The fluorescent images showed that the untreated cells possessed intact nuclei and that the treatment caused chromatin condensation, membrane blebbing and formation of apoptotic bodies (Fig. 3).

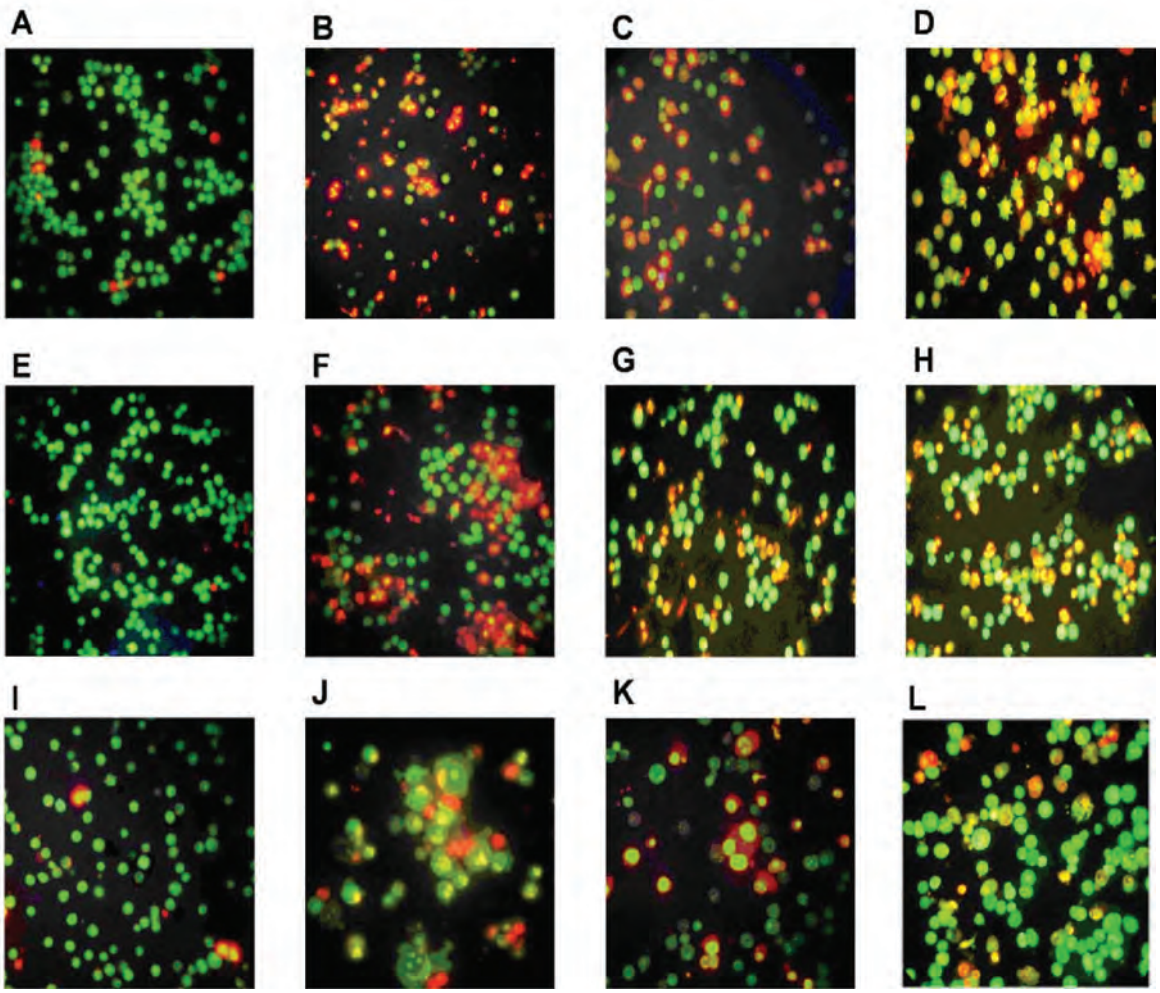


Fig. 3 : Observation of the morphological changes of U937, HL60 and K562 cells. Cells were treated with standard reference drugs (Ara-C for U937 and HL60 and Gleevec for K562), ME and EAF for 24 h and observed by Fluorescence microscopy after nuclear staining with Acridine orange and Ethidium bromide. The fluorescent images showed the apoptosis inducing activity of ME and EAF. Control cells (A-U937, E-HL60, I-K562) gave green fluorescence, while cells treated with standard reference drugs (B-U937, F-HL60, J-K562), ME (C-U937, G-HL60, K-K562) and EAF (D-U937, H-HL60, L-K562) showed apoptotic features since the apoptotic cells were stained by both Acridine orange and Ethidium bromide.

Studies with Heterometrus bengalensis venom. *Heterometrus bengalensis* crude venom possessed potent cytotoxic activity against human leukemic U937 and K562 cells. Fluorescence and confocal micrographic observations of venom treated cells showed signs of apoptosis and severe nuclear damage. Scanning electron micrographs revealed severe membrane blebbing, membrane poration and formation of apoptotic bodies. Comet assay of venom treated cells revealed formation of long comet tail which was a clear evidence of nuclear damage. Flow cytometric analysis using annexinV-FITC and PI showed accumulation of venom treated cells in the apoptotic quadrants. Cell cycle analysis of PI stained treated cells showed an arrest of cell cycle at sub G1 phase. In vivo experiments done with venom against murine EAC showed a reduction of intraperitoneal EAC cell count along with modulations in antioxidant enzymes. In murine solid tumor model, venom treatment also reduced tumor weight and volume. Venom was next subjected to purification for isolating the active component by ion exchange chromatography. The fraction obtained from ion exchange chromatography was further purified by HPLC which showed a single sharp band. This fraction was named Hbf1. Hbf1 showed a single band with SDS-PAGE analysis thus confirming its homogeneity. N-terminal amino acid sequence of first 13 amino acids was obtained by Edman degradation method. Hbf1 showed cytotoxicity against human leukemic U937 and K562 cells. Fluorescence and confocal micrography of the treated cells revealed apoptotic cells with damaged nuclei. Flow cytometric analysis of annexinV-FITC stained cells revealed the presence of apoptotic cells. Hbf1 treated cells were also arrested at subG1 phase of cell cycle. Hbf1 treatment increased Bax:Bcl2 ratio, increased cells with altered mitochondrial membrane potential and increased release of cytochrome c. Hbf1 also increased activity of caspae-9 and caspase-3 along with the expression of cleaved PARP. These observations suggest mitochondrial involvement in Hbf1 mediated U937 and K562 cell apoptosis.

Dr. Pratap K. Das and group

Screening of Indian biodiversity and Indian Systems of medicine for anti gastric ulcer principle(s)

In continuation of the development of appropriate strategy and protocol(s) for effective screening of Indian biodiversity including Indian medicinal plants, bacterial and fungal extracts, marine resources, and Indian Systems of Medicines like *Ayurvedic & Siddha* preparations, and also synthetic as well as naturally isolated single molecules for their efficacy against peptic ulcer diseases, we have recently added *in vivo* chronic *H. pylori* infection model in our repertoire of evaluation models. The central objective of this programme has been to dovetail traditional knowledge base and information systems with the help of currently understood biological targets to generate newer leads, and transfer such know-how to national and multinational pharmaceutical companies for commercial exploitation.

During the period under consideration, we have screened about 1000 samples from plant, bacterial and fungal origin as well as a few single molecules in gastric antisecretory and anti-*H. pylori* models. We could primarily fish out only one plant sample as active. We are reexamining such sample with repeat collection and repeat extraction to validate the primary findings, and to take the sample to next stage of investigation through bioassay-guided fractionation approach. A representative outcome of gastric antisecretory and anti-*H. pylori* activity evaluation under a large-scale screening format is shown in Figs. 4A & 4B. Meanwhile, seven of the previously screened samples that have been revalidated during the period under consideration yielded two plant extracts as lead antisecretory agents for further development through drug discovery exercise. The extracts and their fractions were examined in details for their antisecretory activity in isolated frog gastric mucosae. The results indicated promise of finding active principle(s) in aqueous fractions of one plant and non-polar fractions of another plant.

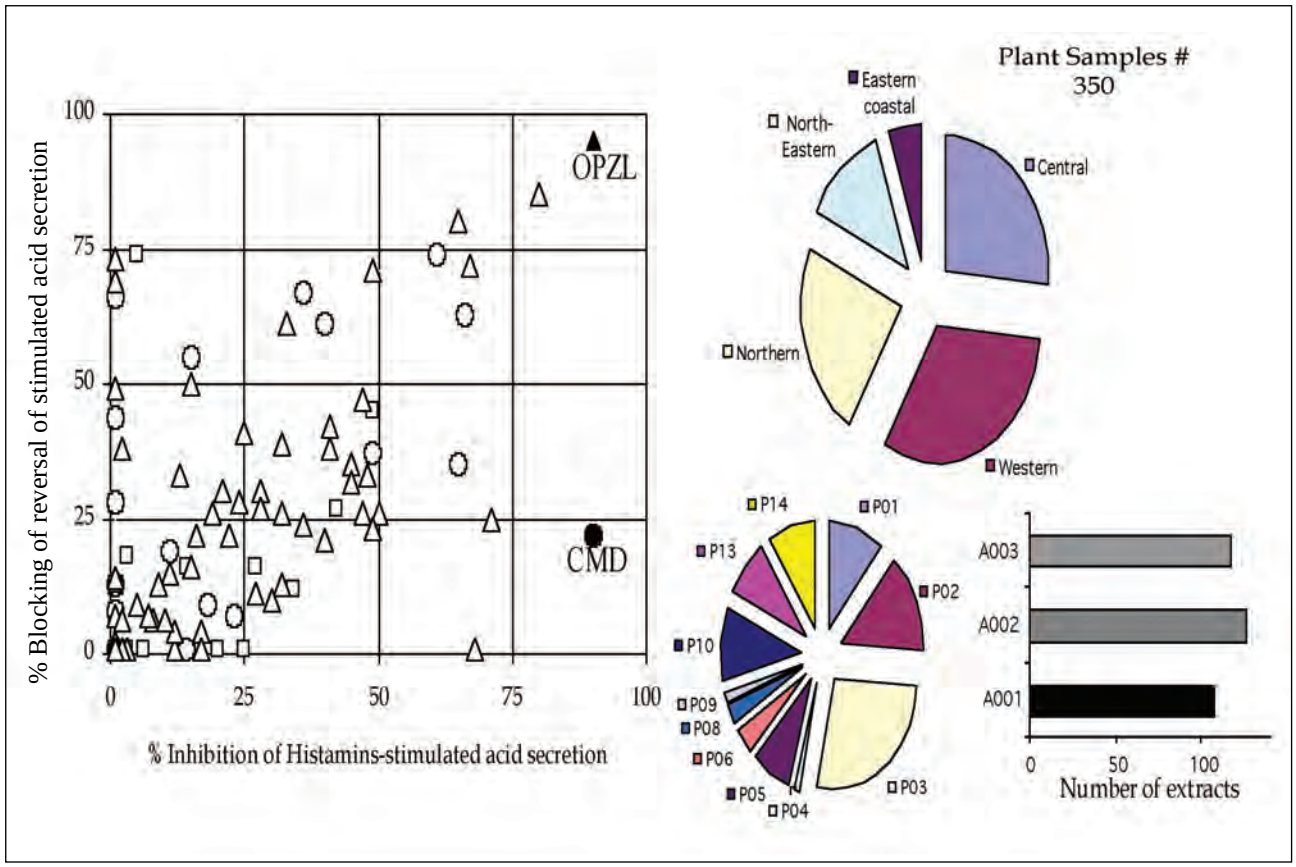


Fig. 4A : Scatter plot diagram of screening of plant samples from Indian Biodiversity for antisecretory potential. The effect of the samples are represented (left panel) by points in terms of % inhibition of histamine-stimulated acid secretion in presence of extract(s), supplemented twice from the nutrient side at 1 h interval (in X-axis) and % blocking of reversal of histamine-stimulated acid secretion upon withdrawal of the extracts (in Y-axis). The samples for screening were received from different regions of India and the distribution of which are described in the pie-chart format (right upper panel). In case of samples tested in combinations, either two or three extracts, these are represented by the symbols (- -) and (-Δ-) of the respective samples. The observed results for the effect of cimetidine (0.5 mM) and omeprazole (50 µM) are depicted by the abbreviations CMD and OPZL respectively in appropriate matrix zone. The distribution of different parts of plants (coded as P01 – P17) is presented as a % of total number of samples in pie-chart format (left lower panel) and the codes A001, A002 and A003 representing alcoholic, hydroalcoholic and aqueous extracts, with respect to all 350 samples, are depicted in the right lower panel.

Random screening of natural product based single molecules led to the finding of potent anti-*H. pylori* activity in artemisinin, a well-known anti-malarial drug. Employing a series of semi-synthetic and natural molecules, the most active compound was established to be ß-artecyclopropylmether (Table 1). The lead molecule as well as a few strongly active congeners exhibited selective killing potential of both the standard strains and clinical isolates of *H. pylori*, demonstrated functional efficacy at acidic pH of the stomach, showed extensive morphological degeneration under electron microscope. The work has been carried out in collaboration with CIMAP scientists of CSIR.

An already identified lead extract (ICB-A002) having both gastric antisecretory activity as well as anti-*H. pylori* activity has been developed further towards anti-ulcer therapeutics in terms of storage stability of the putative drug, and *in vivo* clearance and eradication of *H. pylori* in chronic infection

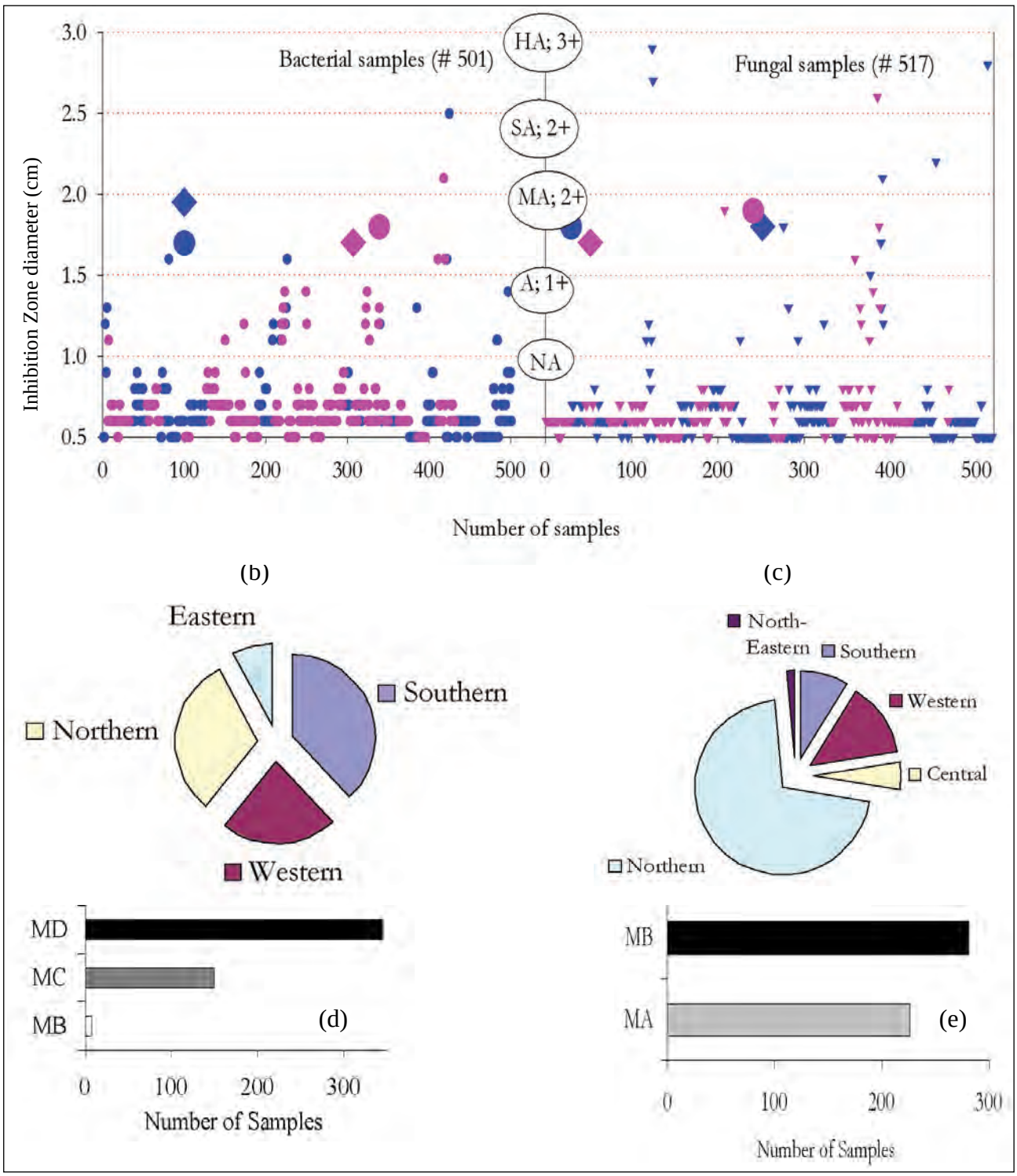
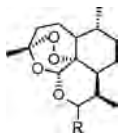
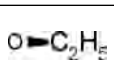
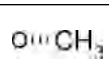
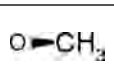
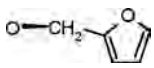
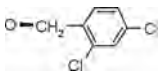
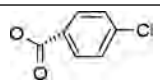
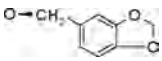
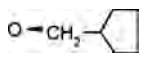
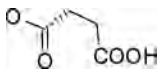
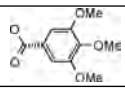
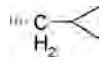


Fig. 4B : Scatter plot diagram of screening for anti Helicobacter pylori activity of 501 bacterial and 517 fungal samples by disc diffusion susceptibility assay. The samples were screened randomly employing either of the clinical strains 80A (blue) and 121A (pink). Screening of bacterial samples has been presented in left panel (a, -ı-), whereas of fungal samples in the right panel (-ı-). The geographical distributions of the bacterial and fungal samples have been presented in plots b and c respectively, and the types of media employed in plots d and e respectively. The sensitivity of the strains towards clarithromycin (0.02-0.04 µg/disc) and metronidazole (100 µg/disc) are depicted by the coloured symbols ı and ◎ © respectively.

Table 1. Anti-*H. pylori* activity of artemisinin and its derivatives

Parent Structure	Compound (name and code)	Substituent (R)	Disc diffusion sensitivity assay Inhibition zone diameter (cm)					Microbroth dilution assay (µg/ml)	
			80A	121A	ATCC 700392	ATCC 43504	ATCC 49503	MIC_{range}	MBC_{range}
	Artemisinin (GRB-017)	—	1.6 2.1	0.8 1.6	1.7 2.5	0.7 0.8	0.9 1.7	0.5-0.8	2.0-8.0
	β-Artecyclopropylmether (GRB-001)		2.1* 2.6*	1.9* 2.5*	1.7* 2.2*	1.7* 2.4*	2.0* 2.7*	0.25-1.0	1.0-4.0
	β-Arteether (GRB-002)		2.0* 2.6*	1.5* 1.9*	1.7* 2.2*	1.1 2.1*	0.7 1.9*	0.25-0.5	0.5-4.0
	α-Artemether (GRB-003)		2.0* 2.6*	1.4 1.8*	2.0 3.0	0.7 1.0	1.2 2.1	0.25-0.5	0.5-2.0
	β-Artemether (GRB-004)		2.6* 4.0*	1.7* 2.3*	2.8* 3.2*	1.4 2.4	2.0* 2.8*	0.25-0.5	0.5-2.0
	β-Artefurfurylether (GRB-005)		2.3 2.8	2.2 2.7	2.8 3.1	2.9* 3.3*	3.0 3.4	0.25-0.5	0.5-4.0
	β-Arte-2,4-dichlorobenzylether (GRB-006)		0.9* 1.1*	0.9* 1.0*	1.0* 1.2*	0.8* 1.0*	0.8* 1.0*	> 8.0	> 8.0
	α-Dihydroartemisininyl-4-dichlorobenzoate (GRB-007)		1.5* 1.8*	1.4* 1.6*	1.5* 1.8*	1.4 1.7	1.5* 1.6*	1.0-8.0	2.0-8.0
	Dihydroartemisinin (GRB-008)	-OH	2.1* 3.0*	2.0 2.7	1.5 2.4	1.3 2.1	1.4 2.1	1.0-8.0	≥ 8.0
	β-Dihydroartemisininylpipernoyl ether (GRB-009)		1.7* 2.0*	1.1 1.2	1.6* 2.1*	1.7 1.9	1.5 2.0	0.5-8.0	> 8.0
	β-Artecyclopentylmether (GRB-010)		1.4* 1.9*	1.1 1.5	1.8 2.2	1.5 1.8	1.6* 2.0*	> 8.0	> 8.0
	9-(β-Dihydroartemisinoxy) methyl anthracene (GRB-011)		1.1 1.4	1.1 1.4	1.2 1.4	1.2 1.4	1.0 1.4	2.0-8.0	> 8.0
	α-Artesunic acid (GRB-014)		1.7 2.6	1.1 2.1	1.2 2.0	0.9 1.7	0.9 1.5	0.13-4.0	1.0-4.0
	α-Dihydroartemisininyl-3, 4,5 tri-O-methylgallate (GRB-015)		1.2 1.7	1.0 1.5	0.9 1.5	0.7 1.3	1.1 1.3	0.25-4.0	4.0-8.0
	α-Artecyclopropylmether (GRB-016)		1.5 2.5	1.3 2.0	1.5 2.3	0.8 1.7	1.1 1.6	0.5-8.0	1.0-8.0
	Artemisinic acid (GRB-012)	—	1.4* 1.7*	1.2 1.7	1.3 2.0	1.1 1.7	1.0 1.7	12.5-50	50-100
	Anhydrodihydroaretimisinin (GRB-013)	—	1.5 2.5	0.9 1.1	0.7 1.7	1.4 1.7	0.9 1.5	0.5-8.0	1.0-8.0

Clarithromycin showed inhibition zone of 1.8 cm for the strains 80A and 121A at 0.01 µg/disc and 2.8, 2.0 and 1.5 cm respectively with strains 700392 (0.4 µg/disc), 43504 (0.04 µg/ disc) and 49503 (0.005 µg/disc). The MIC range of clarithromycin is 0.016-0.10 µg/ml.

model. The active molecule, because of low yield and structural complexity, is now being subjected to SAR investigation by building a library of structural analogues using the core components of the native molecule vis-à-vis evaluating their anti gastric proton pump activity and anti-*H. pylori* activity. This work is being carried out with Dr. GVM Sharma & Group (IICT).

Under Drugs & Pharmaceuticals Programme of DST, a research programme is under progress with funds from DST and an industry, M/s Dey's Medical. In this inter-institutional programme entitled 'Chemical Standardization & Biological Evaluation with a View to Increase Efficacy of Herbal Medicines' wherein two products of the company are being scientifically examined for their efficacy. The purpose of such R&D tie up of DST-Industry-IICB has been to find out the modern scientific basis of these traditional medicines that would permit the industry to compete in national and international market under the changed global scenario of Drugs and Pharmaceuticals sector in the new era of patent regime under GATT and TRIP.

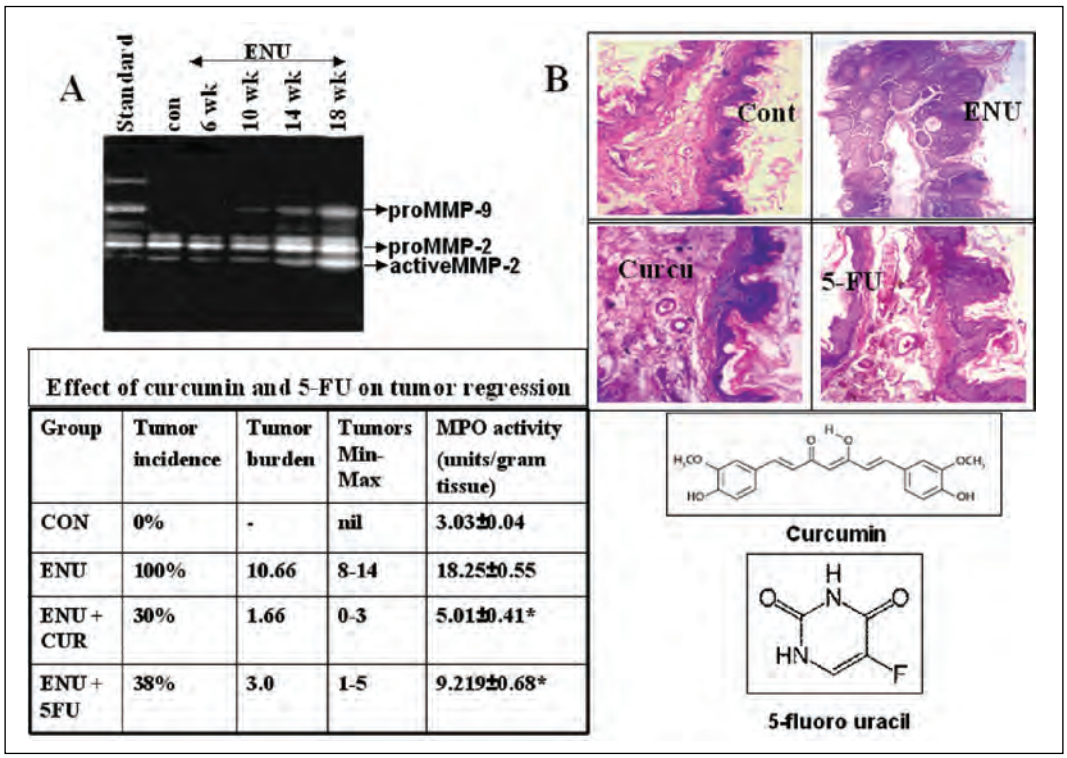
Dr. Snehasikta Swarnakar and group

Role of MMPs in gastric tumorogenesis and carcinoma: Involvement of functional polymorphisms in the promoter regions of MMP-9

The work was focused on understanding mechanism of gastric tumorogenesis via regulation of matrix metalloproteinases (MMPs). The major interest has been on gastric inflammation in relation to protease activity and redox signaling. MMPs are extracellular matrix-degrading endopeptidases that can influence physiological and pathological situations, i.e. tissue development, angiogenesis, atherosclerosis, ovarian function, arthritis, cancer and wound healing. The activity of MMPs is tightly regulated in a complex fashion that includes pro-enzyme activation and the association of specific tissue inhibitor of metalloproteinases (TIMPs). The study was designed to investigate the role of MMPs in tumorogenesis in gastric tissues and potentiality of curcumin (major constituent of turmeric) in suppression of tumor formation. We found that N-Ethyl-N-nitrosourea-induced gastric tumor was associated with increased expression of proMMP-9, vascular endothelial growth factor, epidermal growth factor, tumor necrosis factor -α and moderate increase of active MMP-2 (Fig. 5). Curcumin inhibited tumor formation through suppression of MMP-9 and MMP-2 activities and expressions. We addressed how MMPs play a role in gastric injury under diabetic condition. The activity and expression of proMMP-9 elevated significantly in gastric tissues of diabetic rats as compared to normal rats. In addition, differential expression of MMP-9 in diabetic gastric mucosa upon ethanol or indomethacin treatment reflected MMP-9 dependent and independent pathways for ulceration respectively. Moreover, we investigated the involvement of MMPs and oxidative stress during endometriosis and its rescue by curcumin. Endometriosis, characterized by the presence of endometrial tissues at extrauterine sites, is a disease of reproductive women. As growth of endometrial lesions at ectopic site requires invasion and remodeling of the existing tissues, the action of MMPs has come under scrutiny. A mechanistic basis for MMP-9 upregulation in endometriosis and efficacy of curcumin for regressing endometriosis has been found.

Humans are being exposed constantly to environmental toxic substances through use of fertilizers, smoked foods and contaminated drinking water. Nitroso compounds are one of powerful toxic agents and dangerous for health as they form tumors as well as cancers, including gastric cancer. We have selected N-Ethyl-N-nitrosourea in our study as because it remains longer in the fore stomach and it is both genotoxic and nongenotoxic carcinogen. Gastric cancer (GC) is the 2nd most prevalent cancer in the World. Genetic variations in several MMP promoters influence the transcription and expression of MMPs that result in various carcinoma including GC. Expression of MMPs has been closely related

to lymph node metastasis, vascular invasion and cancer prognosis. Several reports described that MMP9-1562C/T SNP has been associated with various cancers. However, a very few reports exist on relationship between those SNPs and risk of GC. We have prepared blood genomic DNA from GC patients (n= 120) and control (n= 45) subjects to identify any correlation between their SNPs in MMPs promoter and risk of GC. We conducted a hospital based case-control study in eastern Indian population to assess the effects of these MMP promoter SNPs on susceptibility and clinical staging in GC patients using DNA sequencing and PCR-restriction fragment length polymorphism (RFLP) assay (Fig. 6). A statistically valid association of those SNPs with the risk, occurrence and progression of GC will also be tested in a large sample population in future.

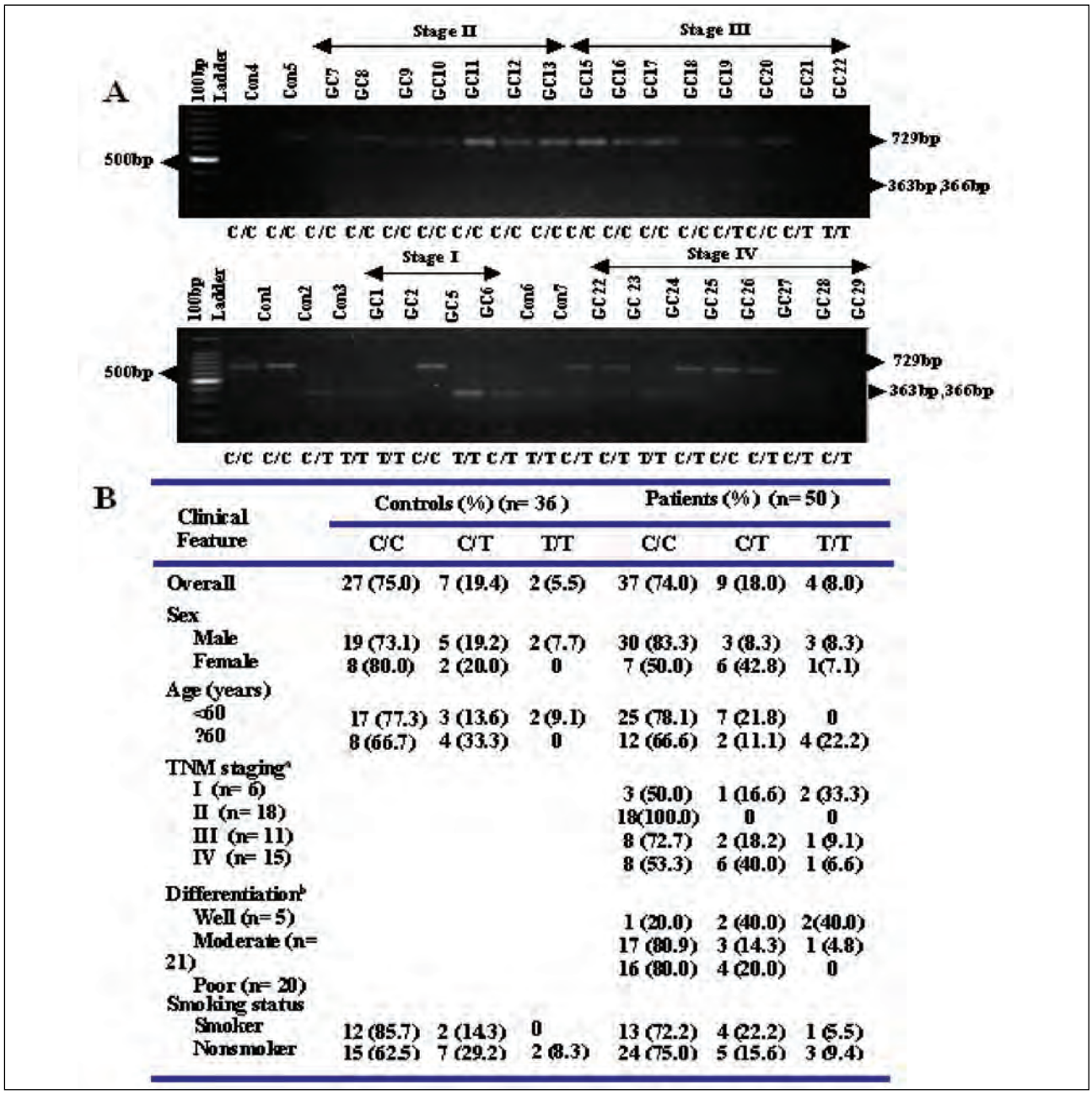


Effect of curcumin and 5-FU on tumor regression

Group	Tumor incidence	Tumor burden	Tumors Min-Max	MPO activity (units/gram tissue)
CON	0%	-	nil	3.03±0.04
ENU	100%	10.66	8-14	18.25±0.55
ENU + CUR	30%	1.66	0-3	5.01±0.41*
ENU + 5FU	38%	3.0	1-5	9.219±0.68*

Fig. 5 : Upregulation of MMP-9 and MMP-2 activities during gastric tumor formation and, effect of curcumin and 5-Fluorouracil there on. Sprague-Dawley rats were administered with ENU for several weeks and a group of 18 weeks treated rats were given curcumin or 5-FU and animals were sacrificed to collect gastric tissues. **(A)** Gelatin Zymography was performed using equal amount of rat gastric tissues extract to detect MMP-9 and MMP-2 activities at different time points of ENU administration. **(B)** Histological representation of fore stomach tissues of control rat, ENU treated rat showing proliferation of squamous epithelial layer, curcumin treated and 5-FU treated rats showing reduction in tissue disruption due to ENU. Table shows anti tumorogenic activity of curcumin and 5-FU in relation to tumor burden, tumor incidence, tumor counts and myeloperoxidase activity. Structure of curcumin and 5-flurouracil has been shown.

Regulation of MMPs by antioxidants in arresting endometriosis and diabetic gastric ulcers. Diabetes mellitus is a life threatening condition and one of the top 10 killer diseases in the world. WHO indicated almost 3 million deaths per year are attributable to diabetes and the total number of people with diabetes will increase from 171 million in 2000 to 366 million in 2030. Diabetes mellitus, under prolonged condition is associated to variety of gastrointestinal symptoms such as diarrhea, constipation, functional dyspepsia, abdominal pain, vomiting, nausea and delayed gastric emptying. Gastric mucosa



B

Clinical Feature	Controls (%) (n= 36)			Patients (%) (n=50)		
	C/C	C/T	T/T	C/C	C/T	T/T
Overall	27 (75.0)	7 (19.4)	2 (5.5)	37 (74.0)	9 (18.0)	4 (8.0)
Sex						
Male	19 (73.1)	5 (19.2)	2 (7.7)	30 (83.3)	3 (8.3)	3 (8.3)
Female	8 (80.0)	2 (20.0)	0	7 (50.0)	6 (42.8)	1(7.1)
Age (years)						
<60	17 (77.3)	3 (13.6)	2 (9.1)	25 (78.1)	7 (21.8)	0
?60	8 (66.7)	4 (33.3)	0	12 (66.6)	2 (11.1)	4 (22.2)
TNM staging[a]						
I (n= 6)				3 (50.0)	1 (16.6)	2 (33.3)
II (n= 18)				18(100.0)	0	0
III (n= 11)				8 (72.7)	2 (18.2)	1 (9.1)
IV (n= 15)				8 (53.3)	6 (40.0)	1 (6.6)
Differentiation[b]						
Well (n= 5)				1 (20.0)	2 (40.0)	2(40.0)
Moderate (n= 21)				17 (80.9)	3 (14.3)	1 (4.8)
Poor (n= 20)				16 (80.0)	4 (20.0)	0
Smoking status						
Smoker	12 (85.7)	2 (14.3)	0	13 (72.2)	4 (22.2)	1 (5.5)
Nonsmoker	15 (62.5)	7 (29.2)	2 (8.3)	24 (75.0)	5 (15.6)	3 (9.4)

[a]TNM staging according to the criteria of the TNM Classification of Malignant Tumors, AJCC.
[b]Differentiation were on the basis of histopathological analysis.

Fig. 6 : Genotyping of gastric cancer patients and MMP-9 polymorphism at -1562 C/T: Data shown here are of total 50 gastric cancer patients. Control subjects (n=36) were randomly selected from individuals visiting hospitals and are free of malignancy by gastrointestinal endoscopy. Blood samples were collected and DNA was extracted. (A) PCR-RFLP analysis of the –1562 C/T polymorphism in patients with gastric cancer. A region of the MMP-9 promoter (–1900 bp to –1200 bp) was amplified with forward primer and reverse primer for analysis of –1562 C/T polymorphism. Amplification conditions were an initial activation step of 94°C for 10 min followed by 35 cycles of denaturation at 94°C for 30 s, annealing at 59°C for 30 s, and extension at 72°C for 30 s. The ethidium bromide-stained 1.5% agarose gel used for genotyping. The target region (729bp) of the MMP-9 gene promoter was digested with SphI, which cleaved the T allele to generate two fragments (363 bp and 366 bp) but not the C allele (729bp). Numbers above the panel are case numbers. Genotypes (CC, CT or TT) are indicated below each case. **(B)** Association between –1562 C/T polymorphism in MMP-9 promoter and clinicopathological features. Numbers indicated in the bracket are the percentage occurrence of the respective alleles.

of streptozotocin-diabetic rat, an accepted model of insulin dependent diabetes mellitus has been shown vulnerable to various ulcerogens such as ischemia-reperfusion injury, stress, ethanol and non-steroidal anti-inflammatory drugs Therefore, the present study was aimed to explore the functional role collagenases i.e. MMP-1 and-13 in the gastric mucosa of streptozotocin-induced type-1 diabetic rats and to evaluate their prognostic significance to ulceration (Fig. 7).

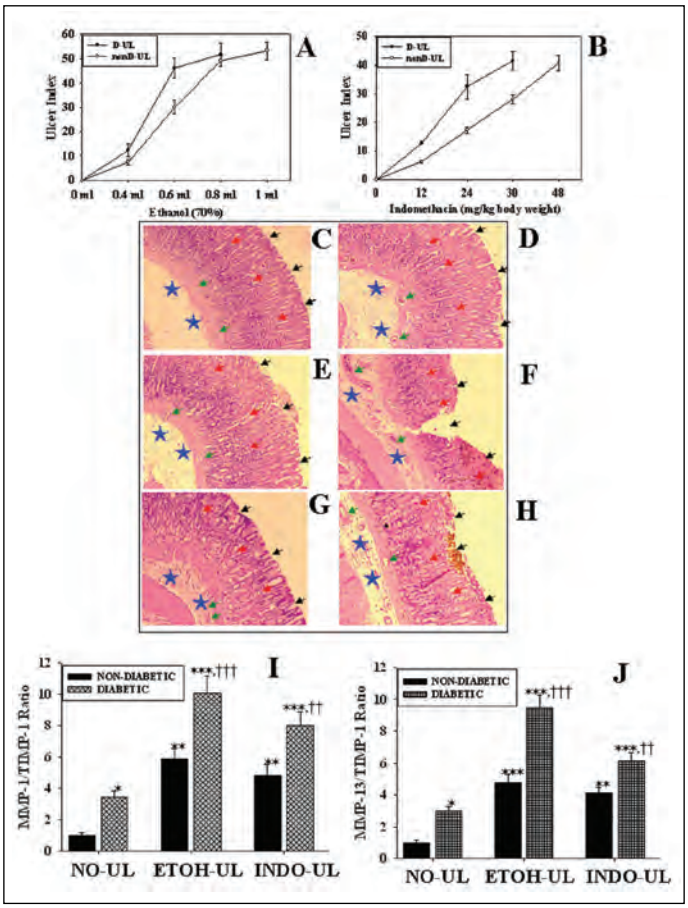


Fig. 7 : Effect of ulcerogens on MMP-1, MMP-13 and TIMP-1 expression in gastric tissues of diabetic and non-diabetic rats. Varying doses of ethanol and indomethacin were administered orally to groups of streptozotocin(Stz)-diabetic and control rats to generate gastric ulcer. The rats were sacrificed, stomachs collected and ulcer indices were scored. Mean ulcer index from each group of rats was plotted against respective doses of **(A)** ethanol and **(B)** indomethacin. Data expressed as mean ± SEM. Histological sections were prepared from the stomachs of different groups of rat and stained with H & E and photographs were taken at the magnification of 10×10. Histological appearance of gastric mucosa from the stomachs of **(C)** vehicle, **(D)** Stz treated **(E)** ethanol treated **(F)** Stz plus ethanol treated, **(G)** indomethacin-treated and **(H)** Stz plus indomethacin treated rats. Gastric mucosal epithelium (black arrow), gastric pits (red arrow), blood vessels (green arrow), inflammatory cells (blue star) were shown. Histological slides show that gastric mucosa was more inflamed due to increased infiltration of inflammatory cells along with dilated blood vessels in diabetic (Stz treated) compared to that of non-diabetic ones (**C** and **D**). Ulcerated diabetic gastric mucosa show more ruptured gastric pits and denuded epithelial layer compared to control rats (**E, F, G, and H**). Both the ulcerogens caused severe damage in diabetic stomach compared to non-diabetic rat stomach. Expression of MMP-1, MMP-13 and TIMP-1in control, diabetic, ulcerated and diabetic ulcerated gastric tissues were analyzed by Western blots. Histographic representation of MMP-1 to TIMP-1 **(I)** and MMP-13 to TIMP-1 **(J)** expression values from non-diabetic, fasted-diabetic, ethanol-treated diabetic and non-diabetic or indomethacin-treated diabetic and non-diabetic gastric tissues. Data expressed as mean ± SEM. Error bars = ± SEM; ***, $p<0.001$; **, $p<0.01$; *, $p<0.05$ versus non-diabetic rat and †††, $p<0.001$; ††, $p<0.01$ versus fasted-diabetic rat. The most notable observation was that of ~3-4 fold increased ratios of MMP-1 to TIMP-1 and MMP-13 to TIMP-1 (**I and J**) in the stomach of fasted-diabetic rats compared to 1:1 ratio of non-diabetic rats prior to ulcerogen treatment.

Therapy for endometriosis, a gynecological disease of reproductive women is a challenge. Herein, we explored the role of MMPs and TIMPs, during the progression of endometriosis. We also investigated the involvement of oxidative stress in endometriosis and their strategic culmination by a potent antioxidant, curcumin. Peritoneal endometriosis in mice was induced to study the role of MMPs. We tested the hypothesis whether curcumin has any role on regression of endometriotic lesions in mice. Briefly, on day 0 the donor mice were anesthetized by ketamine (12 mg/kg b.w.) ,sacrificed and the uterine horns were removed. After removing the muscle layers, the endometrium was finely chopped in PBS buffer. Endometrial fragments was inoculated into the peritoneal cavity of recipient mice. Mice containing five in each groups were sacrificed on 7th (Endo 7), 15th (Endo 15) and 21st day (Endo 21) of post-induction of endometriosis. Uterine tissue of control mice sacrificed on the day of endometriosis induction (Endo 0) was used as control. Different doses of curcumin were administered i.p. 30 min prior to administration of endometrial extract to three different groups of mice and once daily for the next 3 days to test their protective effects in endometriosis. To test the therapeutic effects of curcumin in endometriosis, a single dose of curcumin (48 mg/kg b.w.) was administered to two groups of mice and were sacrificed on day 10 and 20 respectively from day 15 post-endometriosis. Curcumin inhibited MMP-9 that was in parallel to TNF- α expression while its effect on TIMP-1 was in inverse relation (Fig. 8).

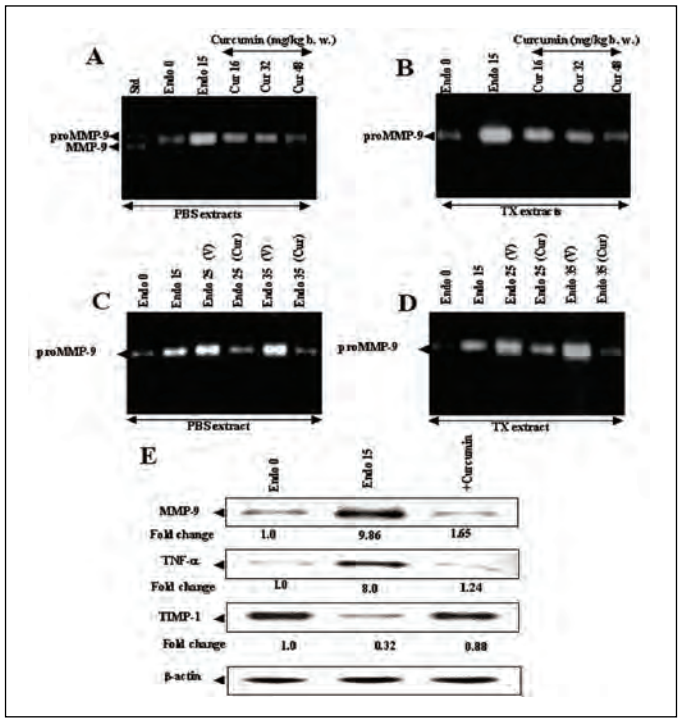


Fig. 8 : Preventive and therapeutic role of curcumin on endometriosis and regulation of proMMP-9 activity. For preventive effects of curcumin the animals were pretreated with curcumin (16, 32 and 48 mg/kg b.w.) on Endo 15 mice. Gelatin zymography was conducted to monitor the activity of **(A)** secreted and **(B)** synthesized proMMP-9 activity, using PBS and TX extracts of control, endometriotic and curcumin-pretreated endometriosis induced tissues of mice. For therapeutic effects of curcumin the animals were administered intraperitoneally with curcumin (48 mg/kg b.w.) 15th day of postendometriosis for another extra 10 and 20 days. The animals were sacrificed on day 10 and 20 post-curcumin or vehicle treatment and gelatin zymography was performed to detect the activity of **(C)** secreted and **(D)** synthesized proMMP-9. PBS extracts of control, endometriotic and curcumin-pretreated endometriotic tissues from mice were subjected to (E) Western blot and probed with polyclonal anti-MMP-9, polyclonal anti-TNF-α,polyclonal anti-TIMP-1 and monoclonal anti-β actin antibody. Number below each blot represents the fold chages as measured by Lab Image softwar.

Dr. T. K. Dhar and group

Development of antibody-based analysis techniques

A novel broad-specific noncompetitive immunoassay and its application in the determination of total aflatoxins: In recent years, there has been a dramatic surge in interest in developing competitive immunochemical methods for the screening of multiple small molecular weight analytes in the field of environmental and food analysis. Approaches include use of recombinant antibodies, appropriate design haptens, and mixing of more than one antibody for detection of structurally similar target compounds within a chemical class. However, all these approaches are both times consuming and laborious.

Aflatoxins (AFs) are a chemically related group of compounds (AFB_1, AFB_2, AFG_1 and AFG_2) mainly produced by the mould Aspergillus flavus and A. parasiticus. Due to their high toxicity and carcinogenicity, AFs are of major concern for food producers, the food processing industry and consumers. We describe a simple approach for performing broad-specific noncompetitive immunoassays for the determination of total aflatoxins (AFB_1+AFB_2+AFG_1+AFG_2) using a highly specific polyclonal antibody against AFB_1. The method is based on blocking the free sites of the capture antibodies by an AFB_1-protein conjugate followed by the replacement of antibody-bound AFs by an enzyme-labeled AFB_1. The rates of displacement of weakly bound AFB_1 congeners by the AFB_1-HRP conjugate are faster than that of AFB_1. Consequently the measured signals from cross-reactants are higher and almost linearly correlated to the AFB_1 concentration. Fig. 9 illustrates the general principle on noncompetitive immunoassay for small molecular weight hapten (AFB_1). The same approach is used for the broad-specific determination of total AFs.

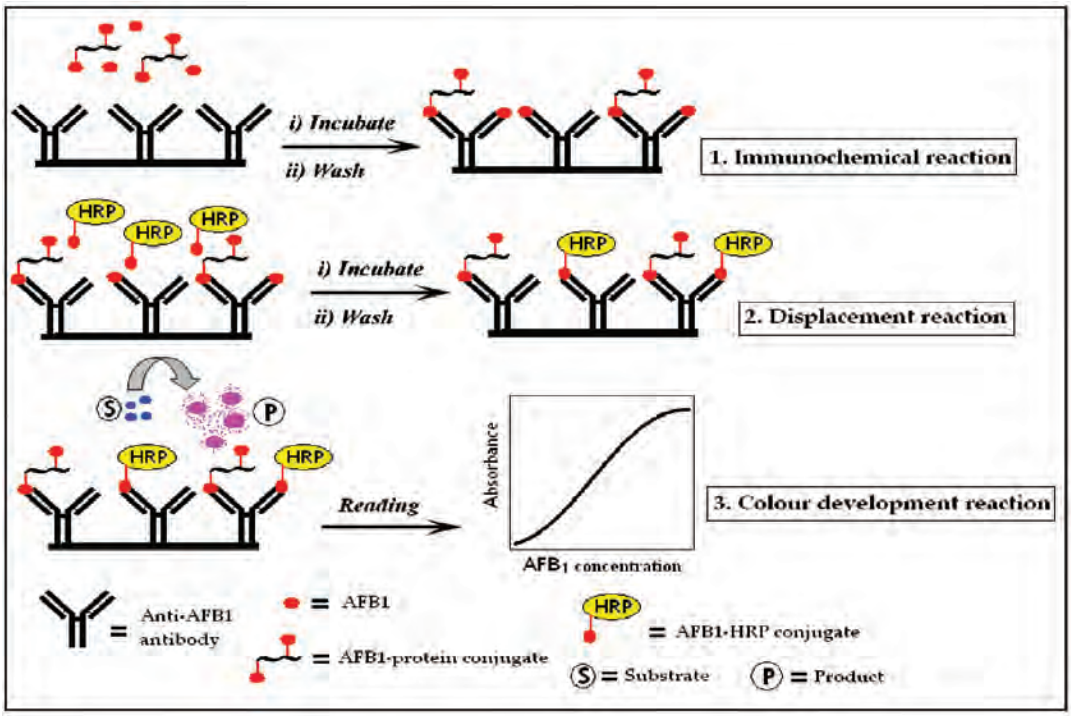


Fig. 9 : General principle of the noncompetitive immunoassay using AFB1-protein conjugate.

To evaluate the efficient blocking agent for the capture antibody binding sites, different AFB_1–protein conjugates were prepared by reacting AFB_1-(O-carboxyymethyl) oxime-NHS ester with casein,

ovalbumin, BSA and εACA-BSA through the amino group and assayed. The results showed all the synthesized protein conjugates at optimal concentration block the antibody binding sites for enzyme conjugate. However, their blocking efficiencies were different and were in the order AFB_1-casein >AFB_1-ovalbumin >AFB_1- ε-ACA-BSA >AFB_1-BSA. They all produced AFB_1 dose response curves at optimal protein conjugate concentration by noncompetitive assay with detection sensitivity of 0.1µg l^{-1} (5pg/well). However, the dose-response curves obtained from AFB_1-ovalbumin conjugate and AFB_1-ε-ACA-BSA was superior as they gave curves with higher A/A_0 values. The same AFB_1-protein conjugates can also be used for competitive ELISA after biotinylation. The dose-response curves obtained by using the AFB_1-BSA-biotin conjugate by both noncompetitive and modified ELISA (m-ELISA) using the same reagent concentrations and assay conditions are shown in Fig. 10.

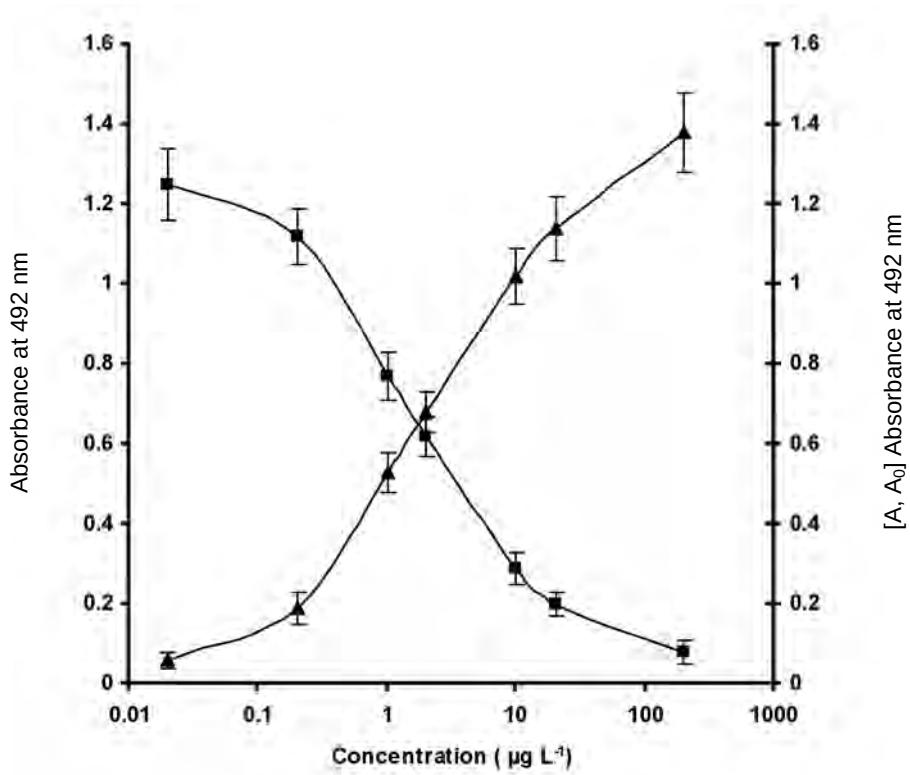


Fig. 10 : Dose-response curves of AFB_1 by noncompetitive (s) and competitive m-ELISA (n) using the AFB_1-BSA-biotin conjugate

Assay specificities of noncompetitive and competitive m-ELISA using the same anti-AFB_1 antibody were investigated. The cross-reactivities assessed by the noncompetitive method towards AFB_2, AFG_1 and AFG_2 compared to AFB_1 were approximately 150, 125 and 35% respectively. On the contrary, competitive m-ELISA with the AFB_1-BSA-biotin conjugate showed limited cross-reactivity similar to conventional ELISA [AFB_2 (23%), AFG_1 (21%) and AFG_2 (2%) compared to AFB_1]. The high cross-reactivity of the noncompetitive ELISA using protein conjugate is possible only when the rates of displacement are in the following order AFG_2 > AFG_1 > AFB_2 > AFB_1. This was corroborated by the signals measured for AFB_2 and AFG_1, which were higher than though close to that of AFB_1 (Fig. 11). The low signal intensity obtained for AFG_2 is due to its low cross-reactivity to antibody (about 20-fold less than AFB_2 and AFG_1) and therefore the replaced amount of enzyme conjugate is still not sufficient to match the AFB_1 signal. The low cross-reactivity of AFG_2 in the present assay does not contribute to inaccuracy, as AFG_2 is least toxic and is not known to occur widely in food.

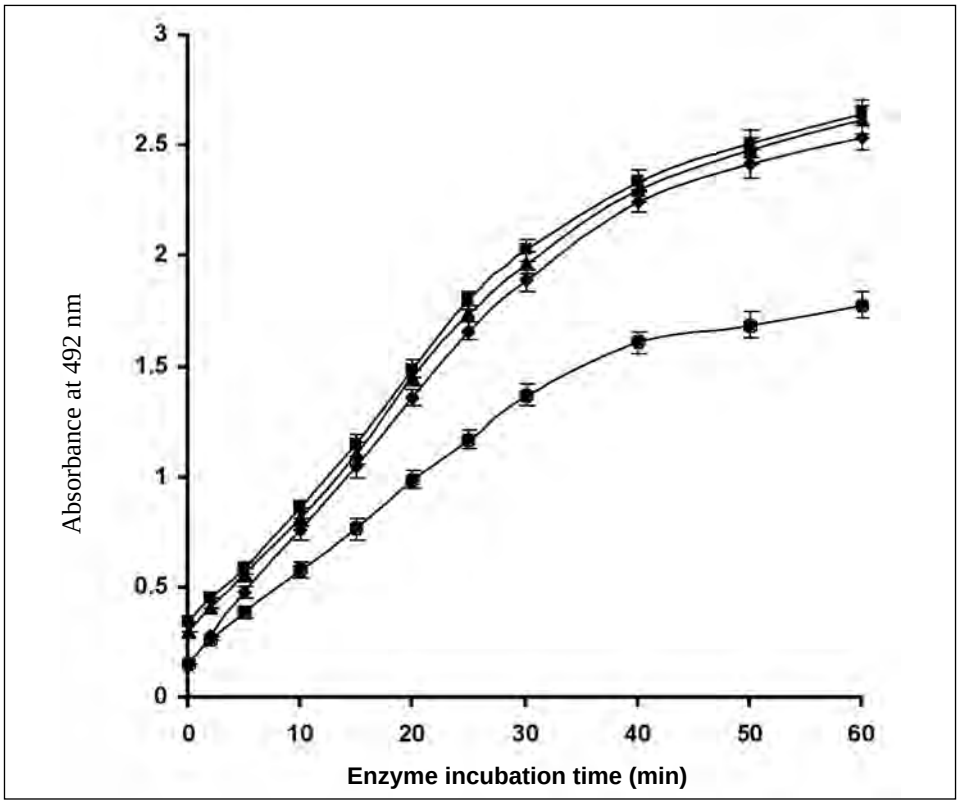


Fig. 11 : Rate of displacement of AFB_1 congeners by the AFB_1-HRP conjugate from the preformed immune complexes between the immobilized capture antibody and the AFB_1-ovalbumin conjugate in presence of 2 µg L^{-1} of: AFB_1 ( ), AFB_2 (n), AFG_1 (s) and AFG_2 (l).

Thus, the present noncompetitive format can be used to monitor the total AF content whereas the competitive ELISA using the same antibody with the AFB_1-BSA-biotin conjugate measured the individual concentration of AFB_1.

The method was applied to measure total AFs in corn samples without the need of laborious sample cleanup steps. Matrix interference can be removed by simply diluting the sample 10-fold with assay buffer. The data on the analytical parameters indicate that the new method for total AF detection in corn is sufficiently reproducible, accurate and sensitive. Taking into account the sample dilution requirement, the limit of detection for total AFs was 5 µg kg^{-1}. The values obtained for naturally contaminated corn samples correlated well (R^2 = 0.99) with the commercially available ELISA kit. Although the present work focuses on the determination of total AFs, the approach is likely to prove more general and may be utilized for the detection of multiple analytes.

Dr. Nirmalendu Das and group

Vesicular flavonoid in combating diethylnitrosamine induced hepatocarcinoma in rat model

Reactive oxygen species (O_2^-, OH^-, H_2O_2) are known to play an important role in tumor initiation in hepatocarcinoma. Hepatocarcinoma was developed in the Swiss Albino rats by administration three doses of diethylnitrosamine (DEN) (200 mg/kg b. wt.) (i.p.) at 15 days interval. Quercetin (QC), herbal Polyphenolic compound, is a potent anticancer drug. Clinical trials are difficult for its hydrophobic

nature. To overcome this problem, our study was aimed to formulate soluble liver specific, galactosylated liposomal QC and to investigate its efficacy against hepatocarcinoma in rat model. Galactosylated liposomal QC was formulated and the suspension was introduced intravenously to rats (8.98 µM/kg) once in a week for 16 weeks. Hepatocarcinoma in rat model and its pathological improvement were evaluated histopathologically, histochemically and electron microscopically (Figs. 12-14). Severe oxidative damage was noticed in the whole liver and its microsomal fraction of DEN treated rats. Huge numbers of hyperplastic nodules (HNs) with pre-neoplastic lesions appeared in rat liver by DEN administration. Galactosylated liposomal QC injections prevented DEN mediated development of hepatocarcinoma and oxidative damage in rat liver (Table 2). Quercetin in liver specific galactosylated liposomal drug delivery system may be recommended as a potent therapeutic formulation against DEN-induced hepatocarcinoma.

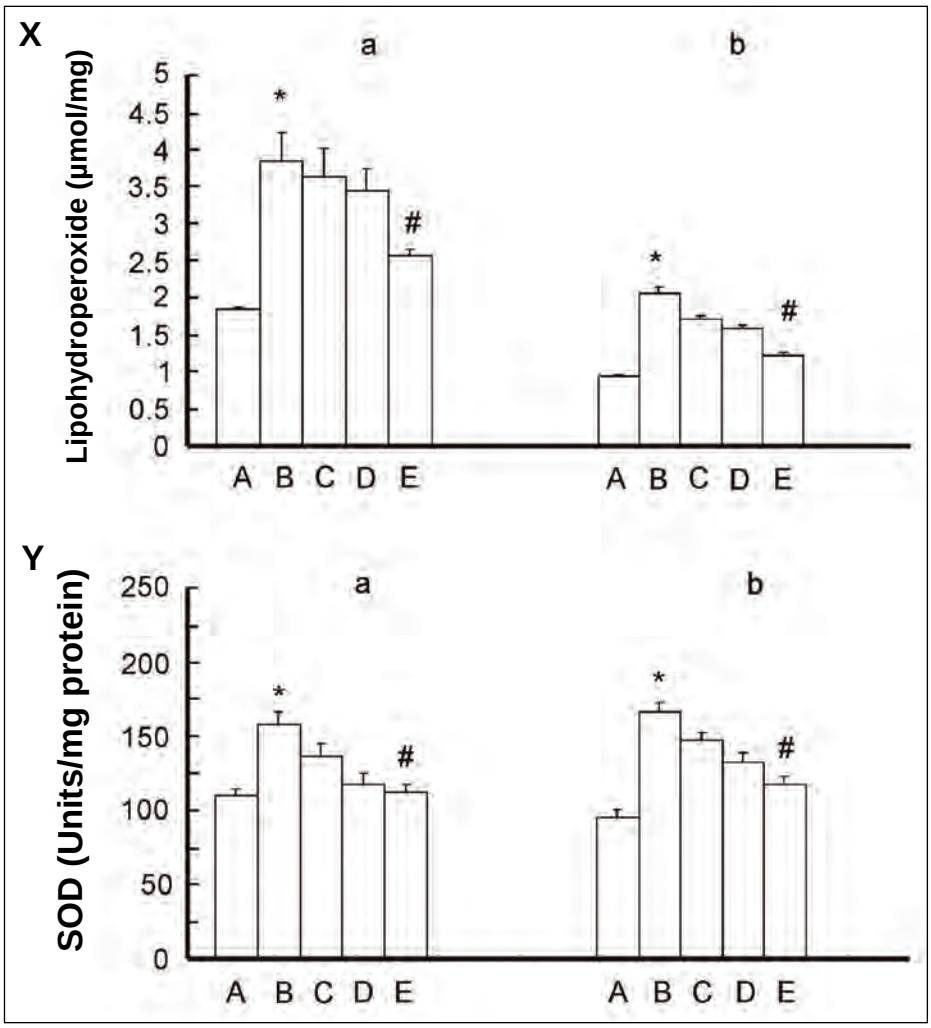


Fig. 12 : Estimations of amount of lipohydroperoxide and superoxide dismutase activity of liver tissue. X: Amount of lipohydroperoxide (mol/mg protein) in whole liver tissue (a) and its microsomal fraction (b). Values are mean ± SD for 5 rats. *P<0.001 significantly different from normal. #P<0.001 significantly different from DEN treated. (A) Olive oil-treated control, (B) DEN-treated, (C) DEN treated + free QC treated, (D) DEN+ liposomal QC treated, (E) DEN + Galactosylated liposomal QC treated. **Y:** Superoxide dismutase activity in liver cytosol(a) and microsomal fraction(b). Values are mean ± SD for 5 rats. *P<0.001 significantly different from normal. #P<0.001 significantly different from DEN treated. (A) Olive oil-treated control, (B) DEN-treated, (C) DEN-treated + free QC treated, (D) DEN+ liposomal QC treated, (E) DEN + Galactosylated liposomal QC treated.

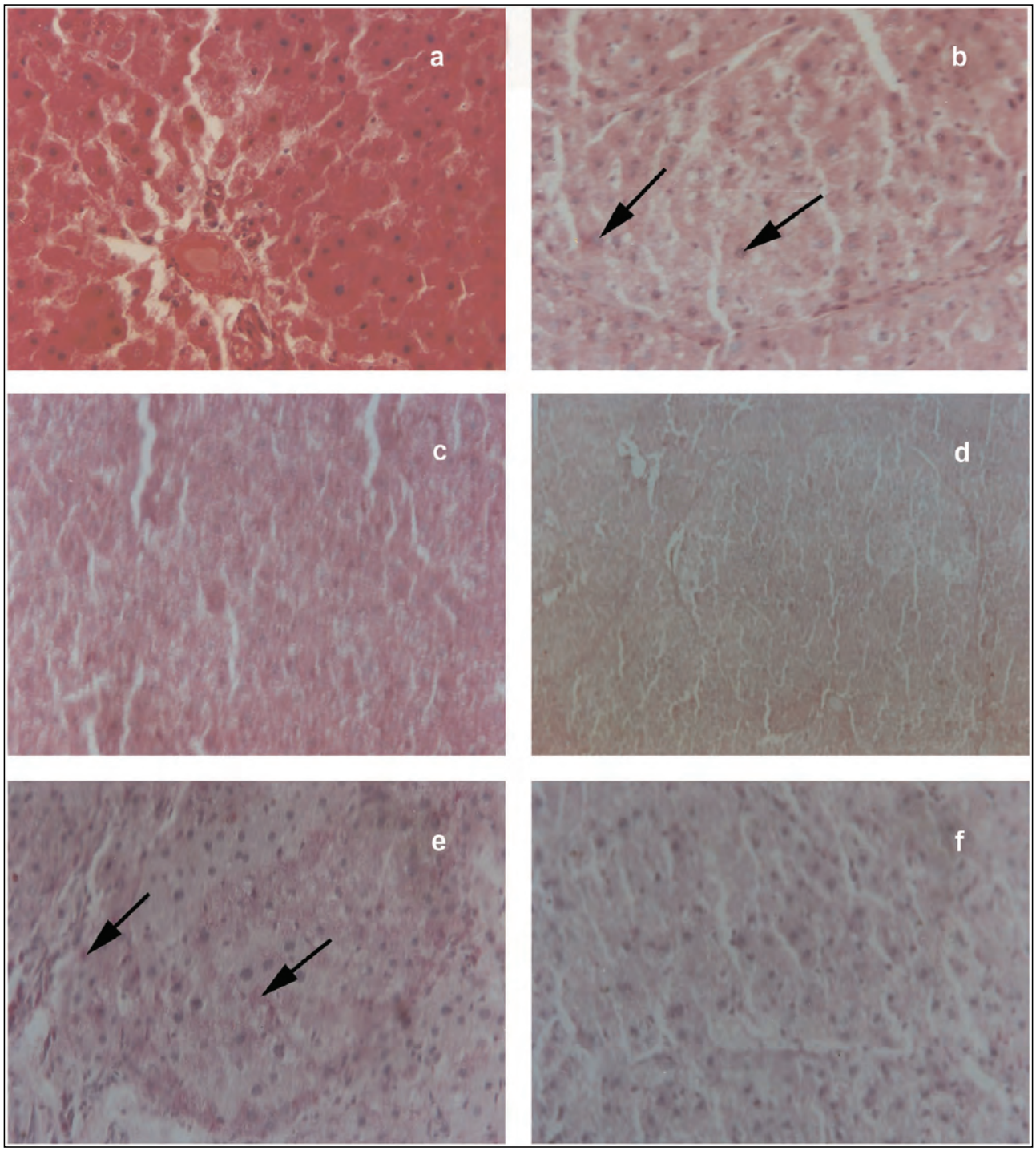


Fig. 13 : Histopathological and histochemical examinations of liver sections. (i) Histopathological examination of eosin-hematoxylin stained liver section of normal and experimental rats with magnification x 400. (a) Olive oil-treated control, (b) DEN-treated, (c) DEN + Galactosylated liposomal QC treated. b: Arrow indicates enlarged hyper-chromatic nuclei. (ii) Histochemical examination of P.A.S. stained liver section of normal and experimental rats with magnification x 400. (d) Olive oil-treated control, (e) DEN-treated, (f) DEN + Galactosylated liposomal QC treated. e: Arrow indicates P.A.S. positive material.

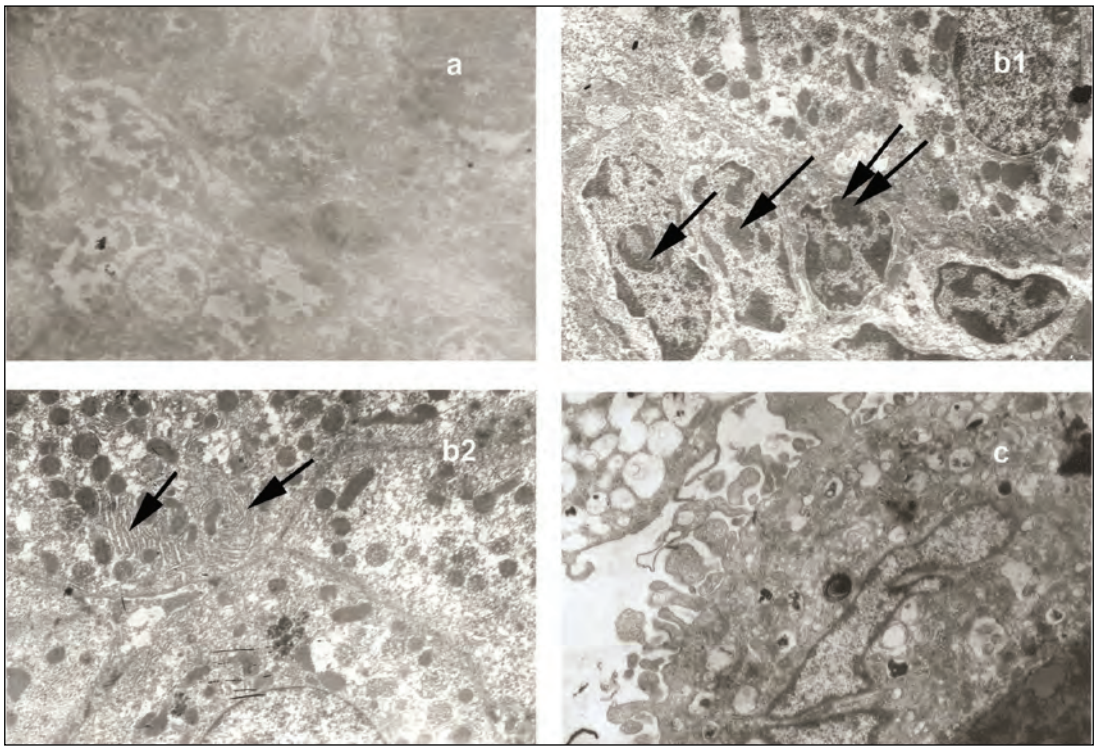


Fig. 14 : Electron microscopical examination of liver sections. Electron microscopical examination of liver sections of normal and experimental rats with magnification x 10,000. (a) Olive oil-treated control, (b1&b2) DEN-treated, (c) DEN + Galactosylated liposomal QC treated. b1: Arrow indicates enlarged nucleolus.Double arrows indicate heterochromatins. b2: Arrow indicates increased number of cisternae of the endoplasmic reticulum.

Table 2. Effect of QC in free and liposomal entrapped forms on the relative liver weight, number and size distribution of preneoplastic and hyperplastic nodules in hepatocytes in DEN induced hepatocarcinogenic rats

Experimental groups	RLW*	% of increase in RLW	Total number of hepatic nodules	% of suppression of hepatic nodules	Preneoplastic lesions[1] Nd[2] 10^3 / cm^3	Size of hyperplastic nodules (numbers)	
						<1mm	>1mm
Normal	3.53 ± 0.10	—	—	—	—	—	—
DEN treated (A)	4.55 ± 0.22	29	89 ± 12	—	1205 ± 102	25	57
(A)+Free QC treated	4.50 ± 0.33	27	85 ± 8	4.5	1111 ± 56	15	36
(A)+Liposomal QC treated	4.36 ± 0.40	26	52 ± 4	41	861 ± 81	12	32
(A)+Galactosylated liposomal QC treated	3.79	7	10 ± 2	89	361 ± 22	—	10

[1]Preneoplastic lesions were determined by compound microscopy.
[2]Nd : numerical density, expressed in number x 10^3 per cm^3 of hepatic tissue.
*Relative liver weight (RLW) = Liver weight/Final body weight x 100.

Nanoparticulated Quercetin in combating age related cerebral oxidative injury

Reactive oxygen species e.g. $O_2^{\cdot-}$, H_2O_2 and $.OH^{-}$ generated by the induction of oxidative stress exert a potential threat on the activity of endogenous antioxidant enzymes and substantially influence the aging process and age dependant neuropathology. Chemical antioxidant is almost ineffective in protecting neuronal cells from oxidative damage as Blood Brain Barrier exists in between blood and brain interstitial fluid that restricts undegradable influx from the circulation into cerebral region. Quercetin (QC), a flavonoidal antioxidant is known as a potent antioxidant for its Polyphenolic configuration. Formulation of QC in polylactide nanocapsule has been done and the efficacy of this vesicular flavonoid has been tested against cerebral ischemia induced oxidative damage in young and old rat brains. Antioxidant potential of QC loaded in nanocapsule (QC 7.2 mmol/kg b.wt., size 50 nm) was investigated by an *in vivo* model of cerebral ischemia and reperfusion on Sprague Dawley young (2 months, b.wt. 160–180 g) and aged (20 months, b.wt. 415–440 g) rats. Diene level, the index of lipid peroxidation and GSSG/GSH ratio were found to be higher in normal aged, compared to normal young rat brain. Endogenous antioxidants activities were lower in aged rat brain compared to young. Further reduction of these antioxidants were observed in aged rat brain by the induction of cerebral ischemia - reperfusion. Nanocapsule encapsulated QC treatment resulted a significant protection to endogenous antioxidant enzymes against ischemia induced oxidative damage in neuronal cells of young and old rats (Tables 3 & 4).

Table 3. Effect of Quercetin(QC) in free and nanocapsule-encapsulated form on the changes in GSH-Px, G6PDH,GR and GST activities in young and aged rat brain by the induction of cerebral ischemia and reperfusion

Experimental condition	GSH-Px µmol NADPH oxidation/min/mg protein		G6PDH nmoleNADP reduced/ min/mgprotein		GR..pmoleof NADPH oxidation/min/mg protein		GST n.mole produced/ mg protein	
	Young	Aged	Young	Aged	Young	Aged	Young	Aged
Normal	9.11 ±0.78	6.27 ±0.52	12.76 ±1.12	8.83 ±0.86	36.41 ±1.39	24.81 ±2.16	151.72 ±9.12	98.66± 11.39
Cerebral ischemia reperfused (A)	4.72 ±0.31*	2.89 ±0.48*	7.62 ±0.96*	5.26 ±0.72*	21.26 ±2.11*	14.56 ±1.67*	88.08± 6.33*	57.16± 7.22*
(A) + Free QC treated	4.96 ±0.82	3.11 ±0.73	8.17 ±0.76	5.76 ±0.59	26.72 ±1.99	17.36 ±2.72	106.85± 7.12	68.79± 8.25
(A) + Empty nanocapsule treated	4.82 ±0.72	2.78 ±0.51	7.86 ±0.49	5.31 ±0.91	20.91 ±1.71	15.11 ±2.11	91.76 ±7.89	59.21 ±8.17
(A) + Nanocapsulated QC treated	9.05 ±0.07#	6.10 ±0.09#	12.50 ±0.20#	8.45 ±0.30#	35.58 ±0.07#	24.37 ±0.06#	150.04 ±0.09#	97.79 ±0.02#

Results are expressed as mean±SD. Cerebral ischemia –reperfused groups* were compared with normal and the values were significantly different $p<0.01$. Experimental groups# (QC entrapped in nanocapsule) were also compared with ischemia-reperfused groups and all those cases $p<0.05$.

Table 4. Effect of Quercetin in free, and nanocapsulated vesicular forms on the age related formation of conjugated diene in rat brain tissue by the induction of cerebral ischemia and reperfusion

Experimental condition	Lipohydroperoxide content (µmol/mg protein)	
	Young	aged
Normal	1.87±0.13	3.45±0.58
Cerebral ischemia reperfused(A)	4.37±0.66*	7.92±0.93*
+ free Quercetin(QC) treated	4.07±0.52	7.63±1.01
(A)+ empty nanocapsulated treated	4.13±0.87	7.87±0.83
(A)+ nanocapsulated QC treated	1.83±0.08#	3.40±0.02#

Rats were made ischemia and reperfusion was done as described in methods section. Prior to cerebral ischemia 1.32µmol of Quercetin /kg b.wt in free, and nanoparticle encapsulated forms was orally fed into rats of experimental groups. Results are expressed as mean ±S.D. Cerebral ischemia –reperfused groups* were compared with normal and the values were significantly different $P<0.01$. Experimental groups# (QC entrapped in nanoparticles) were also compared with ischemia-reperfused groups and all those cases $P<0.05$.

Nanoencapsulation of quercetin enhances its dietary efficacy in combating arsenic-induced oxidative damage in liver and brain of rats

This study was performed to evaluate the therapeutic efficacy of nanocapsulated flavonoidal quercetin (QC) in combating arsenic-induced reactive oxygen species (ROS)-mediated oxidative damage in hepatocytes and brain cells in a rat model.

Hepatic and neuronal cell damage in rats was made by a single injection (sc) of sodium arsenite ($NaAsO_2$, 13 mg/kg b. wt. in 0.5 ml of physiological saline). A single dose of 500 7l of Quercetin suspension (QC) (QC 8.98 7mol/kg) or 5007l of nanocapsulated QC (NPQC) (QC 8.98 7mol/kg) was given orally to rats at 90 min prior to the arsenite injection. Results showed inorganic arsenic depositions (182±15.6 and 110±12.8 ng/g protein) were found in hepatic and neuronal mitochondrial membranes. Antioxidant levels in hepatic and neuronal cells were reduced significantly by arsenic. NPQC prevented the arsenite-induced reduction in antioxidant levels in the liver and brain (Tables 5 & 6). Arsenic induced a substantial decrease in liver and brain cell membrane microviscosities, and NPQC treatment resulted in a unique protection against the loss. A significant correlation between mitochondrial arsenic and its conjugated diene level was observed both in liver and brain cells for all experimental rats (Fig. 15) Thus arsenic-specific antidotes are used against arsenic-induced toxicity. However, the target site is poorly recognized and therefore achieving an active concentration of drug molecules can be a challenge. Thus, our objective was to formulate NPQC and to investigate its therapeutic potential in an oral route against arsenite-induced hepatic and neuronal cell damage in a rat model.

Table 5. Effects of free QC or NPQC on the changes in various components of the antioxidant defense system in hepatic and neuronal cells of rats by the induction of sodium arsenite

	GPx		G6PDH		Glutathione Reductase		Catalase		Glutathione S Transferase	
	Liver	Brain	Liver	Brain	Liver	Brain	Liver	Brain	Liver	Brain
	µmol NADPH oxidation/ min/mg protein		nmol NADPH reduced/min/ mg protein		µmol NADPH oxidation/min/ mg protein		µmol H_2O_2 reduced/min/mg protein		nmol product /min/mg	
Normal	8.75± 0.45	5.23± 0.27	10.33± 0.51	6.32± 0.48	28.52± 2.13	18.72± 1.77	8.32± 0.52	7.31± 0.83	128.2± 21.21	108.76± 13.21
Sodium arsenite-treated (A)	3.92± 0.18	2.17± 0.09	6.17± 0.48	3.61± 0.29	13.79± 1.67	9.92± 0.87	4.69± 0.31	2.79± 0.54	73.91± 11.76	69.26± 9.88
(A)+Free QC-treated	4.22± 0.21	2.81± 0.13	6.82± 0.39	3.97± 0.18	11.82± 0.96	10.11± 1.33	5.17± 0.62	3.17± 0.82	98.72± 17.32	72.66± 5.98
(A)+empty Nano-capsule-treated	3.87± 0.19	2.23± 0.17	6.72± 0.51	3.58± 0.27	14.82± 2.32	10.73± 2.11	4.87± 0.39	2.92± 0.61	78.72± 12.11	62.18± 10.26
(A)+QCEntrap-ped Nanoca-psule-treated	8.56± 0.39	4.98± 0.31	9.89± 0.72	6.07± 0.39	27.91± 3.01	17.92± 2.33	7.96± 0.81	6.87± 0.72	116.86± 19.26	97.86± 7.22

Results are expressed as mean ± SD. The sodium arsenite-treated group was compared with the normal group, and the value was significantly different with P<0.001. The nanocapsulated QC-treated group was also compared with the sodium arsenite-treated group, and the value was also significantly different with P<0.001.

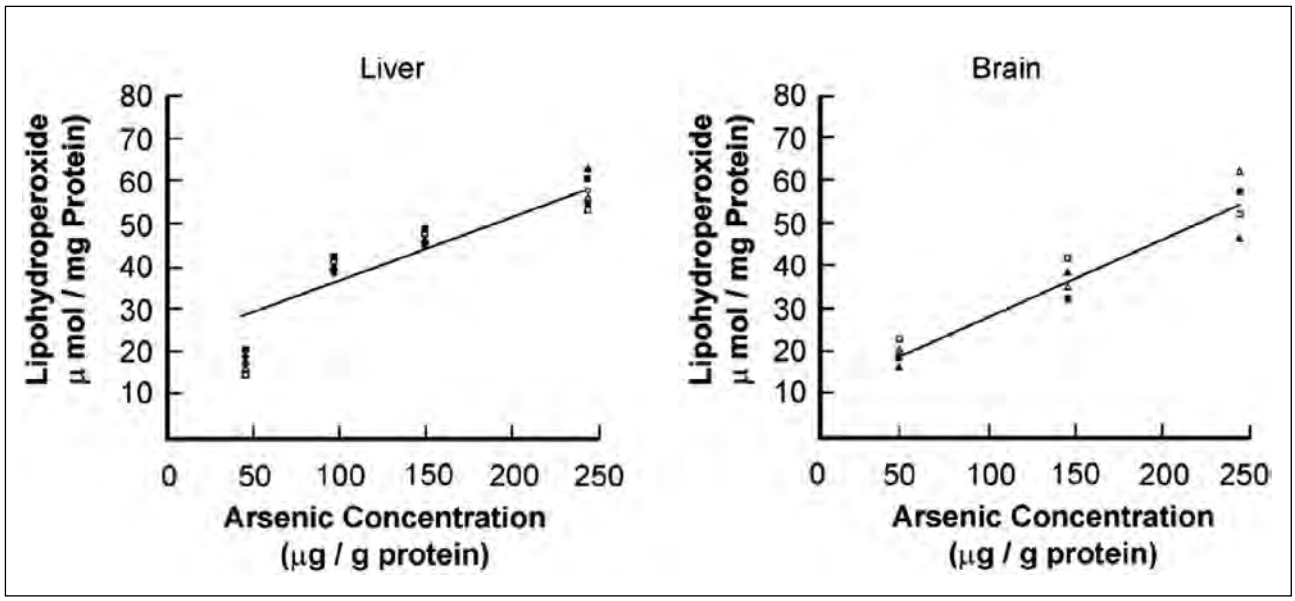


Fig. 15 : Correlation of mitochondrial arsenic content of liver and brain with lipid peroxidation. For liver, y=0.129x+13.496, r=0.95, Pb0.001, and for brain, y=0.143x +17.317, r=0.91, P<0.001. For liver and brain, Sodium arsenite-treated=A (A)+Empty nanocapsule-treated n (A)+Free Quercetin-treated (A)+Nanocapsulated QC-treated s.

Dr. Anil K. Ghosh and group

Characterization of trehalose-6-phosphate synthase from Saccharomyces cerevisiae

Trehalose, a non-reducing disaccharide, is well known as a stress protectant, cryoprotectant and membrane and protein stabilizer, etc. It occurs in wide range of organisms which is synthesized by an enzyme complex - trehalose synthase, made of three subunits: trehalose-6-phosphate (tre-6-p) synthase, trehalose-6-phosphate phosphatase and a regulatory subunit. It is hydrolyzed by trehalase enzymes. In the yeast *Saccharomyces cerevisiae*, two types of trehalase are reported, viz. acid trehalase (AT) and neutral trehalase (NT). Our aim is to understand how the molecular mechanisms of trehalose metabolism in yeast are regulated.

Purified trehalose-6-phosphate synthase (TPS) of *Saccharomyces cerevisiae* was effective over a wide range of substrates, although differing with regard to their relative activity. Polyanions heparin, chondroitin sulfate were seen to stimulate TPS activity, particularly when a pyrimidine glucose nucleotide like UDPG was used, rather than a purine glucose nucleotide like GDPG. A high Vm and a low Km value of UDPG show its greatest affinity with TPS than GDPG or TDPG.

Effect of heparin was also extended to the purification of TPS activity, as it helped to retain both stability and activity of the final purified enzyme. Metal co-factors, specifically $MnCl_2$ acted as stimulators, while enzyme inhibitors had very little effect on TPS activity. Metal chelators like CDTA, EGTA stimulated enzyme activity by chelation of metal inhibitors. The purified enzyme was also inhibited by high phosphate concentration, possibly due to separation of associated subunits at high ionic strength. Temperature and pH optima of the purified enzyme were determined to be 40°C and pH 8.5 respectively. Enzyme activity was stable at 0-40°C and at alkaline pH.

Purification of neutral trehalase-invertase activity from Candida utilis. A *Candida utilis* strain, deficient in any acid trehalase activity, was shown to contain only neutral trehalase activity. This strain could utilize extracellular trehalose as sole carbon source. The neutral trehalase activity from the *C. utilis* strain was purified to electrophoretic homogeneity through HPLC based purification protocol. The purified protein showed Neutral Trehalase as well as Invertase activity. The HPGPLC data have proved that the functional form of the purified enzyme has a molecular mass of 112 kDa, while the molecular weight of the single band visible in SDS-PAGE was estimated to be 56 kDa. So it was hypothesized that functional form of the purified protein is a dimer of 56 kDa polypeptide. The PMF obtained by MALDI-TOF and physicochemical charactaristization proved that the purified enzyme is distinct from other trehalase enzymes reported from yeast. While most of the physico-chemical characters, including pH optimum, were similar to those of neutral trehalase from S. cerevisiae, few resembled the characters of acid trehalase activity.

Chemical Standardization and Biological Evaluation with a view to Increase Efficacy of Herbal Medicines: Bioefficacy and Analytical Evaluation (Antimicrobial activity) Itone Eye Drops

Itone, an ayurvedic eye drop, often prescribed over the counter has tremendous market potential not only in India, but also across the globe. According to recently introduced WHO guidelines the registration of such type of ayurvedic preparation has become stringent and requires several parameters to be supplied before a product can be marketed in foreign countries. One of this parameter is batch standardization including fingerprint generation, in which one or two components are to be identified chemically. Moreover for marketing of this truly potential ayurvedic eye drop needs determination of bio-effectivity as well as correlation of the chemically identified components with their biological activity in curing of different eye diseases.

Itone is a poly herbal eye drop consisting of 21 herbs and 2 preservatives. Earlier we have shown that Itone consists of some essential oils; among them three oils namely eugenol, carvacrol and camphene were identified as a biomarker. In an attempt to find the microbicidal activity of Itone, antimicrobial assay was performed by measuring the growth of two types of microorganisms, yeast and bacteria, in the presence and absence of the test materials and the MIC of Itone on them was found.

This year the study was carried out further by investigating the effect of the individual ingredients on the above mentioned microorganisms. Some of the ingredients showed MIC values as low as 1% whereas few did not have any effect at all. An attempt was made to understand the role of preservatives in Itone. Agar cup well diffusion assay method was used to study the antibacterial effect of Itone with preservatives and Itone without preservatives samples. The GC-MS analysis of Itone sample revealed that itone samples without preservatives did not show any peak of essential oil and hence did not have anti-microbial activity, whereas itone samples with preservatives showed peaks of essential oils and thus showed antimicrobial activity. Thus it might be concluded that preservatives plays an important role in trapping the essential oils.

Standardization and Identification of ingredients present in TRASINA

Trasina, a polyherbal medicine, has five herbal ingredients and is currently marketed to provide adaptogenic strength to patients suffering from stress related conditions. Earlier, we have standardized the product by measuring the total sugar and total sterol present there, by delimiting the batch to batch variations and also two bio-markers, namely S-Adenosyl-L-Methionine (AdoMet, anti-ageing chemical) and oleanolic acid were identified.

This year, we have measured the total trehalose(anti-stress chemical) content of four new batches of the product. The analysis was made in triplicates. It might be concluded that the presence of AdoMet and Trehalose as identified through HPLC, has an essential role in anti-stress and ant-ageing activity within Trasina.

Purification and characterization of a low molecular weight endoxylanase from mushroom Termitomyces clypeatus

Xylan, the most abundant of the hemicelluloses in terrestrial plant cell walls has a linear β-1, 4-linked xylopyranosidic back bone with side chain glucose, arabinose, glucuronic acids and arabinoglucuronic acid residues on its D-xylose backbone. Larch wood xylan also contains similar backbone of β-1, 4-linked D-xylopyranosyl residues with every fifth or sixth xylose residue substituted at C2 with 4-0-methyl-D-glucuronic acid and at C3 with arabinofuranosyl units, where none of the xylosyl residue have more than one branch. The presence of glucose in xylan has already been reported. Commercially available oat spelt xylan upon enzymatic hydrolysis liberates glucose molecule in varied amount, which is also known to contain glucose as per the manufacturer's technical specification (Sigma Chemicals Co, USA).

It was reported that the mushroom *Termitomyces clypeatus* produces one xylanase depending upon carbon source. It produces 56 kDa xylanolytic amyloglucosidase when allowed to grow dextrin but when it was xylan it produces a 12 kDa endo-xylanase.

A low molecular weight endoxylanase (E C. 3.2.1.8) was purified from an edible mushroom *Termitomyces clypeatus* grown in submerged medium with oat spelt xylan. Xylanase was purified to apparent homogeneity by ammonium sulfate fractionation and gel filtration chromatography. Its molecular weight was determined by gel filtration chromatography and SDS-PAGE to be 12 kDa. The enzyme was found to be most active at 50°C and pH 5.0, being most stable at ph 6.5. The Km for oat spelt

xylan was determined to be 10.4 mg/ml. The specificities of the enzyme was observed to be highly specific towards oat spelt xylan and was inhibited by Mercuric chloride ($HgCl_2$), N-bromosuccinimide (NBS) and trans-1,2-diaminocyclohexane-N', N', N', N'- tetraacetic acid (CDTA) strongly. The inhibitory action of N-bromosuccinimide on enzyme confirmed the presence of one tryptophan residue in its substrate binding site. Amino acid analysis for xylanase showed the presence of high amount of hydrophobic Serine, Glycine, Threonine and Alanine residues. The N-terminal sequencing study for the previously purified and characterized 56 kDa xylanolytic amyloglucosidase reveal the presence of 33.30 % identity with glucoamylase chain A from *Aspergillus awamori*. The N-terminal sequence analysis of present 12 kDa enzyme showed highest similarity (72.22 % identity) towards xylanase from *Neurospora crassa*.

Dr. Suman Khowala and group

Molecular mechanisms regulating production and secretion of carbohydrases in the fungus Termitomyces clypeatus

Objectives of the project are to study the regulatory mechanisms of production and secretion of cellobiase from filamentous fungus *Termitomyces clypeatus* influenced by intracellular processing and translocation of the enzymes by post-translational modification in presence of glycosylation inhibitors. Another approach is to understand the significance of hetero-aggregation of sucrase with cellobiase in the secretory pathway affecting activity, stability and conformation of the enzymes.

Interference of Sugars in the Coomassie Blue G Dye Binding Assay of Proteins and role of sugar saccharification by glycosidases. Coomassie Blue G dye binding assay for detection and quantification of proteins, popularly known as the Bradford assay is based on the ability of the dye to form complex with proteins employing both electrostatic & hydrophobic interactions. However, estimation of proteins in crude extracts by Bradford method often fails to tally with that in the purified form. Previous reports indicated that reagents like sodium dodecyl sulphate, guanidium hydrochloride, sodium ascorbate as well as few other naturally occurring compounds like flavones, rutin, etc. compete with proteins for binding and sequestering the leuko species of the dye. Interference by phenolic moieties of plant polysaccharides, tannins, dextran sulphates also has been reported for introduction of errors in the assay.

Findings in our laboratory indicated that presence of sugar molecules interfered strongly in this assay method by binding to the protonated dye species and mimicking the response shown by proteins towards the dye. It was demonstrated that the concerned dye, Coommasie Brilliant Blue G-250, is highly susceptible to interference of sugars. In mixtures of sugars and protein, interference of sugars was much higher than expected from their observed individual contribution in protein estimation (Table 6).

Contribution of mono, di, and polysaccharides were studied individually and in admixture with proteins. Three sets of sugars, namely A) Ficoll, sucrose and glucose, B) Carboxy methyl cellulose (CMC), Cellobiose and glucose, and C) Mannan, mellibiose and mannose were employed to interfere in Bradford complex formation by BSA.

Polysaccharides interfered more strongly than disaccharides and contributed to absorbance at 595 nm as is seen in Fig.16. Both di- and monosaccharides curbed the expected absorbance maximally, sucrose (32.5%) and glucose (31.5%) being the two most potent sequestering sugars. If sugar absorbance was not taken into account, it was observed that in all the three cases BSA in conjunction with sugars led to maximal positive interference (24.5%, 35.7% and 42.86% for sets A, B, and C respectively). However, after sugar compensation the same values dropped drastically to 7.5 % negative deviation,

14.3% positive deviation & 3.6 % negative deviation respectively. Individually, the polysaccharides in conjunction with BSA, caused maximal positive interference as expected from their dye response curves (Fig. 16) (42.86% and 21.4 % being the highest in case of CMC for both types of deviations). Glucose caused maximal decrease (31.5% for both cases) without individually showing any absorbance. Mixtures of sugars led to net deviation in the absorbance in a complex manner depending upon their composition, but irrespective of their individual contribution as well as their concentration.

Table 6. Interference of Sugars in the Coomassie Blue G Dye Binding Assay of Proteins

A: Absorbance of BSA /sugar /sugar mixture

Components	Protein (µg)	Components	Protein (µg)	Components	Protein (µg)
BSA (2 µg)	2.0 (a)	BSA (2.8 µg)	2.8 (a)	BSA (2.8 µg)	2.8 (a)
Ficoll (F) 15mg	0.4 (b)	CMC (C) 30mg	0.6 (b)	Mannan (Mn) 1mg	0.6 (b)
Sucrose (S) 180mg	0.24 (b)	Cellobiose (Cb) 40mg	0 (b)	Melibiose (Mb) 30 mg	0.2 (b)
Glucose (G) 180mg	0.0 (b)	Glucose (G) 180mg	0.0 (b)	Mannose (M) 180mg	0.5 (b)
F + S + G	0.6 (b)	**C + Cb + G**	1.8 (b)	**Mn + Mb + M**	1.2 (b)

B: Contributions in heterogeneous admixture

Protein equivalence of BSA (g)

Complexation mixture	A Calculated Values	B Observed Values [Deviation in %]	C Deviation A (%) (c-a) / a x 100	D Calculated values after sugar compensation	E Deviation B (%) (d-a) / a x 100
	a + b	c		|c – b| = d	
BSA +Ficoll (F)	2.4	2.32 ↓ [3.5]	16.0 ↑	1.92	4.0 ↓
BSA +Sucrose (S)	2.24	1.51 ↓ [32.5]	24.5 ↓	1.27	36.5 ↓
BSA + Glucose (G)	2.0	1.37 ↓ [31.5]	31.5 ↓	1.37	31.5 ↓
BSA+ [F + S]	2.64	2.41 ↓ [8.7]	20.5 ↑	1.77	11.5 ↓
BSA+ [F + G]	2.4	2.4 [0.0]	20.0 ↑	2.0	0.0
BSA+ [S + G]	2.24	1.62 ↓ [27.6]	19.0 ↓	1.38	31.0 ↓
BSA+ [F + S + G]	2.6	2.49 ↓ [4.2]	24.5 ↑	1.85	7.5 ↓
BSA + CMC (C)	3.4	4 ↑ [17.6]	42.86 ↑	3.4	21.4 ↑
BSA + Cellobiose (Cb)	2.8	2.7 ↓ [3.6]	3.57 ↓	2.7	3.5 ↓
BSA + Glucose (G)	2.8	2.5 ↓ [10.7]	10.71 ↓	2.5	10.7 ↓
BSA + [C + Cb]	3.4	3.8 ↑ [11.8]	35.71 ↑	3.2	14.3 ↑
BSA+ [C + G]	3.4	3.8 ↑ [11.8]	35.71 ↑	3.2	14.3 ↑
BSA+ [Cb + G]	2.8	3.5 ↑ [25.0]	25.0 ↑	3.5	25.0 ↑
BSA + [C + Cb + G]	4.6	3.8 ↓ [17.4]	35.71 ↑	3.2	14.3 ↑
BSA + Mannan (Mn)	3.4	3.1 ↓ [8.8]	10.71 ↑	2.5	10.7 ↓
BSA + Melibiose (Mb)	3.0	2.7 ↓ [10.0]	3.57 ↑	2.5	10.7 ↓
BSA + Mannose (M)	3.3	2.6 ↓ [21.2]	7.14 ↓	2.1	25.0 ↓
BSA + [Mn + Mb]	3.6	3.4 ↓ [5.5]	21.43 ↑	2.6	7.1 ↓
BSA + [Mn + M]	3.9	3.1 ↓ [20.5]	10.71 ↑	2.0	28.6 ↓
BSA + [Mb + M]	3.5	3.3 ↓ [5.7]	17.86 ↑	2.6	7.1 ↓
BSA + [Mn+ Mb + M]	4.0	4.0	42.86 ↑	2.7	3.6 ↓

Absorbance values of BSA and respective sugars were determined both individually (Data set "a" and "b" of Table 6, Part I) and in conjunction (Data set "c" of Table 6, Part II). Percentage deviations of observed values of (c) from expected values (a+b) were determined. The values in columns A and B were interpreted from the OD_{595} values in terms of µg equivalence of BSA as standard. Column B corresponded to the theoretically predicted amount of BSA after compensating for the interference of each sugar. The deviations were obtained individually for each sugar. Deviation A (Column C) from actual amount of BSA was calculated by subtracting the µg equivalence of BSA from that in conjunction with sugar. Deviation B (Column D) was calculated by first subtracting the µg equivalence (in terms of BSA) of individual sugars from that in conjunction with BSA and then using the value to calculate deviation from actual amount of BSA.

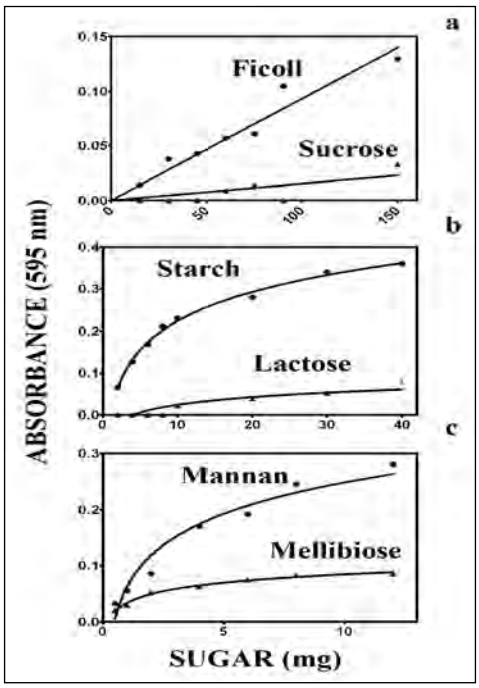
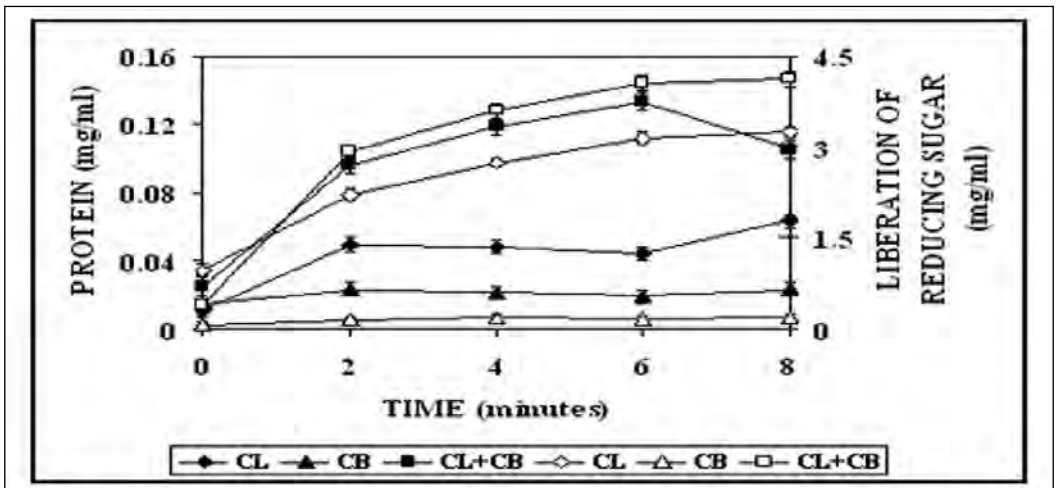


Fig. 16 : Bradford calibration curves of sugars of major poly (ı) & disaccharides (ꞩ). The graphs were plotted in GraphPad Prism software (ver 5.01) and Correlation co-efficients were calculated simultaneously. All the graphs were plotted with non-linear regression (curve fit) function employing the least square method best fit approach; figure 1a was plotted in a "line through origin" mode, whereas figure 1b and 1c were plotted in semi-logarithmic modes. The R^2 values were calculated as 0.9255 and 0.5962 for ficoll and sucrose respectively; 0.9527 and 0.9883 for mannan and mannose respectively; 0.9947 and 0.8237 for starch and lactose respectively.

In order to have a better understanding about the behaviour of sugars in this aspect of the study, the activity of a fungal hydrolysate consisting of a mixture of glycoproteins over a known polysaccharide for defined time periods was tested (Fig. 17). As the degree of polymerization of the polysaccharide along with other sugars already in the hydrolysate would go on decreasing over time, there was a competition among the product sugar species generated to bind to the dye leuko form. A protein from its commercially available crude form precipitated with TCA, resolubilised in a non-interfering, non-denaturing buffer and quantified with Bradford reagent both before and after precipitation gave radically different protein equivalence. A competitive response among the sugar species and the protein molecules to occupy the protonated leuko form of the dye was observed. Complex formation by sugar is instantaneous and does not require an acidic to neutral pH transition as opposed to proteins whose

absorbance was arrested by about 45% at pH 2.0. In a digestion mixture of polysaccharides with glycosidases, where the degree of polymerization of the sugars decrease with time, the absorbance at 595 nm increases significantly (Fig. 17). Proteins after precipitation from fungal culture broths showed 2 to 4 times increased yield.



Incubation time (min)		2	4	6	8
Degree of polymerization	CL	13.68	6	4.84	4.21
	CB	238.6	90.67	74.73	83.44
	CL+CB	32.54	4.21	3.42	3.03

Fig. 17 : Effect of enzymatic saccharification of polysaccharide on dye sequestration in protein assay. Protein: CL ; CB ; CL+CB . Liberation of reducing sugar: CL ◊ ; CB Δ; CL+CB Hydrolysis of Carboxy Methyl Cellulose (5%, w/v) was carried out with fungal cellobiase from *Termitomyces clypeatus* (3 U/ml), Commercial cellulase (3 U/ml) & a mixture of both the enzymes having 3 U/ml of activity each at 40°C in 100 mM sodium acetate buffer. 1 ml aliquots were removed from the incubation mixtures initially after 1 minute and subsequently at every 2 minutes interval. Protein content and liberated reducing sugar of each aliquot were measured to monitor the protein and sugar status of the incubation mixtures. Parallel control incubations were carried out for respective sets with both the enzymes and the substrate individually and net absorbance values were used for further calculations. The fungal cellobiase contained mixtures of basal endo-glucanase and FPase activities. Total sugar liberated as determined by orcinol assay was found to be constant during the entire incubation period for each of the 3 sets and were of the following values (mg/ml): CL-13.26; CB-13.6; CL+CB-12.3.

All the studies confirmed the proposition that sugar molecules interfered strongly in the Bradford dye-binding assay of proteins. It was concluded that actual protein concentrations can be ascertained by precipitating from their crude extracts and resolubilising in a non-interfering buffer.

Regulatory effects of glycosylation inhibition on activity and secretion of glycosidases.

Intracellular post-translational modification by glycosylation is known to affect biochemical and biophysical properties of glucosidases in *Termitomyces clypeatus*, a filamentous fungus. The fungus produced a number of carbohydrases majority of them are glycosylated. In presence of glycosylation inhibitor 2-deoxy-D-Glucose lignocellulolytic activity of enzymes (xylanolytic and cellulolytic) increased and also there biochemical properties were influenced. The enzyme produced under restricted glycosylation showed better activity towards lignocellulose and also had better stability towards salts and detergents.

Co-aggregation of cellobiase and sucrase in the fungus T. clypeatus. Sucrase is a secretory enzyme of the filamentous fungus Termitomyces clypeatus which presents an altogether unique perspective in protein aggregation studies. In the fungus T. clypeatus the enzyme was produced constitutively along with cellobiase (C), another secreted enzyme of the fungus, and was intrinsically associated with the later. This association as coaggregation regulated the activity, stability and conformation of both the enzymes. To understand the regulatory role of sucrase with cellobiase on activity and secretion of enzymes and to get increased sucrase titer, production of sucrase was tried in defined media containing high sucrose as carbon source. It was observed that in high sucrose medium production of sucrase increased but with least amount of cellobiase activity in extracellular medium.

The extracellular sucrase (S5) from the culture filtrate of filamentous basidiomycota *Termitomyces clypeatus* grown on high sucrose (5%, w/v), was purified by gel filtration chromatography, ion exchange chromatography and HPGPLC (Fig. 18). The biochemical properties, molecular weight and conformation of sucrase produced were significantly different from the sucrase (S1) earlier purified from sucrose (1%, w/v) medium in the fungus. Purified sucrase was characterized as a low molecular weight protein of 13.5 kDa as approximated by HPGPLC (Fig. 18c) and SDS-PAGE (Fig. 19) and exhibited predominantly random coil conformation in far-UV CD spectra.

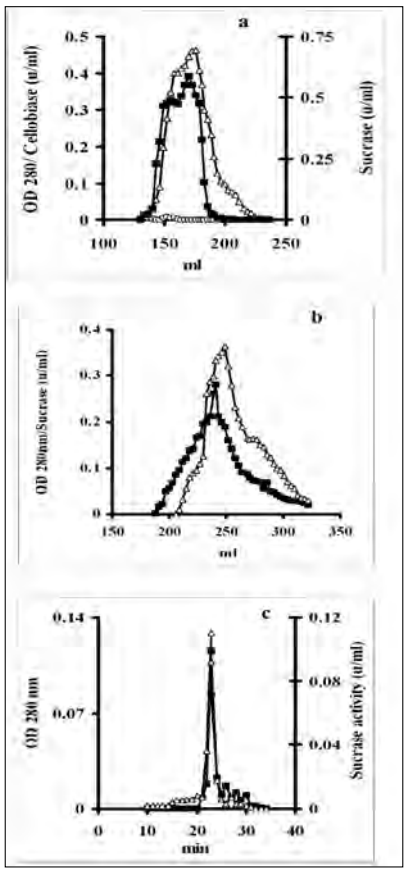


Fig. 18 : Purification of sucrase (S5) of *T. clypeatus.* (a) Sephacryl S-200 chromatography: Extra-cellular proteins (4mg/ml) obtained from filtrate of step 2 was applied to the column in batches and fractions (2 ml) were monitored for A_{280} (-Δ-), Sucrase (-▫-) and Cellobiase (-○-). (b) Ion exchange chromatography: 15mg protein from Pool 1 step3 was equilibrated with 0.01M acetate buffer, pH 5.0 and applied to the column. Enzyme fractions (2 ml) were collected as washings and were monitored for A_{280} (-Δ-), and Sucrase (-▫-). (c) High Perfomance Gel Permeation Liquid Chromatography: Sucrase (120µg) from step 4 was analysed on Protein Pak TSK G2000SW column. Fractions were collected every minute and were monitored for A_{280} (-Δ-), and Sucrase (-▫-).

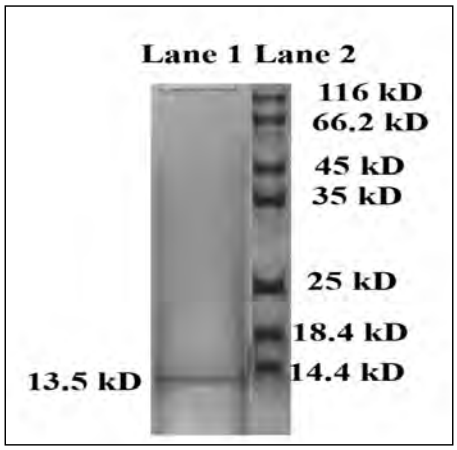


Fig. 19 : SDS-PAGE of purified sucrase (S5). HPGPLC peak enzyme (30µg protein) from step 5 was loaded to 12% SDS-PAGE. Lane1: HPGPLC peak sucrase of 5% sucrose media, Lane2: Molecular weight markers (5µg protein) comprising mixture of denatured β-galactosidase 116.25kDa; serum albumin 66.2kDa; ovalbumin 45kDa; lactate dehydrogenase 35kDa; Restriction endonucleases (Bsp 981) 25kDa; β-lactoglobulin 18.4 kDa; lysozyme 14.4kDa

The enzyme was optimally active at 47°C and pH 5.0. K_m and catalytic activity of the enzyme for sucrose was found to be 3.5 mM and 1.06 U/mg/mM respectively. The enzyme was maximally active towards sucrose than to raffinose (Table 7) and sucrase activity was significantly inhibited by bivalent metal ions and reducing group agents. The results indicated that due to changes in aggregation pattern, molecular organization of purified sucrase, produced in high sucrose medium, was altered and was different from the previously reported enzyme.

Table 7. Substrate specificity of sucrase

Substrate (4mM)	Percentage relative activity	
	S1	S5
Sucrose	100	100
Raffinose	6.0 + 0.6	3.2 + 0.5
Methyl-β-D glucopyranoside	—	0.73 0.1

Purified S1 and S5 with specific activities 4.78U/mg and 12.3U/mg respectively measured with sucrose were assayed by incubating with respective substrates at optimum temperature and pH. Values represent mean ± standard error of mean of three sets of duplicates.

This is the first report of a sucrase of such low size showing activity. Sucrase is mainly used in the food (confectionery) and alcohol industry, especially in syrup production from sugar (sucrose) where fructose is preferred over sucrose, because it is sweeter and does not crystallize as easily and in production of alcohol from molasses by fermentation. All the above studies point towards novel aggregation patterns of these secreted glycohydrolases delineation of which will help us better understand the protein-protein aggregation phenomenon.

Biotechnology of conversion of lignocellulose for production of bioethanol. Use of bio ethanol as a source of energy would be more than just complementing for solar, wind and other intermittent

renewable energy sources in the long run. During the last two decades, advances in technology for ethanol production from biomass have been developed to the point that large-scale production will be a reality in next few years. In our country, the largest resources for biomass energy today are found in industry; they include residues from pulp and paper mills, scrap wood and wood chips from the forest products industry, and agricultural residues. In search of new agro-residues we selected Tamarind kernel powder (TKP) and introduce it as a soluble and renewable source of energy by using as substrate for production of lignocellulolytic enzymes. TKP was used without any pretreatment for the study. It was observed that the raw material supported excellent growth of the fungus and had promising capability to produce the range of cellulolytic and hemicellulolytic enzymes in appreciable titers. Work to optimize production and application of glycosidases for saccharification of lignocellulose is ongoing.

Dr. Sharmila Chattopadhyay and group

Medicinal plants and metabolic engineering

Podophyllum hexandrum is a frontline medicinal herb of significant pharmaceutical interest. The rhizomes of this plant are known to contain several lignans. In particular, podophyllotoxin, the diarylnapthelene group of lignan, is the predominating compound and the active ingredient used as the starting compound for the chemical synthesis of etoposide (VP-16-213), and teniposide (VM-26) and ethophos that are used for the treatment of lung and testicular cancers. Leaf-generated calli (Fig. 20) was used to establish the cell suspension culture in MS liquid medium. MeJA was added to this culture at different concentrations on the third day of culture. Accumulation of podophyllotoxin and its related compounds was noted at higher concentration with 100 µM methyl jasmonate (MeJA) treated cell suspension culture. The subtracted library was constructed using MeJA treated cell suspension culture as the tester and control cell suspension culture as driver according to the manufacturer's instruction. The SSH procedure efficiently selected tester over driver cDNAs (Fig. 21a). The recombination efficiency was 72.2 % and the insert length ranged from 200-900 bp (Fig. 21b). A total of 260 clones were randomly picked up for further analysis. Of these, 252 ESTs were successfully sequenced, and BLASTN was performed against NCBI GenBank database.

Glutathione is an antioxidant, immune booster and detoxifier, without it, our cells would disintegrate from unrestrained oxidation, our body would have little resistance to bacteria, viruses and cancer, and our liver would shrivel up from eventual accumulation of toxins. GSH intake in excess amount is implicated in decreasing the risk of several degenerative diseases like aging, cancer etc. Transgenic manipulations of the glutathione biosynthetic pathway either in microbial or plant system have yet to be reported with a view of the development of genetically modified neutraceuticals (Fig. 22). In this study, we developed transgenic pudina with altered GSH content with a view to make this medicinal metabolite readily available for human consumption. Standard protocol of Agrobacterium-mediated transformation was used which was further standardized in our laboratory. In brief, explants were incubated with recombinant *A. tumefaciens* LBA4404 harbouring γ-ECS-pCAM for 30 minutes at 28°C, and regenerated on MS+NAA+BAP+Kan+Cepho (mg/l). KAN^R regenerated shoots were transferred to $^1/_2$ MS liquid medium to regenerate root to obtain transgenic plants (Fig. 23a-c).

Natural antioxidants are in great demand as neutraceuticals and as dietary supplements. Results showed that *Phyllanthus spp.*, is an edible source of natural antioxidant in terms of ROS scavenging (Table 8) and oxidative DNA damage preventive activity (Fig. 24).

Fig. 20 : Leaf-generated calli of *P. hexandrum* in MS medium supplemented with NAA and BAP.

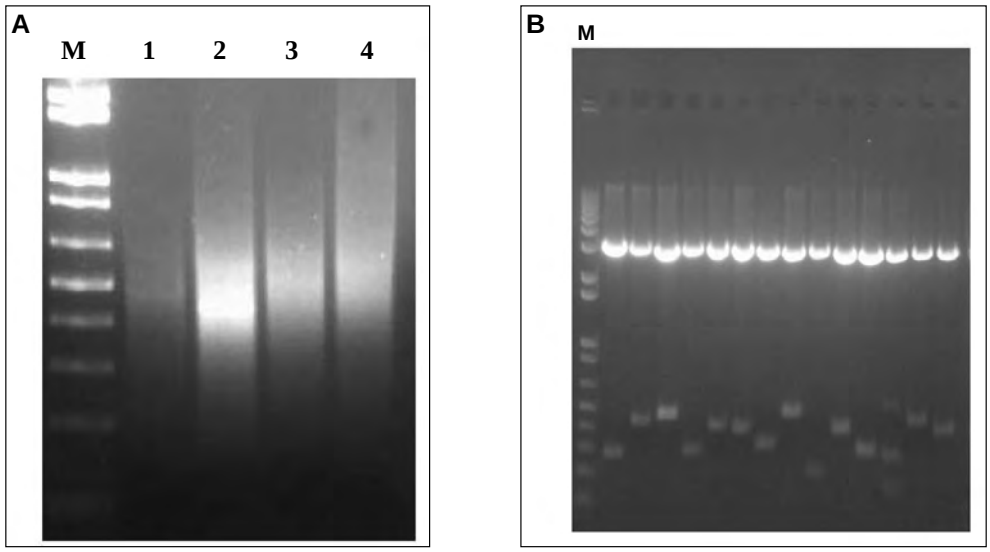


Fig. 21 : Suppressive Subtractive Hybridization (SSH) of P. hexandrum. 2 µg of mRNA from total RNA of cell mass, harvested from treated and control suspension cultures were subtracted. The secondary PCR products were cloned into pGEM-T Easy vector and independent clones were analyzed and subsequently sequenced. **a** Primary and secondary PCR products of subtracted and unsubtracted tester control. **b** Analysis to check the presence and size of inserts of clones after digestion with *EcoRI*.

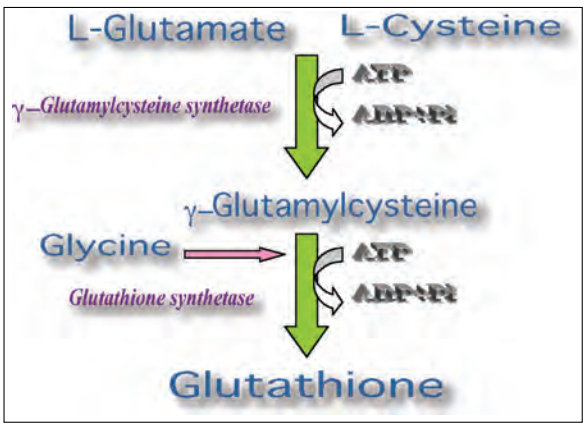
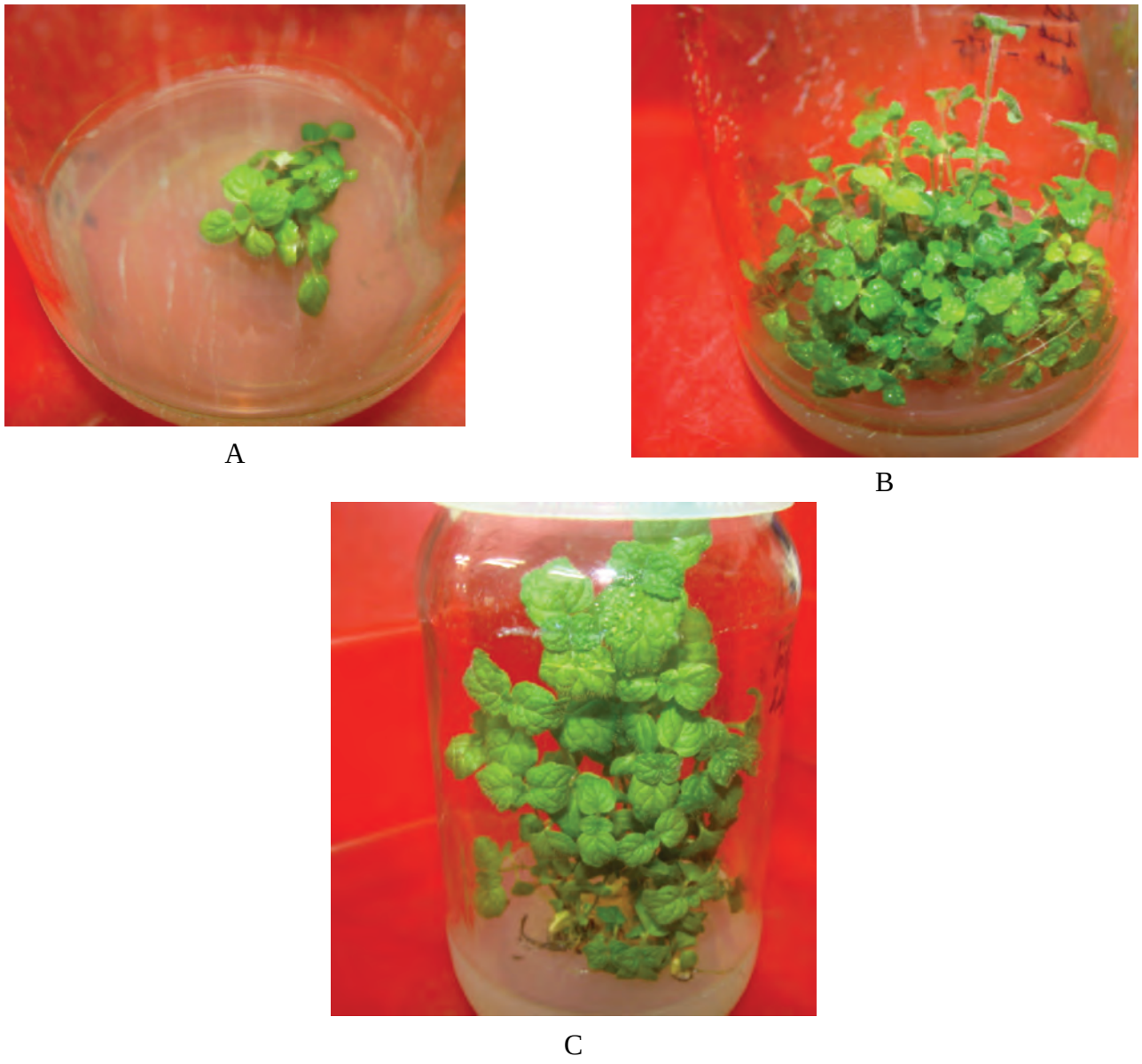


Fig. 22 : Biosynthetic pathway of Glutathione



A

B

C

Fig. 23 : Transgenic *M. arvensis*, (A) 4-weeks old, (B) 8-weeks old and (C) 12-weeks old.

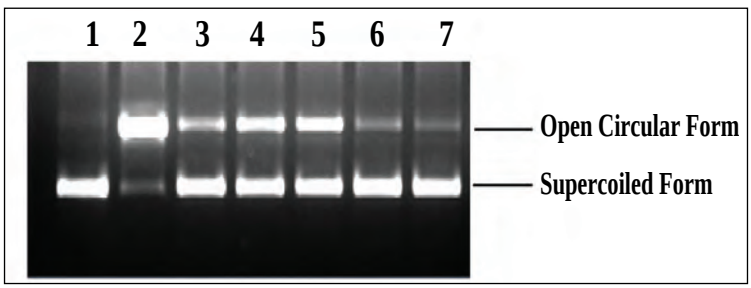


Fig. 24 : Electrophoretic pattern of pBluescript II SK (-) DNA breaks by OH generated from Fenton reaction and prevented by BF. Lane 1: untreated control DNA (250 ng), lane 2: $FeSO_4$ (0.5mM)+ H_2O_2 (25 mM)+ DNA (250 ng), lane 3: only H_2O_2 (25mM)+DNA (250 ng), lane 4: only FeSO4 (0.5mM)+DNA (250 ng), lane 5-7: $FeSO_4$ (0.5mM)+ H_2O_2 (25 mM)+ DNA (250 ng) in the presence of quercetin (1 mM), BF (0.5 and 10 µg) respectively.

Table 8. Comparative profile of IC_{50} (µg/ml) in free radical scavenging potential of *Phyllanthus* spp.

Samples	Bioactivity			
	$ABTS^{\circ+}$	$DPPH^{\circ}$	$^{\circ}OH$	$O_2^{-\circ}$
PH	0.5 ± 0.453	14.5 ± 2.56	60.1 ± 7.83	428.73 ± 10.4
WF	23.5 ± 3.42	48.03 ± 1.1	93.6 ± 5.33	194.07 ± 7
BF	21.89 ± 0.72	63.42 ± 1	38.65 ± 10.7	413.12 ± 2.5
Quercetin	1.38 ± 0.04	3.35 ± 0.07	5.83 ± 0.82	18.59 ± 1.43

*ND Not determined.

Technical Officers

Dr. (Mrs.) Shila E. Besra, Dr. Ardhendu K. Mandal, Dr. Ramdhan Majhi, Mrs. Dipika Roy.

RAs etc.

Dr. (Mrs.) Mrinalini Bhattacharya, Dr. (Mrs) Anamika V. Sharma, Dr. (Miss) Neela Sen Gupta, Dr. (Mrs.) Archita Saha, Dr. Sibani Sarkar.

Research Fellows

Mr. Debopam Acharya, Mrs. Papiya Ghosh, Ms. Anindita Debnath, Mr. Shubho Dasgupta, Ms. Soma Roy, Mr. Krishnendu Ganguly, Mr. Sumit Paul, Mr. Laishram Pradeep Singh, Mr. Sanjib Dey, Mr. Amartya Mishra, Mr. Sudip K. Kar, Mr. Dipto Bhattacharya, Ms. Ragini Sinha, Ms. Shakuntala Ghorai, Ms. Swagata Pal, Mr. Samudra Prosad Banik, Ms. Aparajita Ghosh, Miss.Tanaya Das, Ms. Poulami Karmakar, Ms. Anindita Banerjee, Ms. Srijani Ghanta, Avijit Poddar, Mr. Deepak Verma,

Project Assistants

Ms. Ipsita Pal, Ms. Sumana Mallick, Mr. Shamik Bhattacharya, Mr. Tathagata Gupta, Mr. Subhasis Banerjee, Mr. Dhananjay Soren, Ms. Anwesha Majumdar, Mr. Sagar Lahiri, Ms. Trina Dutta, Ms. Shakri Banerjee, Ms. Soumya Mukherjee, Ms. Baishali Guha, Ms. Arpita Maity, Mr. Rajib Mazumdar, Ms. Swarupa Ghosh, Ms. Debasree Ghosh, Ms. Somsubhra Thakur Chowdhury.

Summer Trainees

Ms. Priyashi Bhowmick, Ms. Sarmistha Pal, Ms. Rushna Firdaus, Ms. Samhita Bose, Ms. Rituparna Majumder, Ms. Suhana Chattopadhyay, Ms. Kamalika Ganguly, Ms. Sandrayee Brahma, Ms. Upasana Sen Gupta, Ms. Progga Sen, Ms. Priyanka, Mr. Sourdipta Chatterjee.

Lab Attendant

Mr. Ashit Mitra, Mr. Shyamal Das.

Atomic Force Microscope

Recently installed, 5500 AFM from AGILENT TECHNOLOGIES which is based on a Olympus IX51 microscope for doing experiments at atomic resolution

Atomic Force Microscope

Rigaku Compact HomeLab(tm) single crystal X-ray diffraction system for protein and macromolecular crystallography, the Rigaku Compact HomeLab enables crystal screening through complete protein structure solution in a small-footprint, energy-efficient package

CHEMISTRY

Drs. V. S. Giri, S. B. Mandal, Asish K. Sen, B. C. Pal, A. K. Sen (Sr.), Ajoy K. Banerjee, S. Mukhopadhyay, P. Chattopadhyay, G. Suresh Kumar, S. Bandyopadhyay, N. B. Mondal, B. Das, P. Jaisankar, R. Mukhopadhyay, Ashis K. Banerjee, R. C. Yadav, Chinmay Chowdhury, Arindam Banerjee, Biswadip Banerjee and S. Garai

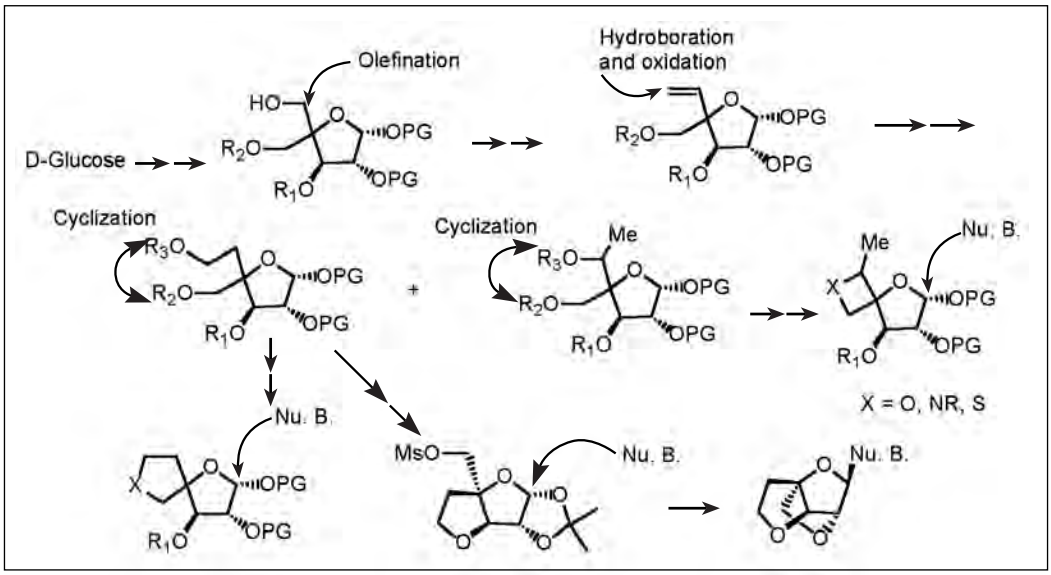
The Chemistry department strives to provide meaningful contribution to Chemical Biology research by the application of principles of chemistry in a sustainable manner. We target our activities to add value to our abundant natural resources, by harnessing them to develop new drugs and related materials from locally available medicinal plants for the treatment of some major diseases working in collaboration with other groups of this institute. Keeping with this mandate the current research activities of this department are oriented on various aspects of synthetic and natural product chemistry, viz. synthesis of novel nucleotides, chiral heterocycles, benz-annulated medium size rings, synthetic studies on heterocyclic chemistry, novel synthetic routes (enantioselective synthesis) to natural products, synthesis of anti-leishmanial compounds, studies on bacterial cell surface antigens, plant polysaccharides and neoglycoproteins, chemical investigation of medicinal plants for bioactive substances and studies on nucleic acid binding properties of natural products. We also have adapted ourselves to Green Chemistry that will deliver more environmentally benign products and processes. Our expertise in natural products chemistry has attracted a number of collaborative industrial research programmes that established meaningful link with several major pharmaceutical industries. The department also has second mandate of teaching and providing guidance to a number of research fellows.

Dr. S. B. Mandal and group

Synthetic approaches to structurally novel nucleosides and analogues from D-glucose

The objective of the subproject is to develop synthetic routes to structurally unique spirocyclic, bicyclic and tricyclic nucleosides through manipulation of D-glucose derived precursors.

A synthetic approach to spirocyclic, bicyclic and tricyclic nucleosides: Paquette introduced the concept of spirocyclic restriction in nucleosides through insertion of a carbocyclic ring at C-4' of furanose/ thiofuranose rings. This was expected to fix the glycosyl torsional angle around the C-4' bond, while the void space below C-4' would be sufficient to avoid nonbonded steric superimposition. In addition, the free radical-induced degradation of the ribose ring of nucleosides by C-4'-H abstraction can be precluded. Various other synthetic routes to C-1'-spiro-, C-2'-spiro-, C-3'-spiro-, and C-4'-spiro-nucleosides as conformationally restricted or biased analogues have appeared in the literature. Some of these nucleosides display anti-HIV and antivirus activity. We have earlier reported on the synthesis of spironucleosides having 4- and 7-membered spiro rings at C-4' through nucleophilic substitution and intramolecular nitrone cycloaddition reaction. The work encouraged us to take up the synthesis of spirocycles based on five-membered heterocyclic rings from a D-glucose-derived precursor carrying two hydroxymethyl groups at C-4. One of these groups was planned to be utilized to introduce a vinyl group via oxidation and Wittig reaction, and then converted to a hydroxyethylgroup by hydroboration-oxidation reaction. Subsequent intra/intermolecular cyclization through the participation of oxygen, nitrogen, and sulfur nucleophiles (Scheme 1) was expected to furnish the desired heterocyclic systems. In the process, we also encountered newer 4,5-spirocyclic and bicyclo [3.3.0]octane systems. The products could be elaborated to interesting spirocyclic and bicyclic nucleosides in addition to an unexpected 5,5,5-tricyclic conformationally locked nucleoside.



Scheme 1. An approach to produce spirocyclic, bicyclic and tricyclic nucleosides

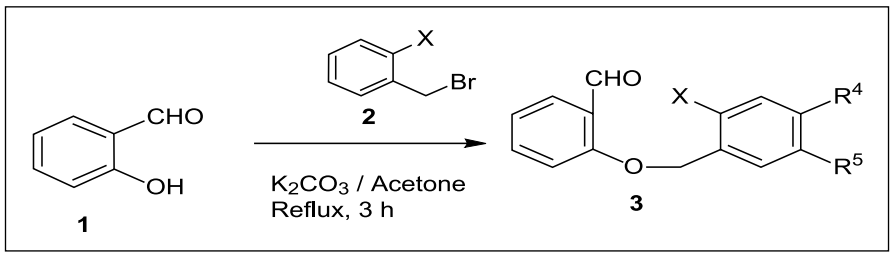
Synthesis of new classes of bioactive nucleosides by the application of appropriate reactions on carbohydrate skeletons will be the future program of this subproject.

Dr. Partha Chattopadhyay and group

Synthesis of annulated medium ring heterocycles

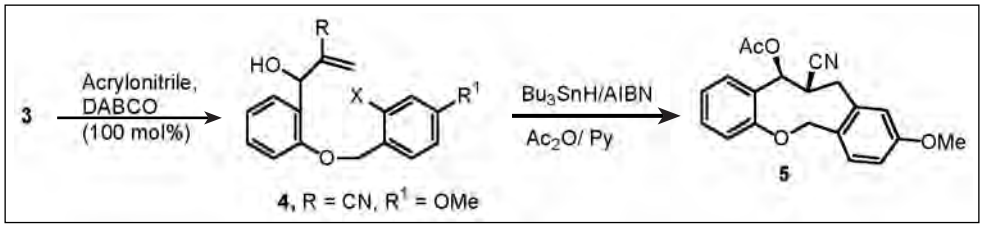
The principal objective of the subproject is to develop synthetic methodology for medium ring ethers or analogues possessing diverse biological properties. Towards this end, we have established a straightforward three-step synthetic route to dibenzofused nine-membered oxacycles using sequential Baylis-Hillman reaction and radical cyclization. These dibenzo medium ring heterocycles have pronounced activity as CNS suppressant and their application as cardioselective muscarinic antagonist is well known. Although several approaches to the synthesis of dibenzofused seven- or eight-membered compounds using RCM, Pd/Cu-induced cyclization or other methods have been reported in the literature, application of these methodologies to the preparation of nine- and ten-membered ring compounds are scarce.

The starting material **3** was prepared in 88-96% yield by benzylation of commercially available aldehyde **1** (1 equiv) with substituted 2-bromo or 2-iodo benzyl bromides **2** (1.2 equiv) using K_2CO_3 (5 equiv) in acetone (Scheme 2).



Scheme 2. Alkylation of hydroxy aldehyde with substituted halobenzyl bromide

Subsequent Baylis-Hillman reaction of the aldehyde **3** (Scheme 3) was carried out with a variety of activated alkenes in acrylonitrile (neat). Intramolecular radical cyclizations were carried out by drop wise addition of benzene solution of Bu_3SnH (1.5 equiv) and AIBN (5 mol%) to a refluxing benzene solution of the alkenes **4** under inert atmosphere. After purification, acetylation of the product followed by flush chromatography furnished the targeted tricyclic ethers **5** as the only isolable products in excellent yield.



Scheme 3. Baylis-Hillman reaction of 4 to generate 5

The stereochemistry of most of the oxonine derivatives could not be established by ^{1}H NMR spectroscopy due to their poorly resolved spectra apparently arising due to conformational mobility of the nine-membered ring. However the relative stereochemistry of **5b** could be unequivocally established by single crystal X-ray analysis (Fig. 1).

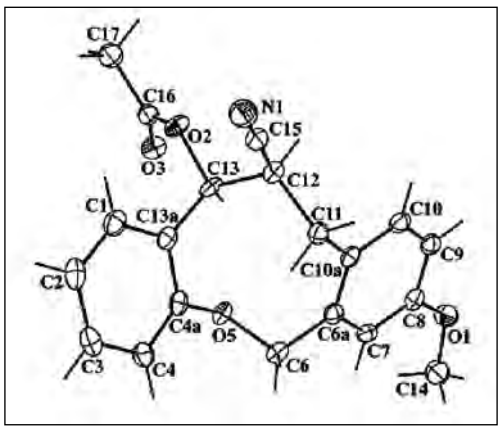


Fig. 1 : ORTEP diagram of 5

In another project, aldoximes reacted with α,β- unsaturated carbonyl and sulfonyl compounds in organized aqueous media (nanoreactor system) using dodecylbenzenesulfonic acid (DBSA) as surfactant to generate *N*-alkylated nitrones, which underwent intramolecular cycloaddition in the same pot with maleimides to furnish the desired cycloadduct in absence of any organic solvent and catalyst. Divinyl sulfones were successfully used for both N-alkylation and intramolecular cycloaddition, affording only one cycloadduct. This is a new example of green chemistry and provides a new aspect of reaction in water.

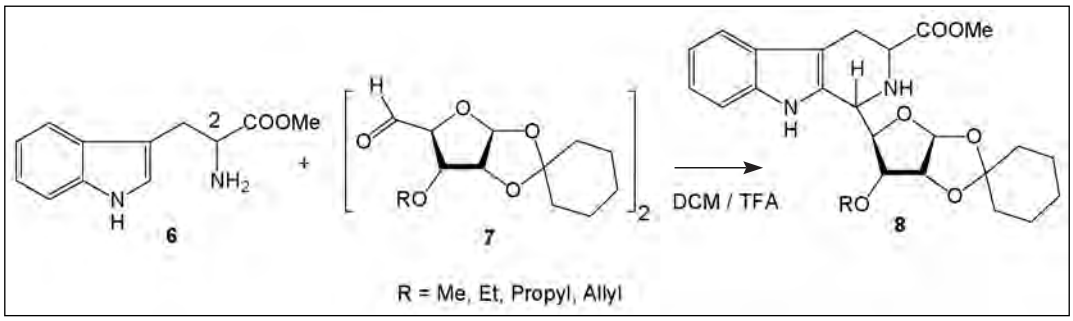
Dr. Venkatachalam Sesha Giri and group

Synthetic studies in heterocyclic chemistry

The aim of this group is to develop new methodologies for synthesis of indole and isoquinoline alkaloids. One of the most widely used method for preparing 1, 2, 3, 4–tetrahydro–β–carbolines is

the Pictet–Spengler condensation. The reaction has been used to prepare tetrahydroisoquinoline and tetrahydro–β–carboline intermediates for the synthesis of isoquinoline and indole alkaloids respectively. The reaction involves condensation of a carbonyl compound and a β-indolylethyl- or phenethyl- amine to form the corresponding Schiff's base which undergoes an intramolecular electrophilic attack leading to cyclization resulting in either the tetrahydro-β-carboline or tetrahydroisoquinoline framework containing molecule.

We have studied this reaction with 1,2-*O*-isopropylidene-3-alkoxy-α-D-xylofuranose derivatives **7** and observed that reaction with L-tryptophan methyl ester **6** gave the corresponding *cis* diastereomer as the major product whereas the same reaction with D-tryptophan methyl ester gave the *trans* diastereomer as the major product **8** (Scheme 4).



Scheme 4. Pictet-Spengler reaction between 6 and 7

CHEMISTRY

Dr. Asish Kr. Banerjee and group

Novel synthetic routes for natural products: Enantioselective approaches and radical cyclization strategies

(*R*)-Pantothenic acid (**9**) (a member of vitamin B complex), (*R*)-panthenol (**10**) (bactericide), (*R*)-pantetheine (**11**) constitute an important family for drug synthesis (Fig. 2). Recently, the novel *N*-acyl vinylogous carbamic (β-amino acrylic) acid containing molecule, CJ-15, 801 (**12**) was reported as an inhibitor of multi-drug-resistant (MDR) *Staphylococcus aureus* strain. Both (*S*) & (*R*)-pantolactone (**13a** and **13b**) are widely used as chiral auxiliary or chiral building block for the synthesis of a variety of natural products.

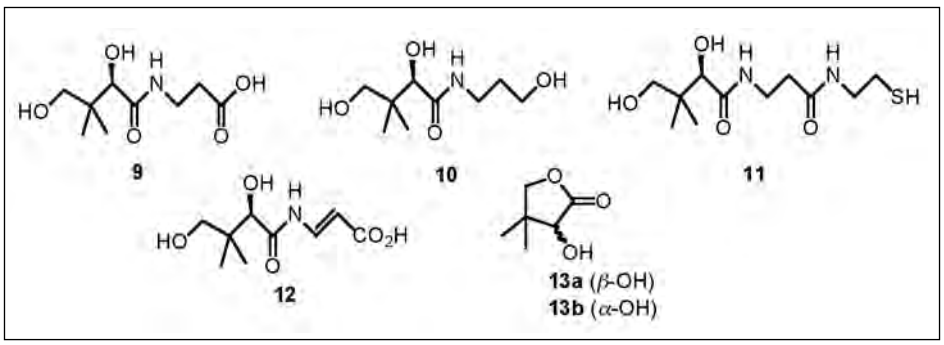
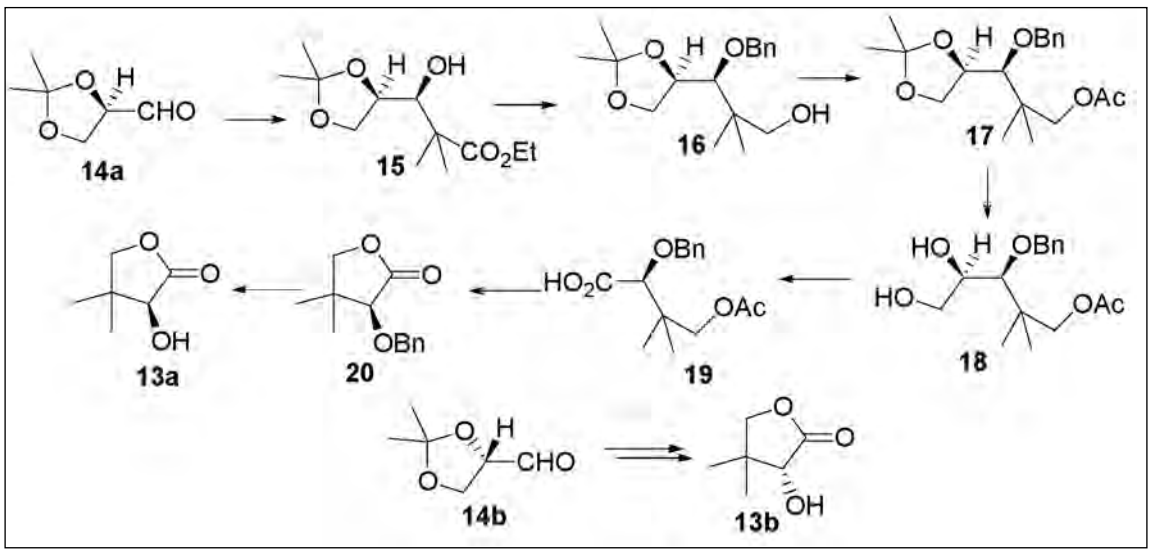


Fig. 2 : Structure of some important chiral compounds

The unique structural features and potential bioactivity of these molecules have triggered considerable synthetic activity in this class of compounds. We have taken up a research program to synthesise intermediates for some of these molecules as well as (*S*)- and (*R*)- pantolactone in optically pure form using different strategies.

Synthesis of (S)- and (R)- pantolactone: Synthesis of (*S*)-pantolactone (**13a**) starting from D-mannitol and (*R*)-pantolactone (**13b**) starting from L-ascorbic acid, both being commercially available cheap starting materials, is depicted in Scheme 5. Toward this end, (*R*)- glyceraldehyde acetonide (**14a**) prepared from D-mannitol was subjected to aldol reaction with ethyl isobutyrate to give hydroxy ester **15** as the major product. Benzyl protection of **15** followed by LAH reduction yielded alchol **16**, which on acetylation and subsequent deprotection of acetonide functionality of **17** gave the diol **18** in high yield. Oxidation of **18** with $NaIO_4$ produced an aldehyde, which was further oxidized to carboxylic acid **19** with $NaClO_2$. Deacetylation of this acid followed by lactonization provided the lactone **20**, which upon debenzylation of **12** produced (*S*)- pantolactone (**13a**). Similarly, (*R*)-pantolactone (**13b**) has been synthesized from (*S*)-glyceraldehyde acetonide (**14b**) following same sequence of steps as described for (*S*)-pantolactone.



Scheme 5. Preparation of enantiomerically pure pantolactones

It is noteworthy that both the enantiomeric intermediates (-)-**19** & (+)-**19** can be utilized towards the synthesis of pantothenic acid (**9**), panthenol (**10**), pantetheine (**11**), and antibiotic CJ-15, 801 (**12**); the work is in progress.

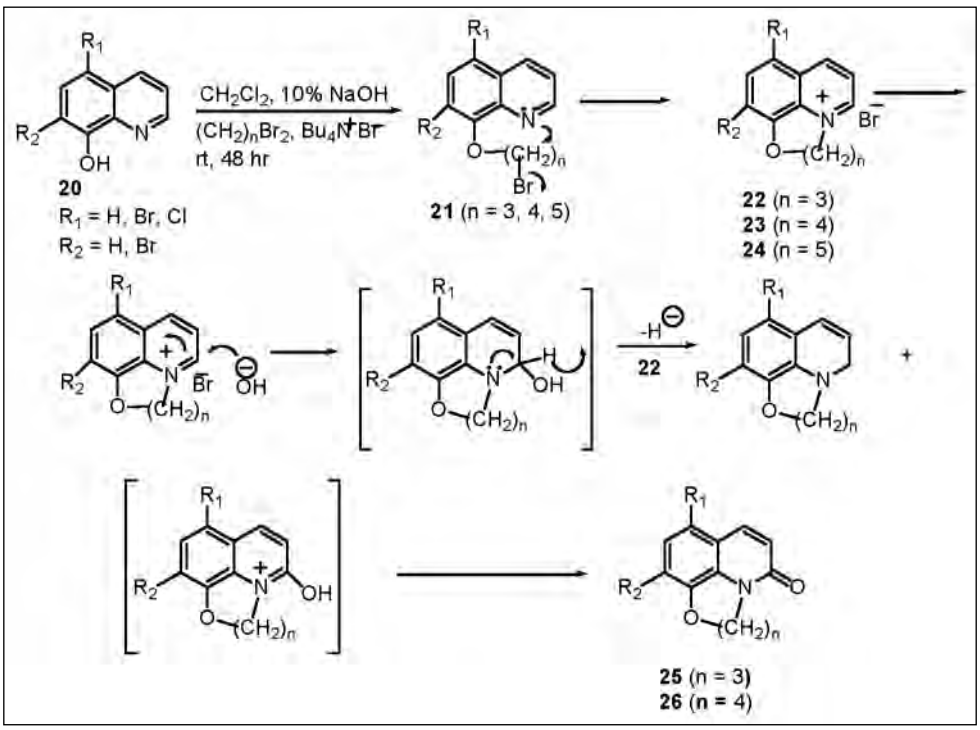
Dr. Nirup Bikash Mondal, Dr. Sukdeb Bandyopadhyay and group

Synthesis of structurally unique bioactive heterocycles

The main aim of the group is to synthesize pharmaceutically important heterocyclic compounds and analogues.

Main findings: Syntheses of *N*-heteroaromatic cations, which often form the framework of DNA intercalating agents, were carried out. In this perspective, molecules containing quinolinium core

constitute one of the important subsets of heteroaromatic cations. Phase transfer catalyzed one-pot syntheses of fused oxazepino, oxazocino, and oxazonino quinolinium cations and quinolones were achieved (Scheme 6) from 8-hydroxy quinoline derivatives with 1, ω-dihaloalkanes. Single crystal X-ray crystallographic analysis of three compounds and graphical superposition of the structures (Fig. 3) indicate that products having seven membered rings are less planar compared to the product having eight-membered ring. The plausible mechanism of formation of the products has also been established.



Scheme 6. A plausible reaction pathway leading to quinolone analogues

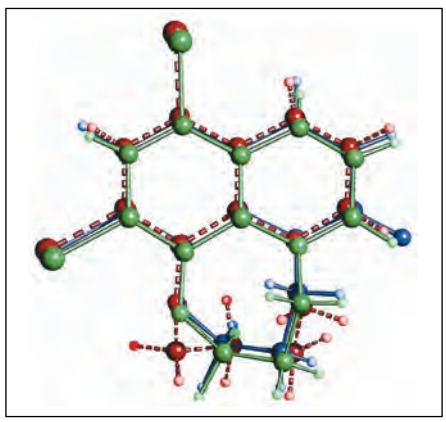
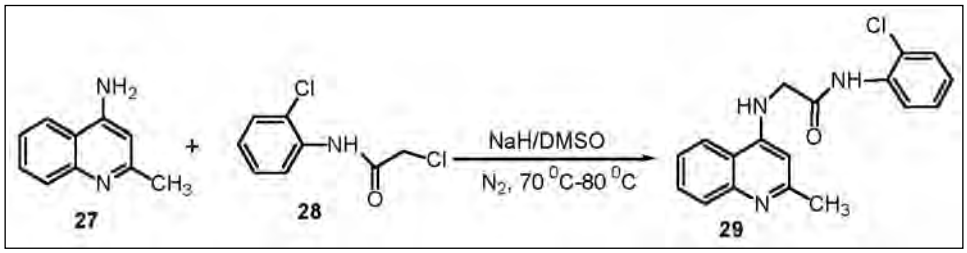


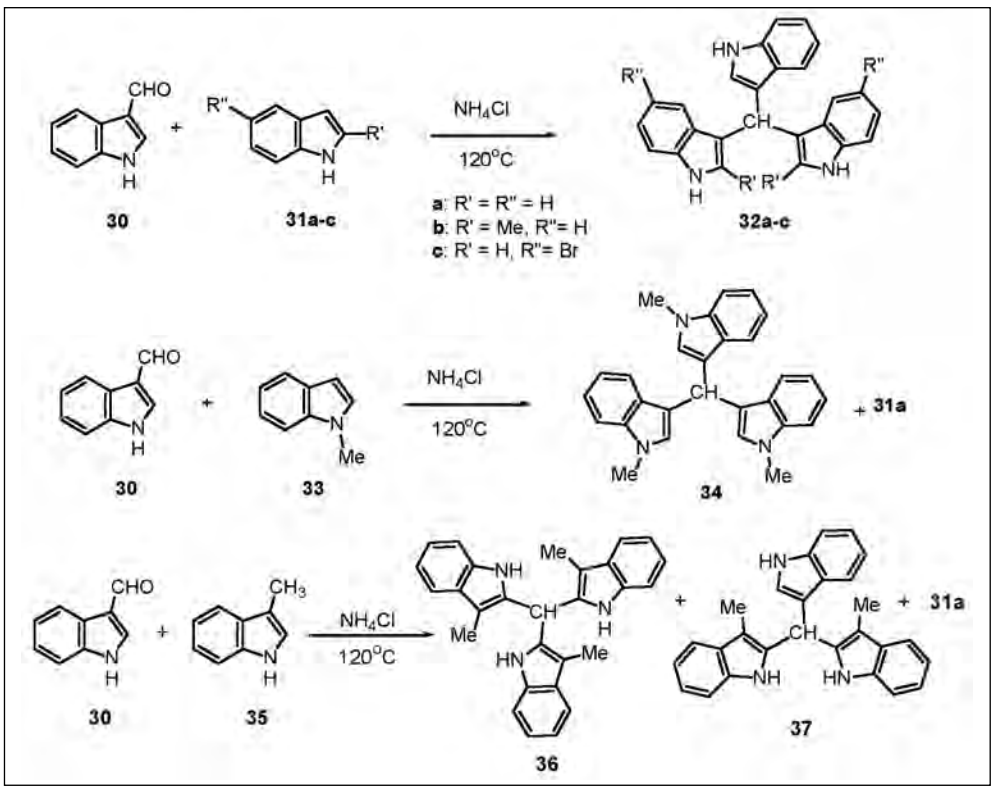
Fig. 3 : Graphical superposition of 22 (in green) 25 (in blue) and 23 (in red, dashed), SCHAKAL drawing

2-(2-Methyl-quinoline-4-ylamino)-*N*-(2-chlorophenyl)-acetamide (**29**), a novel anilidoquinoline derivative, was synthesized (Scheme 7) from the reaction between **27** and **28** and evaluated for its therapeutic efficacy in treating Japanese Encephalitis Virus (JEV). The compound showed significant antiviral and anti-apoptotic effects in vitro. Significant decreases in viral load ($P < 0.01$) combined with an increase in survival was observed in Japanese encephalitis virus-infected mice treated with 2-(2-methyl-quinoline-4-ylamino)-*N*-(2-chlorophenyl)-acetamide.



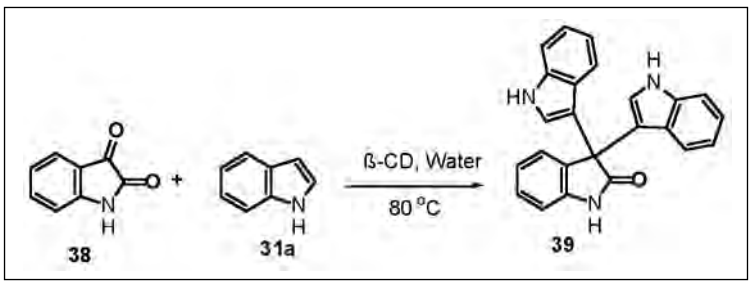
Scheme 7. Synthesis of a novel anilidoquinoline derivative

The synthesis of various triindolylmethanes from indole-3-carboxaldehyde, using indole derivatives as reactants and NH_4Cl as catalyst under solvent-free conditions was achieved. This methodology provides access to both symmetrical and unsymmetrical triindolylmethanes in excellent yields (Scheme 8). With *N*-methylindole particularly, indole-3-carboxaldehyde appears to act as a formyl donor, leading to the exclusive formation of a symmetrically trisubstituted product. The novelty of the methodology lies in its operational simplicity, environment friendly reaction conditions, and inexpensive and easy availability of the catalyst.



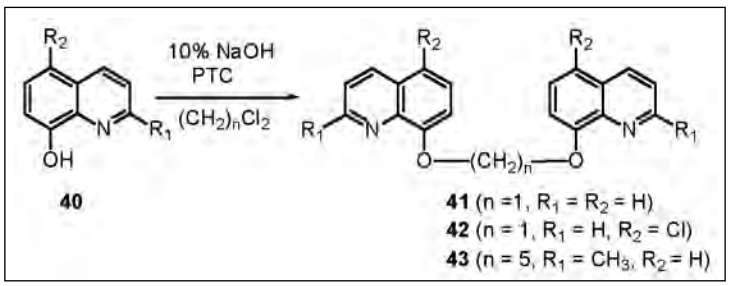
Scheme 8. NH_4CI catalyzed reaction with various indole derivatives

A high yielding green protocol is described for the synthesis of 3,2 and 3,3 diheteroaromatic oxindoles involving the condensation of isatin with indole or pyrrole in an aqueous medium under neutral conditions by supramolecular catalysis using β-cyclodextrin (Scheme 9). The β-cyclodextrin can be easily recovered and reused without any loss of activity.



Scheme 9. A synthetic approach to 3, 3-disubstituted oxindole

A one-pot synthesis of some novel bis-quinolines has been achieved under phase transfer catalyzed conditions using 8-hydroxy quinoline derivatives **40** as substrates (Scheme 10). The synthesized analogues were evaluated for antileishmanial activity against *Leishmania donovani* promastigotes and amastigotes. The entire bis-quinolines showed efficacy in both *in vitro* and *in vivo* studies. Compound **42 (**1,1-Bis- [(5-chloro-8-quinolyl)oxy]methane) exhibited most significant activity. Compound **41** (1,1-Bis-[(8-quinolyl)oxy]methane) and **43** (1,5-Bis-[(2-methyl-8-quinolyl)oxy]pentane) also demonstrated significant leishmanicidal efficacy against established visceral leishmaniasis in BALB/c mouse model. Ultra structural studies of promastigotes treated with compound **42** demonstrated membrane blebbing, chromatin condensation and vacuolization in the parasites and the flagellated parasites became round shaped after treatment. Moreover, *in vitro* antibacterial activity of the compound against several bacterial strains revealed its promising efficacy. The findings suggested that **42** is a bright candidate to be considered as lead compound for leishmanicidal drug.



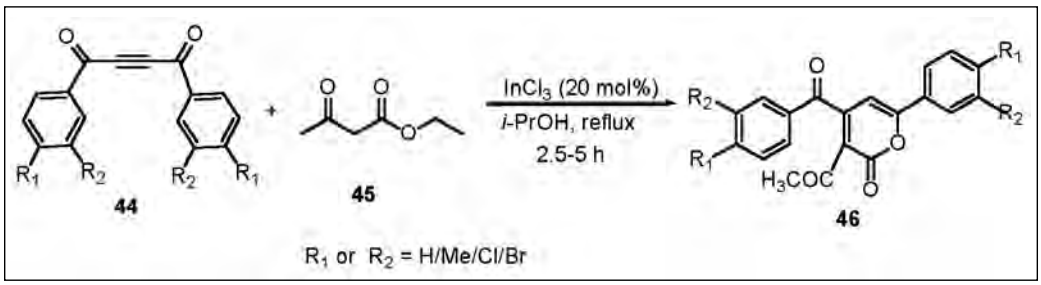
Scheme 10. Synthesis of novel bisquinoline derivatives

Dr. Parasuraman Jaisankar and group

Synthetic studies in heterocyclic chemistry using catalysts

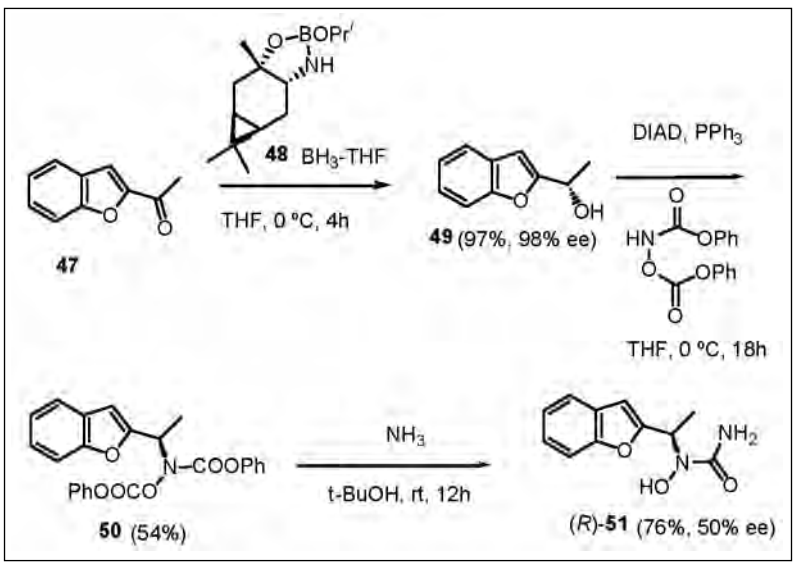
Synthesis of heterocyclic compounds both in chiral and achiral forms have become part and parcel of synthetic chemists due to their wider applications as drug candidates for various diseases. The use of catalysts not only results in the specific and desired skeletons but also unexpected and completely new compounds.

Synthesis of 2-pyrones: Our initiative towards synthesizing new biologically active heterocyclic compounds using Lewis acid catalyst has resulted in the observation that $InCl_3$ could be effectively used for preparing different 2-pyrone derivatives. Treatment of one equivalent of dibenzoyl acetylene (**44**) with one equivalent of ethyl acetoacetate (**45**) in the presence of catalytic amount of Indium trichloride resulted in 72% yield of 6-aetyl-5-benzoyl-3-phenyl-2-pyrone (**46**) (Scheme 11).



Scheme 11. An approach to 2-pyrones synthesis

Asymmetric synthesis of N-1-(heteroaryl)ethyl-N-hydroxyureas: Certain *N*-substituted *N*-hydroxyureas derived from arenes, furan, benzofuran, thiophene and benzo[*b*]thiophene exhibit 5-lipoxygenase inhibiting activity. 5-Lipoxygenase initiates the biosynthesis of leukotrienes, potent mediators of vascular inflammation and contraction of smooth muscles, involved in diseases such as allergy, asthma, psoriasis, inflammatory bowel disease and various cardiopulmonary diseases. *N*-1-(heteroaryl) ethyl-N-hydroxyureas were the first 5-lipoxygenase inhibitors representing a new class of therapeutic agents containing the N-hydroxyurea functionality. Thus, 1-(benzofuran-2-yl) ethanone (**47)** was reduced with borane/oxazaborolidine **48**, generated *in situ* from triisopropoxyborane and (1*S*,3*S*,4*R*,6*R*)-4-amino-3,7,7-trimethylbicyclo[4.1.0] heptan-3-ol, producing (*S*)-1-(benzofuran-2-yl) ethanol **49** in 98% ee. In the next step, **49** was reacted with *N*,*O*-bis (diphenoxycarbonyl) hydroxylamine under Mitsunobu conditions to yield the Mitsunobu product **50** in 54% yield. The substitution product was treated with ammonia and (*R*)-**51**, 50% ee, was obtained in 76% yield (Scheme 12).

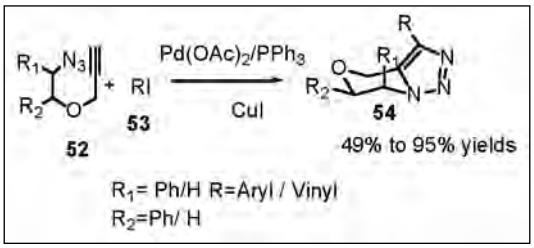


Scheme 12. Asymmetric synthesis of *N*-alkylated hydroxyurea

Dr. Chinmay Chowdhury and group

Development of novel methods for the synthesis of heterocycles of biological interests

Because of the abundance of medium-sized heterocyclic scaffolds in many natural products, drugs, and preclinical leads, synthesis of these compounds through novel methodologies has been targeted. Towards this endeavor, we have recently accomplished the synthesis of 1,2,3-triazolo [5,1-*c*] morpholines **54** through palladium-copper catalysis. Azido-alkyne **52** reacted with aryl iodide **53** in the presence of palladium acetate (5 mol %) and PPh3 (20 mol %) in DMF to furnish the product **54** with moderate to excellent yields (Scheme 13). Interestingly, careful scrutiny of the vicinal H-H coupling constant in ^{1}H NMR reveals that the phenyl ring adjacent to the nitrogen prefers to adopt an axial like conformation, whereas that next to the oxygen takes up the equatorial conformation. The above structural conclusion was further supported by the X-ray analysis as shown (Fig. 5) (for product **54**: $R_1 = R_2 = Ph$, R = -C_6H_4(OMe-*m*). This methodology was applied to the synthesis of bis-heteroannulated product **55** (Fig. 4) under one pot. Based on control experiments and known palladium chemistry, a reasonable reaction mechanism has also been suggested to explain the product formation.



Scheme 13. Pd/Cu-catalyzed synthesis of triazolomorpholines

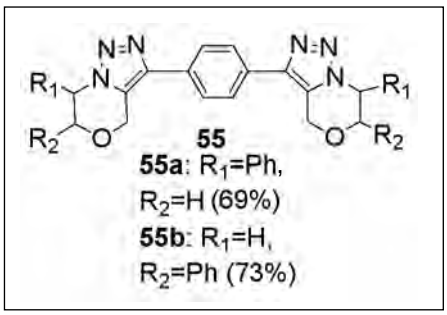


Fig. 4.

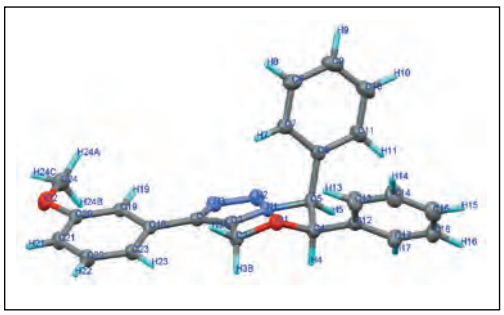


Fig. 5 : ORTEP diagram of 54

Dr. S. Mukhopadhyay and group

Chemistry of Naturally Occurring DNA topoisomerase inhibitors

We have already reported that betulinic acid (3β-hydroxy-20(29)-lupen-28-oic acid) inhibits topoisomerase I in a dose dependant manner, with complete inhibition of enzyme activity achieved at 10 μM concentration. The hydrogen bonding capability or acidity at position C-17 in betulinic acid is important for the inhibitory activity as demonstrated by the loss of activity in lupeol, lupeol acetate and dihydrolupeol acetate where COOH group at C-17 is transformed into methyl group. Complete

loss of activity is again observed where the double bond is replaced by C-20(29) epoxide in 3β-acetoxy-20(29)-epoxy-lupen-28-oic acid. Moreover the replacement of COOH group at C-17 with CH_2OH group as in betulin or an ester as in methylbetulinate. diminishes the inhibitory effect indicating the free carboxylic acid in position C-17 is important for inhibiting the catalytic activity of topoisomerase I. In order to identify some potent inhibitors derived from betulin and betulinic acid a number of derivatives, e.g. 3-*O*- & 28-*O*- diglutaryl, diphthaloyl, disuccinyl, diacetyl, dicrotonyl betulin and dihydrobetulin derivatives (Fig. 6) have been prepared. Some of the derivatives cause significant inhibition of topoisomerase I.

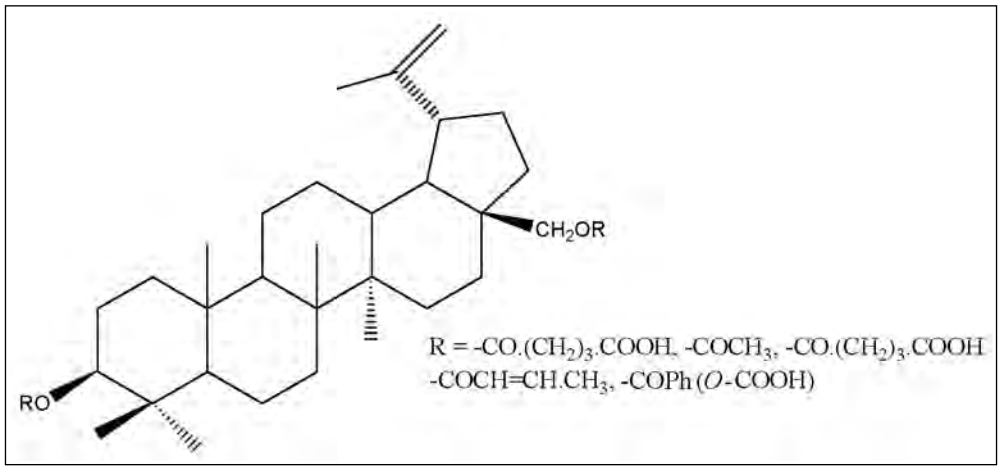
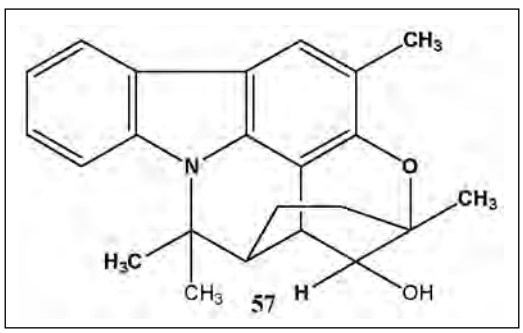


Fig. 6 : Some derivatives of betulin

A new carbazole alkaloid, designated as murrayakoeninol (**57**), was isolated from the leaves of *Murraya koenigii* (Linn) Spreng, along with four known carbazole alkaloids, viz. mahanimbine, koenimbine, *O*-methylmurrayamine-A and murrayazolinine and one from the bark, *viz.* girinimbine. The structure of the new alkaloid murrayakoeninol was elucidated on the basis of 2D NMR spectral analysis and chemical reactions.



Dr. B. C. Pal and group *(in collaboration with other groups)*

Development of herbal medicine

The group is engaged in identifying bioactive lead molecules from Indian medicinal plants. Towards this end, we reported last year the identification of two plants having anti-diabetic Type II activity.

Alcohol extract of *Murraya koenigii* leaves showed anti-diabetic Type II activity. Bioactivity guided fractionation of this extract led to the isolation and identification of Mahanine (**58**) as marker compound (Fig. 7).

Cajanus cajan is a nontoxic edible herb, widely used in Indian folk medicine for the prevention of various liver disorders. We have demonstrated that methanol-aqueous extract of this plant could prevent the chronically treated alcohol induced rat liver damage. Carlinoside (**59**) was isolated and characterized from this extract as biomarker through activity- guided fractionation (Fig. 7).

The methanolic extract of *Dillenia indica* fruits showed significant anti-leukemic activity in human leukemic cell lines U937, HL60 and K562. This finding led to fractionation of the methanolic extract, on the basis of polarity, in which the ethyl acetate fraction showed the highest anti-leukemic activity. A major compound, betulinic acid (**60**), was identified as biomarker (Fig. 7).

Further research work on the development of bioactive molecules is in progress.

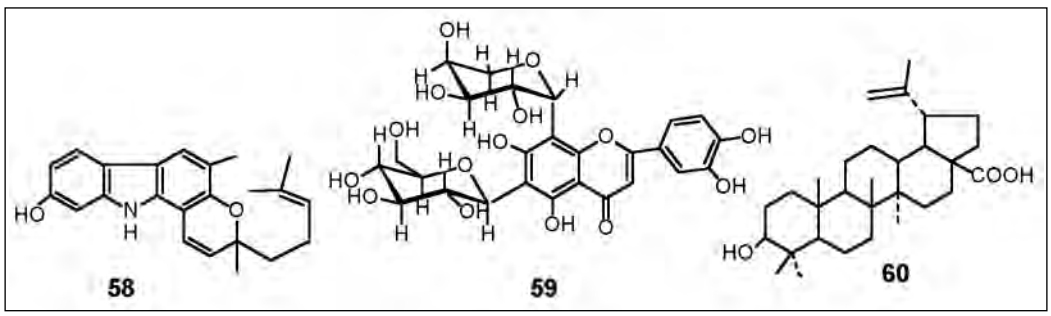


Fig. 7 : Structure of some bioactive molecules

Dr. Sukdeb Bandyopadhyay, Dr. Nirup Bikash Mondal and group

Chemical investigation of medicinal plants for bioactive substances

Chemical examination of Indian medicinal plants identified by practitioners of traditional medicine or used as folk remedies in the treatment of various ailments led to the isolation and characterization of active and/or novel constituents. The objective of the group is to isolate and identify useful bioactive compounds and develop methodologies for making them readily available. Besides, this group also tries to find out the mechanism of action of plant extracts/pure compounds to various targets.

Plausible pathway of *Chenopodium album* seed extract (CAE)-mediated sperm cell death was studied. Results (Fig. 8) indicated that CAE-induced sperm death is due to (a) lipid peroxidation of the sperm cell membrane, oxidation of some critical cellular proteins and depletion of intracellular reduced gluthathione, indicating in situ production of ROS; (b) activation of Mn-SOD and inactivation of catalase favoring endogenous accumulation of H_2O_2; (c) generation of $O_2^{\cdot -}$ at an enhanced rate during oxidative stress as evidenced by increased Mn-SOD activity and protein expression; (d) accumulation of ROS in spermatozoa reflected in the fluorimetric experiments; and (e) increased production of $O_2^{\cdot -}$ and H_2O_2 induced apoptosis-like death in sperm cells as observed by DNA ladder formation.

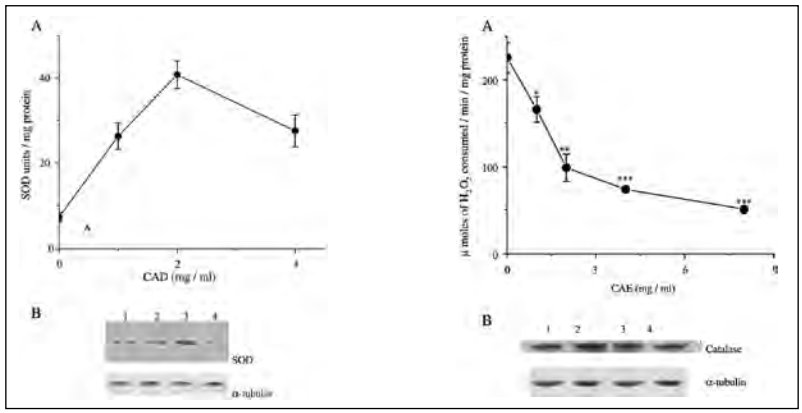


Fig. 8 : Graphical representation of activity of seed extract

Dr. Chinmay Chowdhury and group (in collaboration with other groups)

Bioactive constituents from medicinal plants

In continuation of our previous work for identification of potent anticancer and antiviral agents from Indian plant sources, we have started working on the methanol extract of the leaves of *Vitex negundo*, which was selected through activity guided fractionation. A novel flavone glycoside (luteolin-3 -*O*-β-D-glucuronide) was isolated through HPLC separation of one of the sub-fractions of *n*-butanol. The establishment of unambiguous structure was carried out mainly through ID and 2D NMR. In conjunction, several known flavones (luteonin, negundoside, iso-orientin and others) were also isolated. The anti-cancer activities of the aforementioned compounds are being evaluated.

In another research program, we have selected andrographolide for making analogue library for structure-activity relationship (SAR) studies. Towards this endeavor, we have made structural modifications at C-14 hydroxy of andrographolide, leading to the generation of several diverse analogues. Interestingly, two analogues showed promising anti-leukemic activity (*in vitro*). Further studies of these compounds are also in progress.

Dr. Asish K. Sen and group

Structural studies on bacterial cell surface antigen

Isolation and characterization of a novel triamino sugar from bacterial cell. The objective of this project is to isolate and elucidate the structures of the bacterial cell surface antigenic lipopolysaccharides (LPS) and/or O-antigenic polysaccharides (OPS), and capsular polysaccharides (CPS) from pathogenic strains responsible for gastrointestinal disease. The lipopolysaccharide from a clinical isolate has been isolated and purified. The presence of a novel triamino sugar namely, 5,7-diacetamido-8-amino-3,5,7,8,9-pentadeoxy-D-glycero-D-galacto-non-2-ulosonic acid in the OPS has been established. Further work is in progress to establish the total structure of the OPS. Structural study of the purified CPS from *Vibrio parahaemolyticus* O3:K6 has also been initiated.

Characterization and structural modification of coir fiber for enhanced longevity. The project has been sponsored by Coir Board, Kochi from October 2006. The objective of this project is to chemically characterize the constituents of coir fibre from different varieties of coir found in southern costal area

of India and also to modify the coir fiber by chemical or enzymatic procedure to protect them from degradation by light (UV). Various types of hemicelluloses were isolated from four varieties of coir and were characterized. Different types of derivatives of coir fibre have been prepared by using chemical methods and their light fastness and physical parameters were evaluated at CCRI, Alleppy, Kerala.

Synthesis of oligosaccharides. (i) The chemical synthesis of a pentasaccharide (Fig. 9) that binds to a banana lectin (Prof. Vijayan et al.) is in progress; (ii) the oligosaccharide is being synthesized by using appropriate strategy. Synthesis of the tetrasaccharide repeating unit of O-antigenic polysaccharide of *Vibrio cholerae* O6 has been undertaken (Fig. 10).

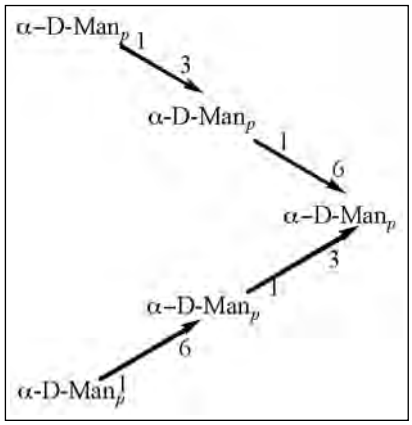


Fig. 9.

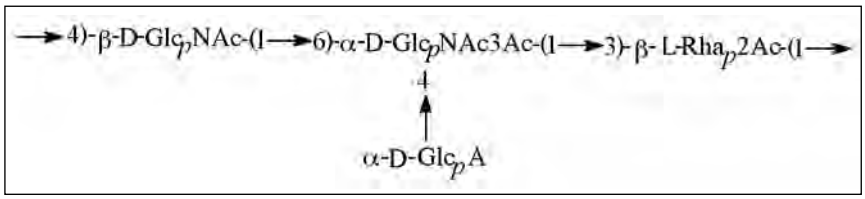


Fig. 10.

CHEMISTRY

Dr. G. Suresh Kumar and group

Nucleic acid polymorphic structures and their interaction with plant alkaloids

RNA targeting through binding of cytotoxic natural alkaloids: *Studies on antitumor agent coralyne to t-RNA.* In continuation of the work on natural alkaloids binding to nucleic acid structures, the binding aspects, and energetics of the interaction of the protoberberine alkaloids (Fig. 11a) have been studied with various synthetic RNAs. Interaction of the protoberberine alkaloid coralyne with t-RNA^{phe} was investigated using various biophysical techniques. Results of absorption and fluorescence studies revealed that the alkaloid binds to t-RNA exhibiting positive cooperativity. Isothermal titration calorimetry results suggested that the binding of the alkaloid was predominantly enthalpy driven with a smaller favourable entropy term. A surprisingly large favourable component for non-electrostatic contribution to the binding of coralyne to t-RNA was revealed from salt dependence data and the dissection of the free energy. The alkaloid enhanced the thermal stability of t-RNA and the binding affinity values obtained from optical thermal melting data were in agreement with that from calorimetry. The heat capacity change of -125 cal./mol. K and the observed significant enthalpy-entropy compensation phenomenon confirmed the involvement of multiple weak noncovalent interactions. Circular dichroism studies provided evidence for significant perturbation of the t-RNA structure with concomitant induction of optical activity in the bound achiral alkaloid molecules. Binding isotherms generated from circular dichroic data confirmed the cooperative binding mode of the alkaloid as deduced from spectroscopic data. Docking studies provided further insights in to the partially intercalated state of coralyne inside the t-RNA structure (Fig. 12). This study presents a complete binding and thermodynamic profile of coralyne interaction to t-RNA.

Studies on the binding of alkaloids to Double Stranded RNAs: The interaction of berberine and palmatine (Fig. 11b) and synthetic coralyne (Fig 11c) to three double stranded ribonucleic acids, poly(A). poly(U), poly(I).poly(C) and poly(C).poly(G) was studied using various biophysical techniques. Absorbance and fluorescence studies showed that the alkaloids bound cooperatively to these RNAs with the binding affinities of the order 10^4 M^{-1}. Circular dichroic results suggested that the conformation of poly(A). poly(U) was perturbed by all the three alkaloids, that of poly(I).poly(C) by coralyne only and that of poly(C).poly(G) by none. Fluorescence quenching studies gave evidence for partial intercalation of berberine and palmatine and complete intercalation of coralyne to these RNA duplexes. Isothermal titration calorimetric studies revealed that the binding was characterized by negative enthalpy and positive entropy changes and the affinity constants derived were in agreement with the overall binding affinity from spectral data. The binding of all the three alkaloids considerably stabilized the melting of poly(A). poly(U) and poly(I).poly(C) and the binding data evaluated from the melting data was in agreement with that obtained from other techniques. The overall binding affinity of the alkaloids to these double stranded RNAs varied in the order, berberine=palmatine<coralyne. The temperature dependence of the enthalpy changes afforded large negative values of heat capacity changes for the binding of palmatine and coralyne to poly(A).poly(U) and of coralyne to poly(I).poly(C) suggesting substantial hydrophobic contribution in the binding process. Further, enthalpy-entropy compensation was also seen in almost all the systems that showed binding. These results advance our understanding on the binding of small molecules that are specific binders to double stranded RNA sequences.

DNA binding of benzophenanthridine compound sanguinarine versus ethidium: *Comparative binding and thermodynamic profile of intercalation*. There is compelling evidence that cellular DNA is the target of many small molecule anticancer agents. Consequently, elucidation of the molecular nature governing the interaction of small molecules to DNA is paramount to the progression of the rational drug design strategies. We have compared the binding and thermodynamic aspects of two known DNA binding agents, sanguinarine (Fig. 11c) and ethidium (Fig. 11d), with DNA. The study revealed non-cooperative binding phenomena for both the drugs to DNA and the affinity was similar for ethidium and sanguinarine as observed from different techniques. The binding phenomena analyzed from isothermal titration calorimetry showed exothermic binding for both compounds that was favoured by negative enthalpy and positive entropy changes typical of intercalative binding. The binding of both the drugs was further characterized by strong stabilization of DNA against thermal strand separation as revealed by optical melting as well as differential scanning calorimetry studies. The data of the salt dependence of binding of sanguinarine and ethidium from the plot of log K versus log [Na^+] revealed a slope of 0.711 and 0.875 consistent with the values predicted by the theories for the binding of monovalent cations and the binding free energy has been analyzed for contributions from polyelectrolytic and non-polyelectrolytic forces. The salt dependence of the binding was also evident from the conformational changes in the circular dichroism where both extrinsic and induced changes were lowered on increasing the salt concentration. The heat capacity changes obtained from temperature dependence of enthalpy change gave values of –590 and –670 J mol^{-1} K^{-1} respectively for the binding of sanguinarine and ethidium to DNA. Overall the DNA binding of ethidium was slightly more favoured over sanguinarine.

Future programme of this sub project is to further focus on the study of the various RNA structures and binding small molecules with particular emphasis on specificity and energetics of interaction of new natural and synthetic alkaloids.

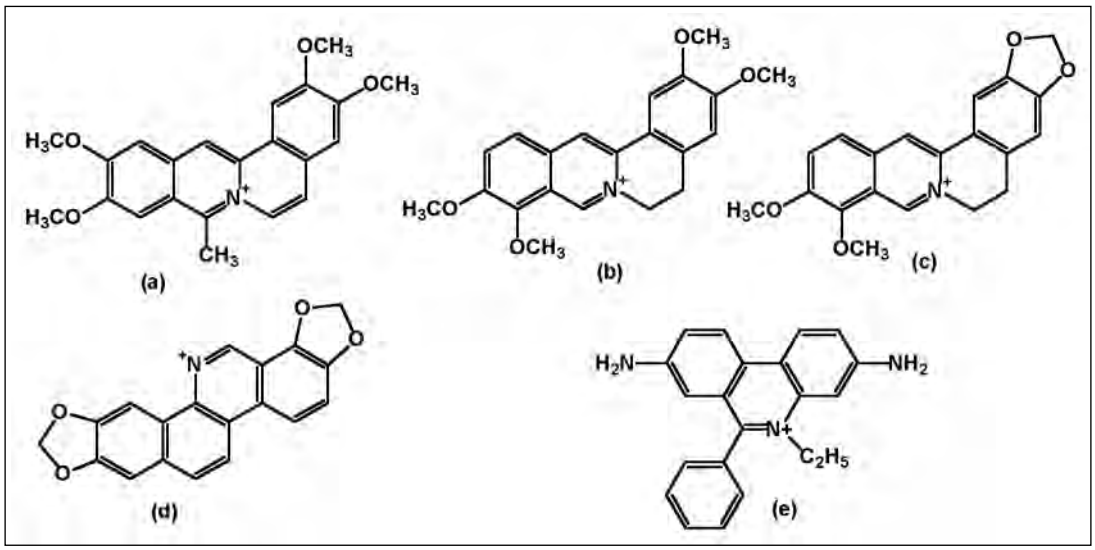


Fig. 11 : Chemical structures of (a) coralyne (b) palmatine (c) berberine (d) sanguinarine and (e) ethidium.

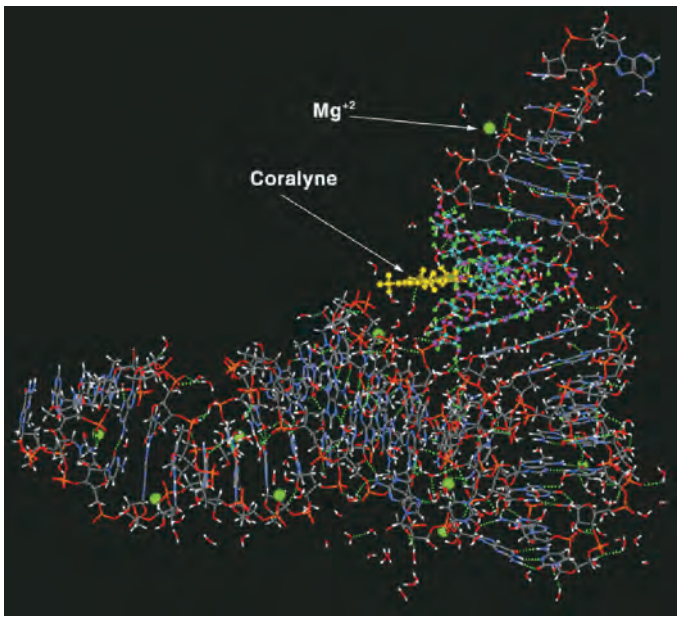


Fig. 12 : Docked pose of coralyne on tRNA. The drug is shown in yellow color (cover page illustratioin, Molecular Biosystems 5, 244-254 (2009).

Dr. R. C. Yadav

Studies on nonlinear chaotic systems

In order to understand the dynamical behaviors of biological and physical systems, non linear dynamical approach is adopted using concept of synchronization of non linear oscillators and complex networks. A unidirectional coupling scheme has been investigated in double scroll type oscillators that reveal

interesting multiscroll dynamics. In this scheme double scroll chaos from one oscillator forced into another similar oscillator in a resting state has been applied in the Chua oscillator, a modified Chua oscillator and the Lorenz oscillator. We have observed 4-scroll, 6-scroll attractors in the driven Chua oscillator and the modified Chua oscillator respectively in an intermittency regime of weaker coupling.

OPERATION AND MAINTENANCE OF SOPHISTICATED INSTRUMENTS

600 MHz NMR Bruker spectrometer

Dr. Ranjan Mukhopadhyay and Mr. E. Padmanaban

The highly sophisticated 600 MHz Bruker NMR spectrometer has been maintained and analyses of about 1750 samples were done during the year for both internal and external research workers. Apart from routine 1D experiments like PMR, PMR (HOD suppression), CMR, DEPT 135, DEPT 90, NOE difference and 2H-NMR various 2D and 3D experiments are being done regularly.2D experiments include COSY, DQF-COSY, NOESY, NOESY-WG, TOCSY, TOCSY-WG, ROESY, HSQC, HMQC, HMBC, ADEQUATE and HSQCNOESY-15N.The 3D experiments mostly done are HNCOWG (13C/15N) and NOESYHSQC-15N.

300 MHz NMR Bruker spectrometer

Drs. V.S. Giri, Ranjan Mukhopadhyay and Tapas Sarkar

The Silicon Graphics Indy workstation of the 300 MHz NMR spectrometer has been upgraded to PC base workstation and the processing software also upgraded from XWIN-NMR 2.0 version to XWIN-NMR 3.5 version. The instrument has been extensively used during the year. About 4000 samples have been analyzed which includes both internal and external samples. 1D experiments mostly done are PMR, CMR (with DEPT 135 and DEPT 90), proton decoupling, NOE difference and variable temperature analyses. The 2D analyses routinely done include COSY, NOESY, HMBC, HMQC, HSQC and COLOC experiments.

Jasco 4200 FT/IR and Jasco 410 FT/ IR spectrophotometer

Dr. V. S. Giri and Dr. P. Jaisankar

The JASCO FT/IR 410 and 4200 spectrophotometers have been routinely maintained and extensively used to analyse both internal and external samples. The instruments have given support to the newly introduced NIPER course also.

LC-MS-MS-Q-TOF Micromass instrument

Dr. Asish K. Banerjee, Mr. Kalyan Kumar Sarkar and Mr. Diptendu Bhattacharya

One LC-MS-MS (Q-TOF Mico) instrument was installed in the middle of 2003. Since then it has been in use for routine mass spectral analysis of both internal and external samples. Small molecules as well as bio-macromolecules like proteins, carbohydrates etc. are being analyzed. Facilities include determination of their molecular weight, MS-MS experiments etc.

Perkin-Elmer 2400 CHNS/O analyzer Series II System

Dr Asish K. Banerjee and Shri Sandip Chowdhury

The analyzer has been installed and routine analyses of samples have been undertaken.

Jeol AX500 GC-mass Spectrometer

Shri Ajoy Banerjee (with operational support by Shri Sandip Chowdhury)

The Jeol AX500 Mass spectrometer, maintained by us and extensively used for the last seven years, was finally disposed off this year with a view to purchase a new mass spectrometer with higher specifications and attachments as required by chemistry group. The new machine is expected to be operational shortly.

Jeol MS-700 mass Spectrometer

Dr. S. B. Mandal (with operational support by Shri Sandip Chowdhury)

This instrument has recently been installed (June 2009) and is expected to be operational within a short time.

Gas liquid chromatograph

Dr. Asish K. Sen

Two Gas Liquid Chromatograph instruments (Agilent 6890 plus and Hewlett-Packard 5890, fitted with FID detectors) have been maintained and samples are analyzed throughout the year to cater both in-house and external research workers and industries. During the year, ~200 samples within the institute and ~70 outside samples have been analyzed.

Shimadzu GC-mass spectrometer (GP5050 A)

Dr. Asish K. Sen and Mr. A. K. Das

GLC-MS (Shimadzu, Japan) facility has been offered to IICB scientists and research fellows, and Scientists, academicians and Industries from elsewhere. During the year, 177 DI & 157 GC-MS samples within the institute and ~44 outside samples have been analyzed.

DIONEX ICS 3000 Ion Chromatography

Dr. Asish K. Sen and Mr. A. K. Das

The ion chromatography facility is offered to IICB scientists and research fellows to detect and estimate sugars, amino acids and peptides (sialic acids, amino sugars, oligosaccharides etc.) in nanogram level.

VP-ITC Model Isothermal Titration Calorimeter and VP-DSC Model Differential Scanning Calorimeter

Dr. G. Suresh Kumar

An ultra sensitive Isothermal Titration Calorimetry Unit Model VP-ITC and Differential Scanning Calorimeter model VP-DSC (both from Microcal, LLC USA) for studying the thermodynamics of biomolecular interactions is providing service to researchers from several divisions of our institute.

Jasco J 815 Spectropolarimeter

Dr. G. Suresh Kumar

The new Circular Dichroism unit installed is providing services to both internal and external workers. Several research groups are routinely analyzing solution conformations of peptides/proteins and nucleic acids.

Single crystal X-ray spectrometer

Dr. Partha Chattopadhyay

Single crystal X-ray spectrometer, Bruker model Kappa Apex-2, has been maintained and samples analyzed to serve institute's research workers.

Technical Staff

Asit Kumar Das, Sankar K. Maitra, Tapas K. Sarkar, Diptendu Bhattacharya, Gautam Gupta, Sandip Chowdhury, Sekhar Ghosh, Sarit K Sarkhel, Rajendra Mahato, E. Padmanaban and Nimai C. Pradhan.

Research Fellows and Associates

Ramprasad Ghosh, Prithwish K Jana, Subhrangshu Mukherjee, Shrabanti Kumar, Priyankar Paira, Abhijit Hazra, Krishnendu Bikash Sahu, Subhendu Naskar, Pritam Saha, Rupankar Paira, Shyamal Mondal, Arindam Maity, Nirmal Das Adhikari, Rangana Sinha, Kakali Bhadra, Md. Maidul Islam, Maidul Hossain, Ishita Saha, Anirban Basu, Avijit Maity, Mumu Chakraborty, Soumyanil Bhowmick, Anup K Sasmal, Kaushik Brahma, Bimalendu Das, Dr. (Mrs.) Sumanlata Pillai, Churala Pal, Debkumar Nandi, Sanjit Kumar Mahato, Ramesh Kumari Dasgupta, Madhumita Mandal, Tulika Mukherjee, Chiranjit Acharya, Samrat Dutta, Swarbhanu Sarkar.

Project Assistants

Sandip K Hota, Sudipta Mitra, Deboleena Bhattacharjya, Soumendra Nath Das, Suman Samanta, Sebanti Roy Chowdhury, Sanjukta Mukherjee, Puja Paul, Sohini Sarkar.

Project Trainees (NIPER)

P.C. Lalawmpuii , Shiba Prasad Malik, T. Ajay Kumar, Bikram K. Agrawalla.

Summer Trainee

Ms. Ayesha Kabir, Subrata Pathak.

Administrative Staff

Sankar Prasad Dutta, Sr. Stenographer.

Participants of HUGO satellite meeting at IICB

Dr. Surya Kanta Misra, Honorable Minister of Health, Panchayat and Rural Development, Government of West Bengal lighting the inaugural lamp in neuroscience conference, Neuroupdate 2008 during September 20-21, 2008

STRUCTURAL BIOLOGY & BIOINFORMATICS

Prof. Siddhartha Roy, Drs. M. C. Bagchi, Chitra Dutta, Debasish Bhattacharyya, Nanda Ghoshal, Soumen Datta, Subrata Adak, Krishnananda Chattopadhyay, Jayati Sengupta

Structural characteristics and conformational specificity to a large extent determine the mode of interaction between/or among all the biological macromolecules, leading to expression of their regulated functions. This institute has a long tradition of carrying out research on protein chemistry, molecular modeling of proteins, protein-nucleic acid interactions, nucleic acid-drug interactions, and drug-protein interactions. Clearly, such structure-function studies require multi-pronged approach from different angles involving several areas of biological, chemical and physical sciences. Recently, we have undertaken an effort to bring all these disciplines under a common roof, resulting in the formation of the "Structural Biology & Bio-informatics" division. The charter of this division is to carry out research in areas that focus on structural characterization of potentially prospective biological macromolecules and other small molecules of therapeutic interest against various diseases, e.g. tuberculosis, leishmaniasis, cholera, cancer, diabetes and for other anti-inflamatory, anticonvulsant and immunomodulatory activities. Fundamental studies on protein functions, protein-protein and protein-nucleic acid interactions applying modern sophisticated technologies like nuclear magnetic resonance (NMR), X-ray crystallography, analytical ultracentrifuge, fluorescence correlation spectroscopy, diode array stopped-flow spectrophotometry, mass-spectrometry, quantitative structure activity relationship (QSAR) and 3D-QSAR are also being pursued. Softwares are being developed for genome / proteome analysis, prediction, modification and analysis of macromolecular structures and for elucidating their interactions with bio-active molecules.

Prof. Siddhartha Roy and group

Studies on macromolecule

Formation of ternary complex between p53-MDM2-SMAR1

The intra-cellular level of tumor suppressor protein p53 is tightly controlled by an autoregulatory feedback loop between the protein and its negative regulator MDM2. The role of MDM2 in down-regulating the p53 response in unstressed conditions and in the post-stress recovery phase is well documented. However, interplay between the N-terminal phosphorylations and C-terminal acetylations of p53 in this context remains unclear. Here, we show that an MAR binding protein SMAR1 interacts with N terminus of p53 (Fig. 1), the affinity being higher for Ser 15 phosphorylated form of p53.

SMAR 1 was also seen to interact with MDM2-p53 complex (Fig. 2) thus forming a ternary complex between p53, MDM2 and SMAR1 in the post stress-recovery phase.

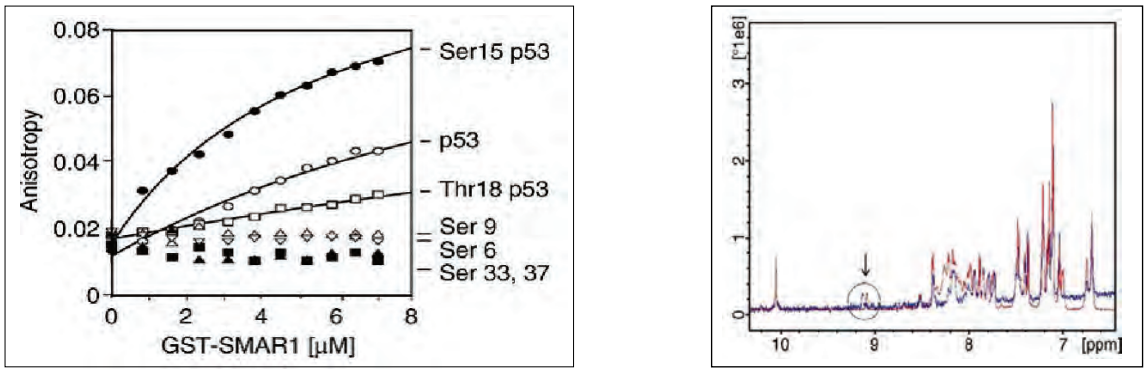


Fig. 1 : SMAR1 interacts with N terminus of p53. (a) Titration of 200 nM differentially phosphorylated p53 peptides with GST SMAR1 protein indicated that SMAR1 bound with Kd of 15.2 μM, 5.6 μM and 49.2 μM to unphosphorylated p53 (o), phosphoserine 15 p53 (↓) and phosphothreonine 18 p53•), respectively. No other modified residue showed any binding. (b) Chemical shift perturbation experiments employing the 44-mer peptide of SMAR1 and Ser15 phosphorylated p53 peptide. NMR studies depict the spectral shift of (15-39) p-p53 upon addition of SMAR1 peptide.

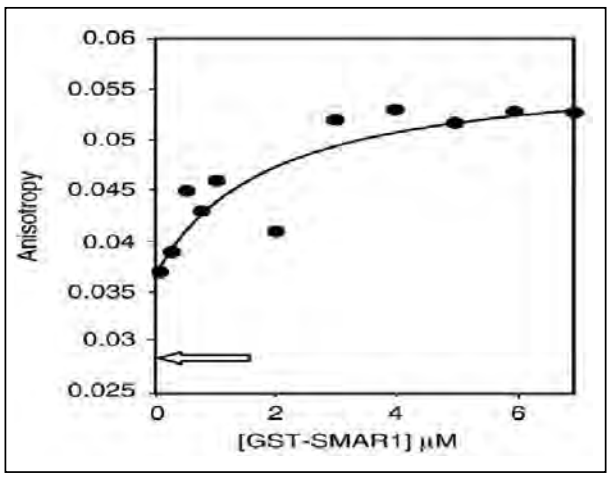


Fig. 2 : SMAR1 interacts with MDM2. (a) A 1 μg sample of GST-MDM2 and deletion proteins of MDM2 were immobilized and SMAR1 expressing 293-cell lysate was passed through the column. SMAR1 showed complex formation with full-length MDM2 and 1-110 residues of MDM2. (b) GST-SMAR1 (160-350) and GST-SMAR1 (350-548) were immobilized on beads and MCF-7 lysate passed through the column. GST-SMAR1 (160-350) showed binding to MDM2.

This triple complex formation between p53, MDM2 and SMAR1 results in recruitment of HDAC1 to deacetylate p53.The deacetylated p53 binds poorly to the target promoter (p21), which results in switching off the p53 response, essential for re-entry into the cell cycle.

Design of peptidomimetics to inhibit p53-MDM2 interaction

A major approach towards cancer therapy has been designing inhibitors of the p53-MDM2 interaction. We have tried to inhibit this interaction between p53 and MDM2 by blocking the interacting domain of MDM2 with structure guided design of high affinity and stable peptides containing some mutations in the 17-26 amino acid sequence of p53. We have observed that among the several peptides synthesized the one having lysine in 21 position bind most strongly with MDM2. It might be due to the replacement of Aspartic acid 21 with a positively charged lysine which facilitates the through space interaction with phosphothreonine-18.

Based on those results we further synthesized two peptides (DRApep1 & DRApep2) with Lysine in 21 position, six D-Arginine residues for cell entry and Aib residues at certain specific positions to

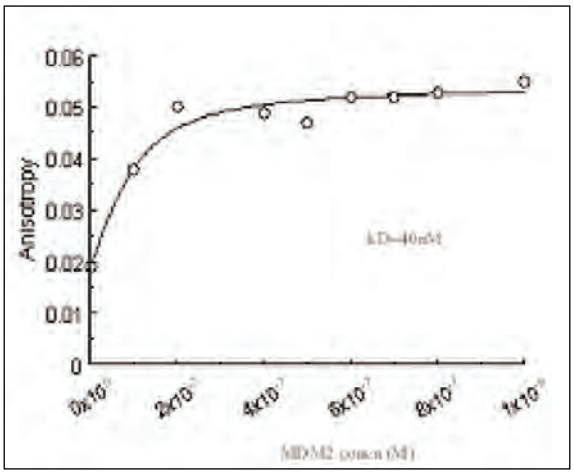


Fig. 3 : The binding isotherm of labeled (17-26)p53 with phosphothreonine-18 and lysine-21

increase the helicity of the peptides. The two peptides (DRApep1 & DRApep2) differ only in the 18 position where DRApep1 has phosphothreonine while DRApep2 contains glutamic acid. We have investigated the effects of DRApep1 & DRApep2 on the melanoma cell line, SK-Mel-5. The morphological changes appear at an earlier time point (6 hrs) with DRApep2.

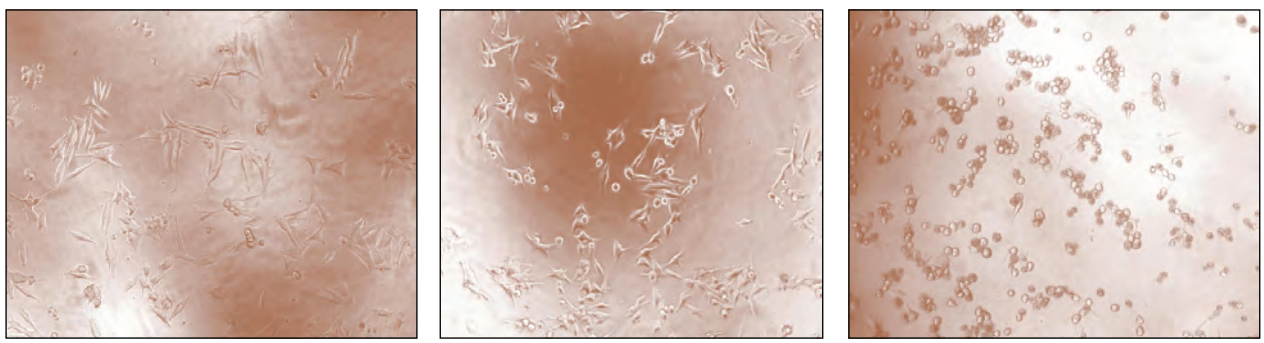


Fig. 4 : The morphological changes of the melanoma cell line, SK-Mel-5 after 6 h treatment with different concentrations of DRApep2 (1=control, 2=10μM, 3=20μM)

Dr. M. C. Bagchi and group

Mathematical modelling in drug design using Structural Descriptors

The major objective of the present project is to study some important topological and other structural parameters of known active compounds as well as many active analogs of the same using various linear statistical methods and non-linear counter propagation neural networks for developing quantitative structure activity relationships of anti-tubercular and anti-cancer compounds.

Application of genetic algorithm and simulated annealing in QSAR of nitrofuranyl amides and quinoxaline derivatives

In an ongoing effort to design for new and potent anti-tuberculosis agents, a series of nitrofuranyl amides were subjected to quantitative structure-activity relationship (QSAR) analysis using various

feature selection methods. Nitrofuranyl amide derivatives with good therapeutic indices are known to inhibit an enzyme responsible for bacterial cell-wall synthesis and act as novel mycobacterial inhibitors. Successful implementation of a predictive QSAR model largely depends on the selection of a preferred set of molecular descriptors that can signify the chemical-biological interaction. Genetic algorithm (GA), simulated annealing (SA) and stepwise (SW) regression are applied as variable selection methods for an effective comparison and model development. The results of two-dimensional QSAR showed that a combination of topological indices, hydrophobic properties and autocorrelation descriptors of different atomic properties could be explored to design potent anti-tubercular inhibitors. To ensure a fair comparison, the same training and test sets were used for each model development. The GA-PLS, SA-PLS and SW-PLS models predicted the training data with an R^2 of 0.7012, 0.7045 and 0.7674 respectively. However, the respective prediction result (pred_ R^2) for the test set amounts to 0.7314, 0.6836 and 0.6838. The plots of calculated versus observed values of p[MIC] are shown in Fig. 5 in case of all three models. Further analysis using three-dimensional QSAR technique identifies a suitable model obtained by GA-partial least square method leading to anti-tubercular activity prediction. The influences of steric and electrostatic field effects generated by the contribution plot are analyzed. The contribution plot representations of the three-dimensional QSAR results for TB inhibitors are presented in Fig. 6. To aid the visualization, the most potent compound N-96 is overlaid on the map. The green-coloured balls specify the positions of the steric descriptors and the descriptors with positive coefficients [S_2002 (21.8%) and S_2551 (9.89%)] indicate the areas where

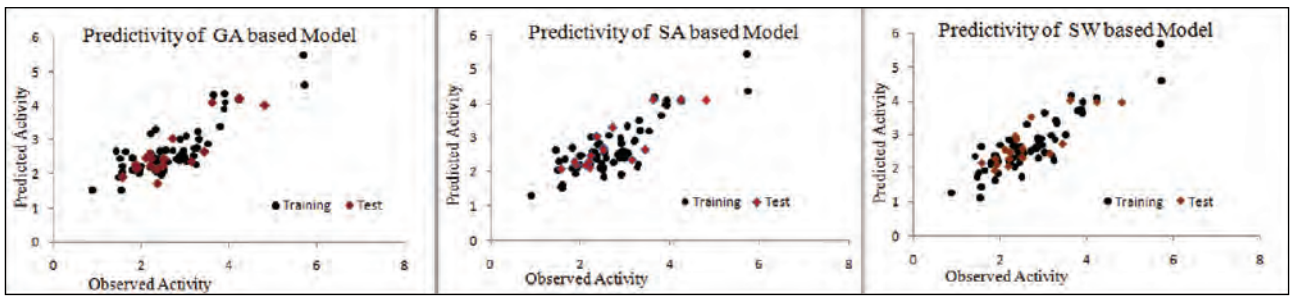


Fig. 5 : Prediction of two-dimensional QSAR models for nitrofuranyl amide derivatives.

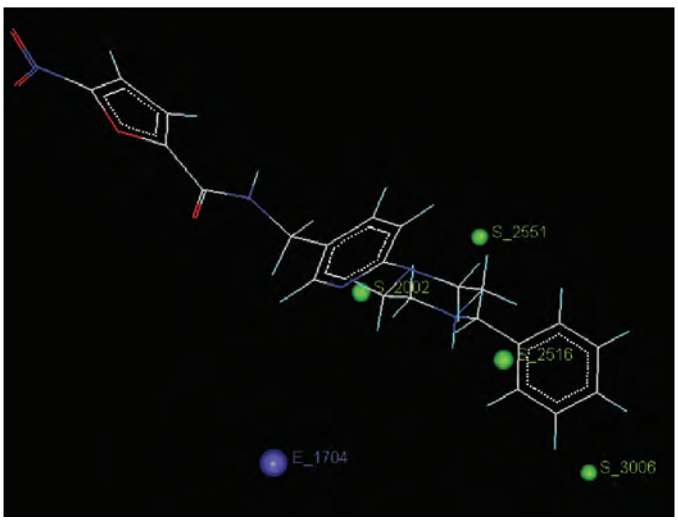


Fig. 6 : Contribution plot for steric and electrostatic interactions considering the lead molecule of Nitrofuranyl amide.

the steric bulky group enhances TB inhibitory activity, while the descriptors with negative coefficient [S_2516 (216.8%), S_301 (220.76%) and S_3006 (221.35%)] point out regions where the steric bulky group is detrimental for the biological activity. Only one electrostatic interaction, E_1704 (9.41%), with a positive coefficient has been considered in the model, represented by a blue-coloured ball, showing the area where electropositive charged groups enhance TB inhibitory activity. Both two- and three-dimensional QSAR analyses of such derivatives provide important structural insights for designing potent anti-tuberculosis drugs.

The quinoxaline derivatives show very interesting biological properties and the data sets considered in our study consist of 44 compounds, which exhibit antitubercular activity. Genetic algorithm (GA) and simulated annealing (SA) are applied as variable selection methods for model development. 2D-QSAR modeling using GA or SA based on partial least squares (GA-PLS and SA-PLS) methods identified some important topological and electrostatic descriptors as key factors for tubercular activity. At the same time, Kohonen network and counter propagation artificial neural network (CP-ANN) considering GA and SA based feature selection methods have been applied for such QSAR modeling with Quinoxaline compounds and a comparative study of the relative effectiveness of linear and non-linear approaches has been investigated. Further analysis using 3D-QSAR technique identifies two models obtained by GA-PLS and SA-PLS methods leading to anti-tubercular activity prediction. The results indicate that SA is a very effective variable selection approach for such 3D-QSAR modeling. Fig.7 signifies contribution of steric and electrostatic field interactions for quinoxaline derivatives for the SA based model.

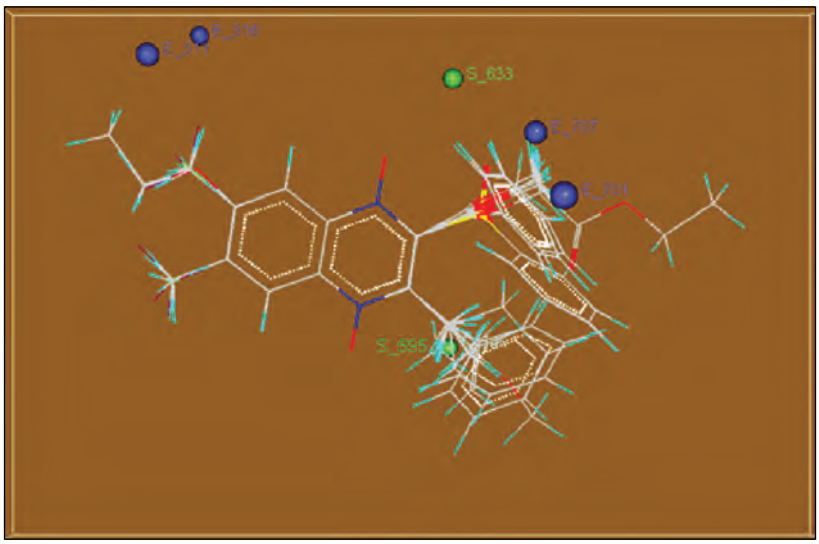


Fig. 7 : Contribution plot for steric and electrostatic interactions for quinoxaline derivatives.

2D and 3D QSARs of aminopyrido [2,3-d] pyrimidin-7-yl compounds

In continuation to formulating 2D and 3D QSAR models for aminopyrido[2,3-d]pyrimidin-7-yl compounds acting as the potential tyrosine kinase inhibitors having anticancer activities against different rapidly proliferating cell lines relating to murine tumors, attempt has been made to compute various theoretical molecular descriptors solely from the structures of these compounds. Ridge regression methodology has been used to solve this problem as the number of molecular descriptors greatly exceeds the number of observations. The influence of different class of molecular descriptors

over the activity has been predicted and most significant descriptors are obtained. The 2D QSAR results show that the calculated molecular descriptors can provide good quality predictive models for the compounds considered in the present investigation. Partial least squares (PLS) models are developed based on training set for the 3D QSAR models of the above compounds. Contribution plot of steric and electrostatic field descriptors generated by 3D QSARs shows the requirement of favourable group substituents in the 2, 6 and 7 positions of aminopyrido[2,3-d]pyrimidin-7-yl template as shown in Figs. 8, 9 and 10. For the FGFr and c-Src kinases, it is seen that electrostatic fields are most prominent in FGFr and steric influences are predominant in c-Src.

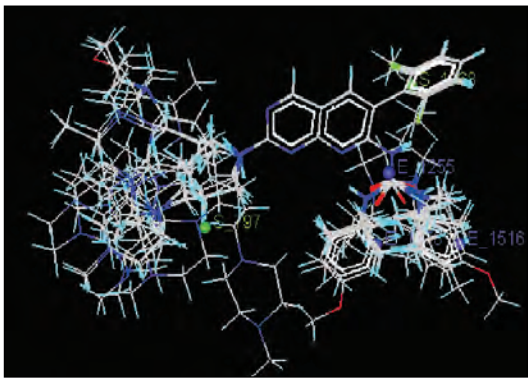


Fig. 8 : Contribution plot of steric and electrostatic field interactions for PDGFr

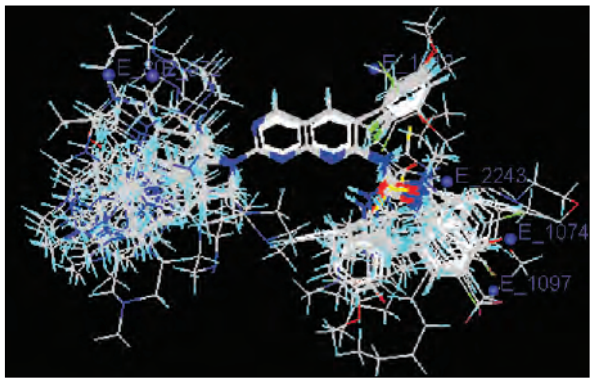


Fig. 9 : Contribution plot of steric and electrostatic field interactions for FGFr

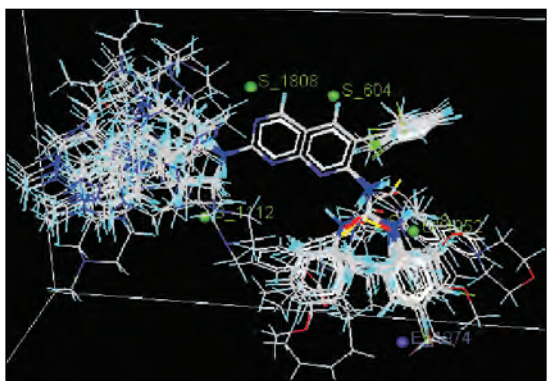


Fig. 10 : Contribution plot of steric and electrostatic field interactions for c-Src

Dr. Nanda Ghoshal and group

In-silico studies for rational drug design and Receptor Modelling

A. Structural Basis for Ligand recognition at the Benzodiazepine Binding Site of GABAA α3 Receptor, and Pharmacophore-Based Virtual Screening Approach

Given the heterogeneity of $GABA_A$ receptor, the pharmacological significance of identifying subtype selective modulators is increasingly being recognized. Thus, drugs selective for $GABA_A$ α_3 receptors are expected to display fewer side effects than the drugs presently in clinical use. Hence we carried out 3D QSAR studies on a series of novel $GABA_A$ α_3 subtype selective modulators to gain more insight into subtype affinity. To identify the 3D functional attributes required for subtype selectivity, a chemical feature based pharmacophore, primarily based on selective ligands representing diverse

structural classes was generated. The obtained pseudo receptor model of the benzodiazepine binding site revealed a binding mode akin to "Message -Address" concept. Scaffold hopping was carried out across multi-conformational May Bridge database for the identification of novel chemotypes. Further a focused data reduction approach was employed to choose a subset of enriched compounds based on "Drug likeness" and "Similarity based" methods. These results taken together could provide impetus for rational design and optimization of more selective and high affinity leads with a potential to have decreased adverse effects.

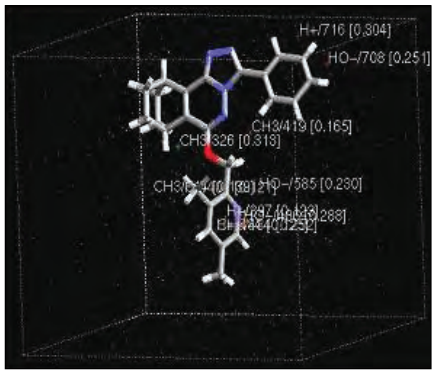


Fig. 11 : Compound 14 enclosed inside a rectangular grid showing the 3D points of MFA, generated.

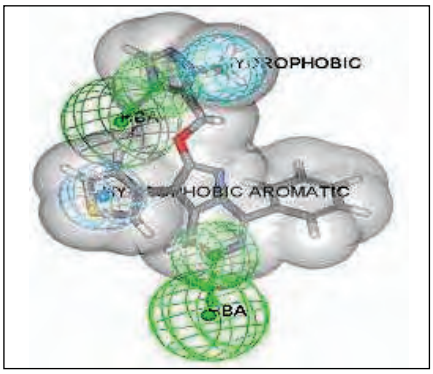


Fig. 12 : "Target specific pharamacophore" mapped on the high affinity ligand 11 together with shape feature, "Inclusion Volume", depicted in gray. (Image rendered using Ds Visualizer, Accelrys Inc.).

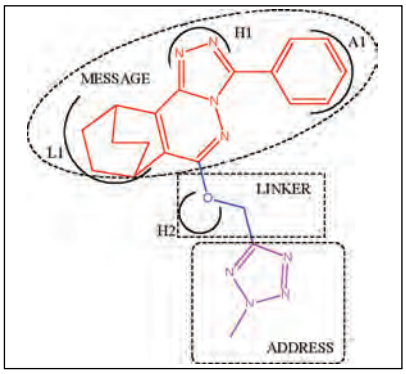


Fig. 13 : A hypothetical binding pocket along with sub-sites showing message-address concept

B. Combined Ligand and Structure Based Approaches for Narrowing on the Essential Physicochemical Characterestics for CDK4 Inhibition

The cell cycle is a frequent target of genetic alterations in cancer because of its central role in the control of cell growth and proliferation. The central players in the cell cycle machinery are Cyclin-Dependent Kinases (CDKs). CDKs are a family of heterodimeric serine/threonine kinases consisting of a catalytic CDK and an activating cyclin subunit. In mammals, there are different CDKs controlling different stages of the cell cycle and play the role of switch on/off on the cell cycle process. When on, the cell passes through the stage that the particular CDK controls, while when off, the cell cycle stops when it reaches the stage controlled by that CDK. CDK4/6-CyclinD complexes, very recently, have been demonstrated as bonafide cancer targets, especially for breast cancer.

In the absence of an experimentally determined 3D structure of CDK4 (Cyclin-Dependent Kinase 4), QSARs (Quantitative Structure Activity Relationship) have been explored to rationalize binding affinity in terms of physicochemical and structural parameters. Further, docking on a homology model of CDK4 validated the derived QSARs and predicted the binding mode of this series of inhibitors. Relevant parameters and leave-one-out (LOO) cross-validation (q^2) as well as an external test set validation (r^2_{pred}) judged the statistical significance and predictive ability of the models. Docking enabled a better understanding of protein-ligand interaction and provided a mechanistic interpretation in terms of physicochemical characteristics. It identified a unique hydrogen bonding between the imidazole of His-95 and the pyridine nitrogen in the ligand. It rationalized the need for R_2 substituents

to be bulky and polar while substituent at R_8 to be hydrophobic and comparatively less steric. It also explained why at R_6 a variety of substituents are tolerated and how the presence of methyl at R_5 enhances binding affinity.

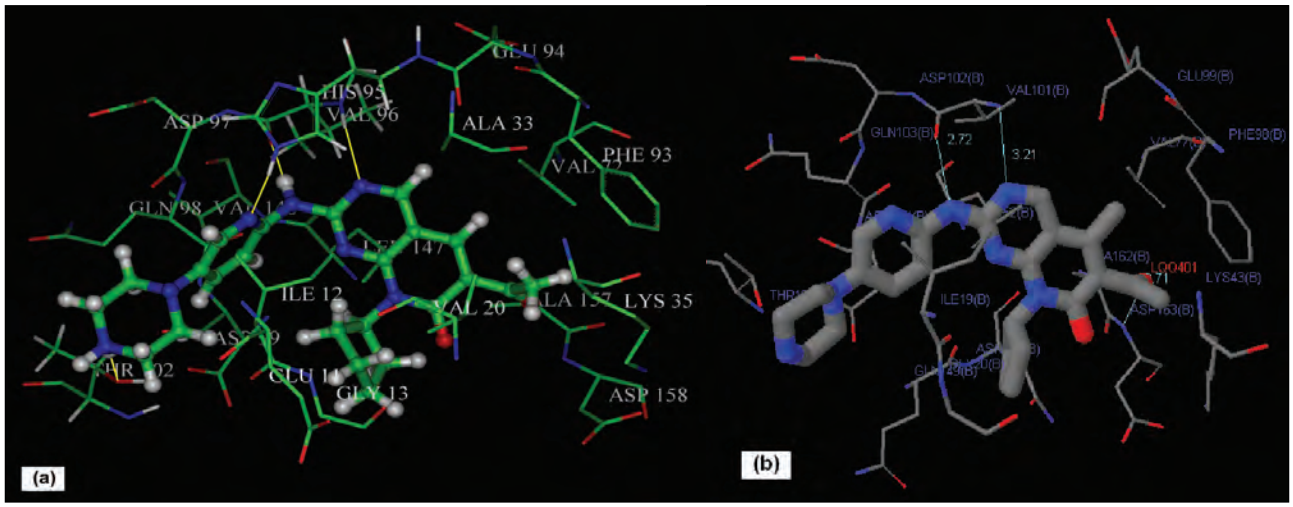


Fig. 14 : (a) The predicted binding mode of Compound 113. (b) The cocrystallized protein-ligand conformation of compound 113 within ATP pocket of CDK6 (PDB ID: 2EUF) (acquired from PDBsum website).

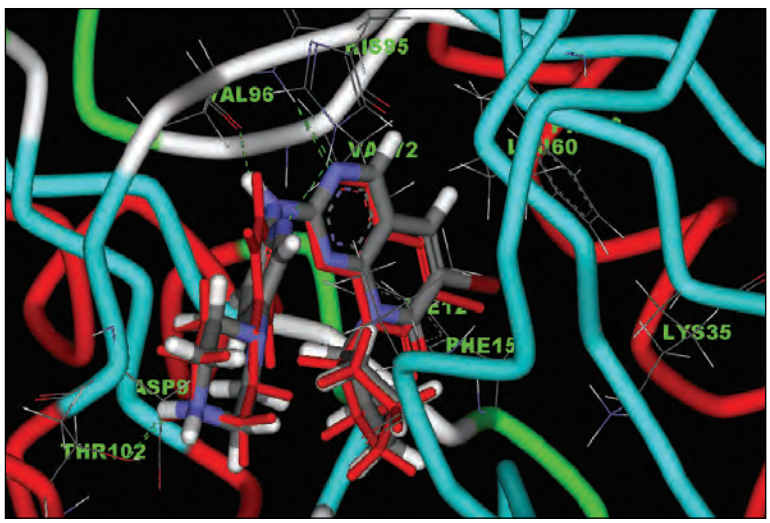


Fig. 15 : Compound 89 (CPK color scheme) and 88(red) shown within the ATP pocket of CDK4. Note the hydrogen bonding interaction of 89 with His95.

C. Hybrid structure based virtual screening protocol for the identification of novel BACE 1 Inhibitors

BACE1, also termed as β–Secretase or Memapsin 2, is an extensively studied aspartic protease, involved in etiopathogenesis and progression of Alzheimer's disease (AD). A hybrid structure based virtual screening protocol that incorporates elements from both ligand based and structure based techniques was used for the identification of prospective small molecule inhibitors against BACE1. Virtual screening, using an active site derived pharmacophore, followed by ROCS based GOLD docking was used to identify a library of focused candidates. The efficacy of ROCS based GOLD docking method together with our customized weighted consensus scoring function was evaluated against conventional docking methods for its ability to discern true positives from a screening library. An in-depth structural analysis of the binding mode of the top ranking molecules reveals to emulate

the curial interaction patterns deemed necessary for BACE1 inhibition. The results obtained from our validation study ensure the superiority of our docking methodology over conventional docking methods in yielding higher enrichment rates.

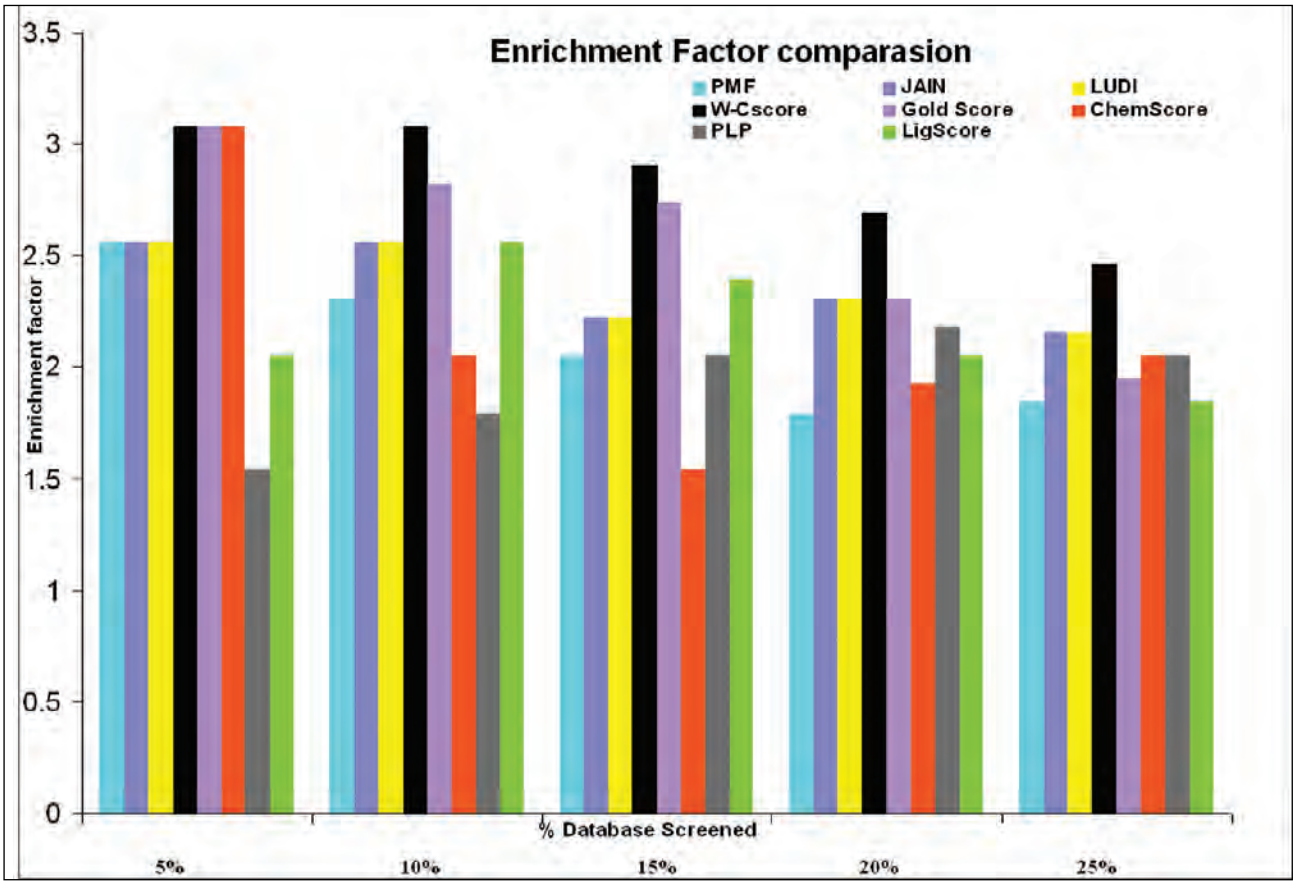
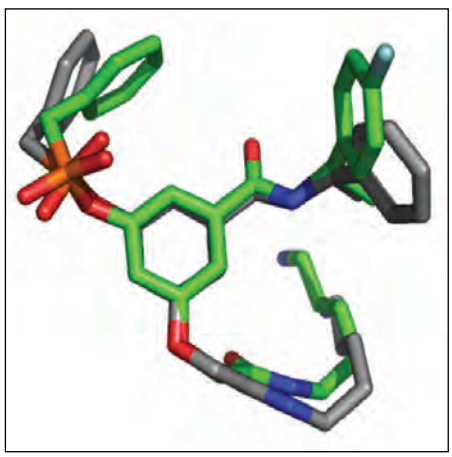
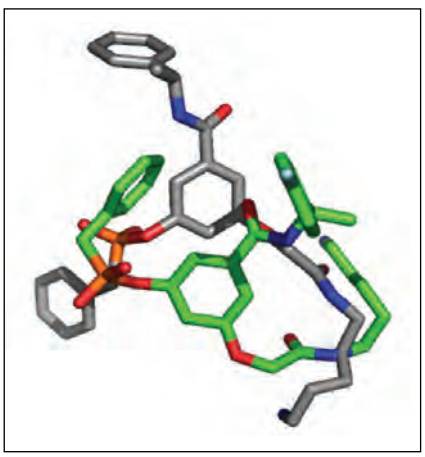


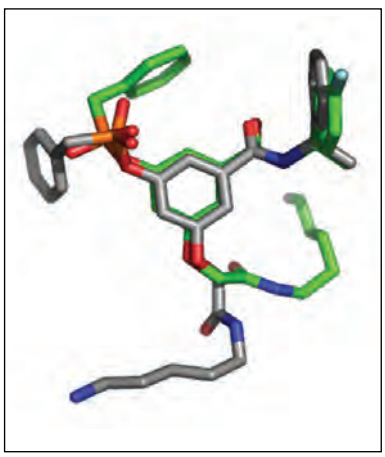
Fig. 16 : Enrichment factor plot obtained for ROCS based GOLD docking is shown in context with other molecular docking methods together with their respective scoring functions.



ROCS based GOLD Docking *(T_{Shape} 0.62)*



Ligand Fit *(T_{Shape} 0.17)*



GOLD *(T_{Shape} 0.45)*

D. Relational Database of Antinarcotic Drugs

With the help of Oracle 9i software a database named Antinarcotic Drugs has been created with field names: Generic name, Trade name, Dosage level, Target types, Pharmacological action and Side effects. The information submitted under each field name has been retrieved from PubMed *(http://www.ncbi.nlm.nih.gov/pubmed/)*, Drug Bank *(http://www.drugbank.ca/)* and Drugs.com *(http://www.drugs.com/)*. The home pages of these sites contain links to the datafiles, journals, biomedical articles from where information has been obtained. The database contains 22 data (i.e. information on 22 antinarcotic drugs).

E. Contribution in BlockII units for Mtb database

Contributed by giving inputs for the data base structure of unit 2.5 (second line drugs - structure activity) and unit 2.6 (drug failures) for Mtb database.

Dr. Chitra Dutta and group

Identification and analysis of patterns and anomalies in microbial / mammalian genome sequences

(a) Distinct, ecotype-specific genome and proteome signatures in the marine cyanobacteria prochlorococcus

The marine cyanobacterium *Prochlorococcus marinus*, having multiple ecotypes of distinct genotypic/phenotypic traits and being the first documented example of genome shrinkage in free-living organism, offers an ideal system for studying niche-driven molecular micro-diversity in closely

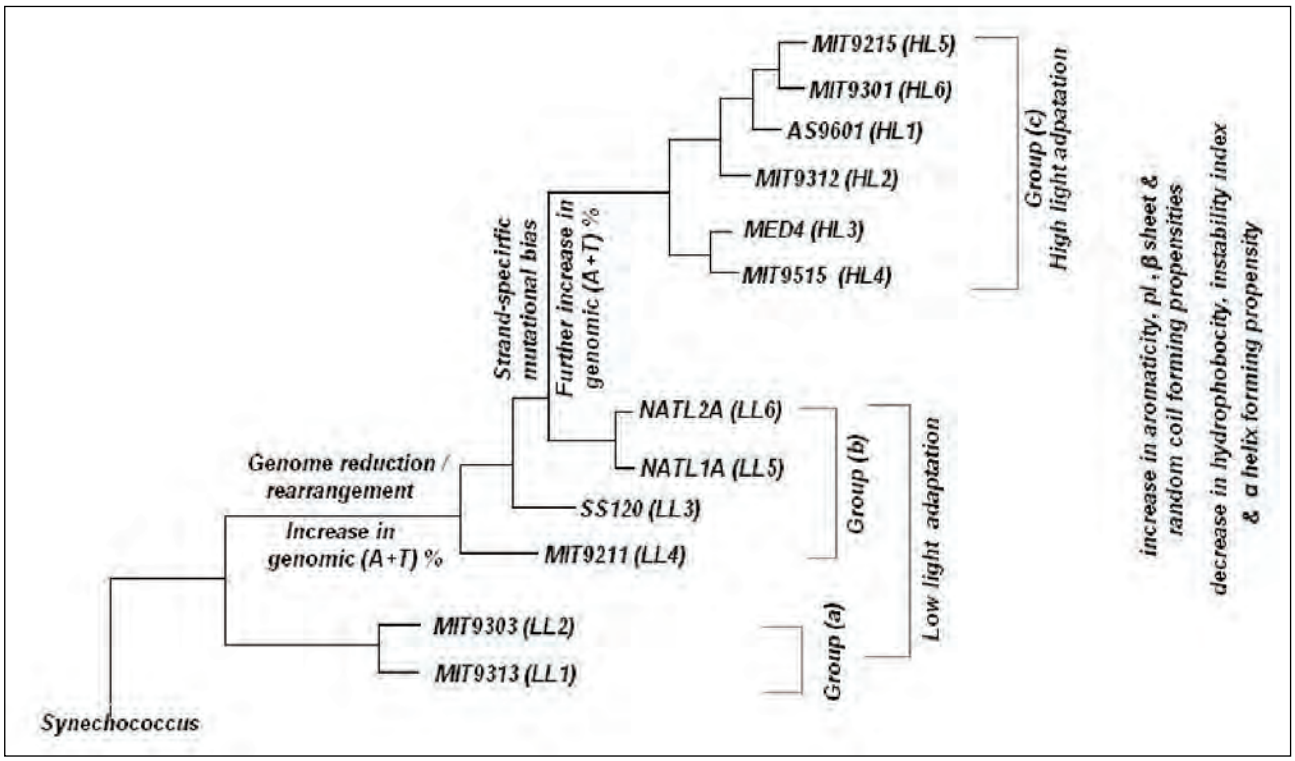


Fig. 17 : Trends in genome/proteome evolution of *Prochlorococcus* evolution, suggesting a stepwise diversification of major ecotypes. The model is based on the 16S rRNA phylogeny of the 12 strains of *P. marinus*, inferred from a bootstrap consensus tree (500 replicates) generated using the Minimum Evolution method (CNI algorithm), with the software MEGA (version 4).

related microbes. The present study, through an extensive, comparative analysis of various genomic/proteomic features of 6 high-light adapted (HL) and 6 low-light adapted (LL) strains, makes an attempt to identify molecular determinants associated with their vertical niche partitioning. Pronounced strand-specific asymmetry in synonymous codon usage is observed exclusively in LL strains. Distinct dinucleotide abundance profiles are exhibited by 2 LL strains with larger genomes and G+C-contents ≈ 50% (group LLa), 4 LL strains having reduced genomes and 35-37% G+C-contents (group LLb) and 6 HL strains. As one moves from LLa to LLb to HL strains, one observes a gradual increase in average aromaticity, pI values and beta- & coil-forming propensities and decrease in mean hydrophobicity, instability indices and helix-forming propensities of core proteins. Greater variations in orthologous gene repertoire are found between LLa and LLb strains, while higher number of positively selected genes exist between LL and HL strains. Strains of different *Prochlorococcus* groups are characterized by distinct compositional, physico-chemical and structural traits that are not mere remnants of a continuous genetic drift, but are potential outcomes of a grand scheme of niche-oriented stepwise diversification (Fig. 17), that might have driven them chronologically towards greater stability/fidelity and invoked upon them a special ability to inhabit diverse oceanic environments.

(b) Molecular modeling of Helicobacter pylori HPAG1 proteins in quest of novel drug targets

An attempt has been made to identify novel putative targets for therapeutic intervention in the gram-

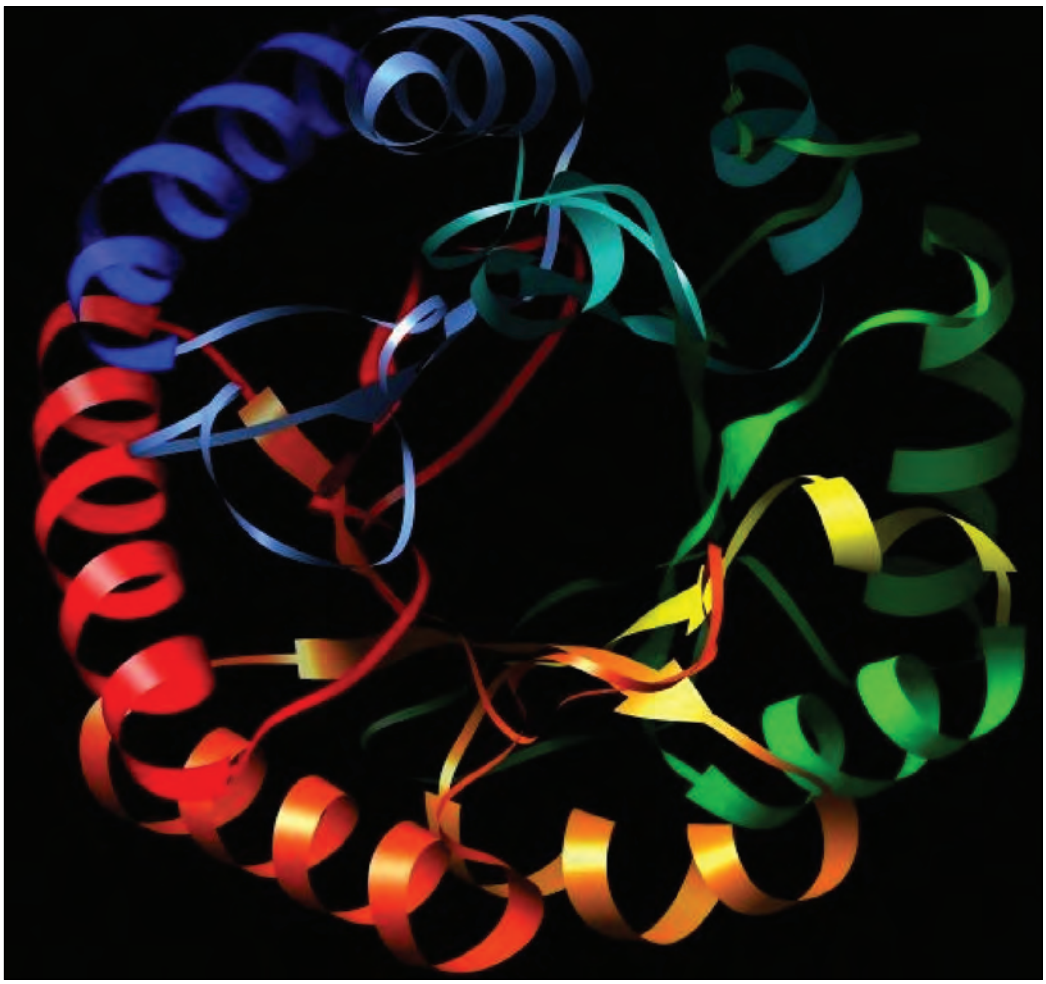


Fig. 18 : Structure of 2-dehydro-3-deoxyphosphooctonate aldolase of *H. pylori HPAG1*

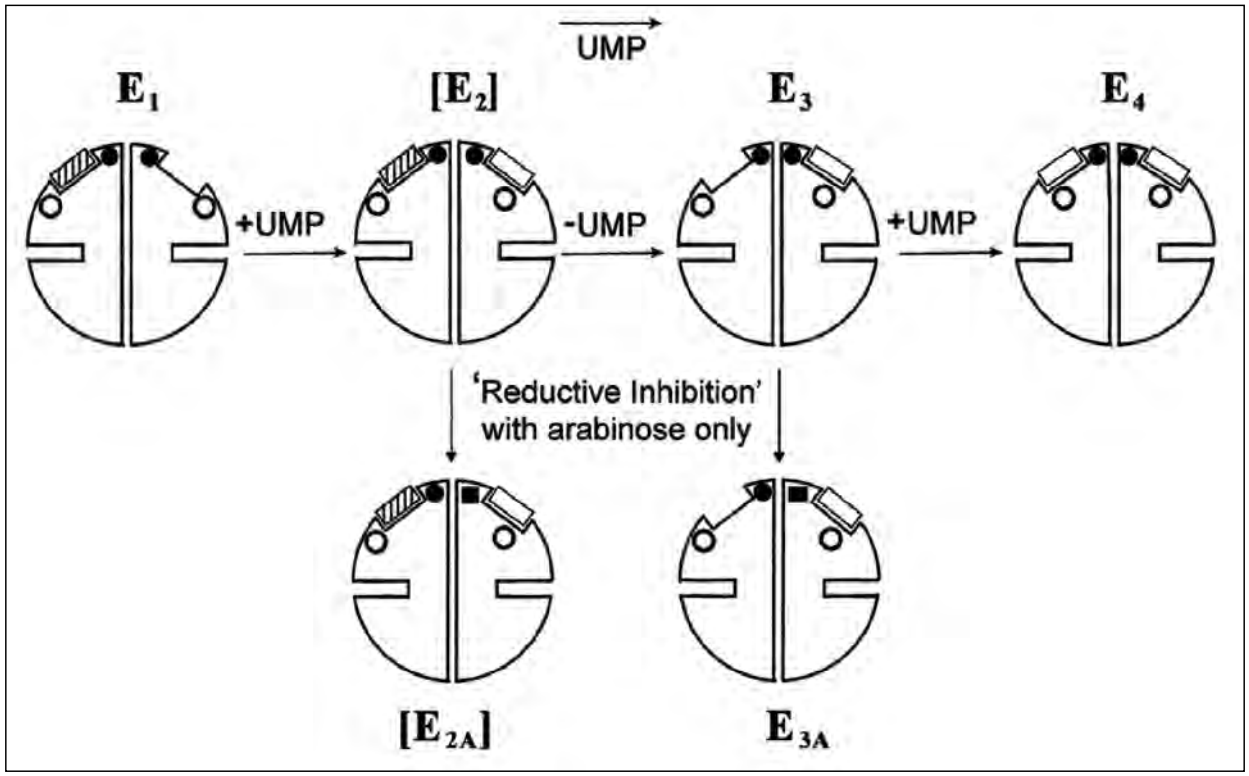
negative bacteria *Helicobacter pylori* HPAG1 that may cause peptic ulcer diseases and even gastric carcinoma. There are two crucial factors for determination of potential drug targets among the genes identified in a pathogenic genome: essentiality and conservation. The targeted proteins must be essential for the growth, replication, viability or survival of the pathogenic organism, i.e. encoded by genes critical for pathogenic life stages. The target protein should not have any well-conserved homolog in the host in order to address cytotoxicity issues. Using metabolic pathway analysis of the organism and genome sequence data, potential essential genes of *H. pylori* HPAG1 have been identified. Conservation of different essential genes has been studied by searching similarity between pathogenic proteins and human proteins through BLAST. Due to lack of experimental data on the 3D-structures of the respective proteins, computational methods for structure prediction, especially the homology modeling approach are being used to predict their 3D structures (Fig. 18). From further investigation of modeled structures, it may be possible to identify potential drug targets and their relative positions in the targeted proteins. These findings are likely to open up opportunities for using the powerful computational techniques for development of new drugs that will bind those identified targets.

Dr Debasish Bhattacharyya and group

Functional regulation and assembly of multimeric enzymes, stability and spectroscopic properties of enzymes, characterization of venom toxins and the drug 'Placentrex'

The enzyme, UDP-galactose 4-epimerase from yeast and *E. coli* that reversibly converts UDP-galactose to UDP-glucose, plays a fascinating role for enzymologists because of its bound NAD and underlying oxido-reductase type of mechanism. The catalytic site of this enzyme from yeast *Kluyveromysis fragilis* was believed to be constituted of two subunits (subunit sharing model) till 2000. Since then, hysteretic kinetic behavior and binding of one mole of 5'-UMP, a competitive inhibitor to the enzyme raised serious doubt about the validity of the existing model. Now we have conclusively demonstrated that the enzyme has two independent catalytic sites that are allosterically regulated (Scheme 1). Since kinetic evidences cannot prove a reaction mechanism rather disprove one, we also have physically identified an intermediate enzyme conformer where one of the catalytic site is selectively inactivated by chemical modifications. While elaborating the kinetic parameters of the two catalytic sites, they were separately characterized where significant difference of properties were observed. It appears that the catalytic sites of the inhibitor free enzyme operate simultaneously but at different rates. Currently we are trying to distinguish the catalytic sites on the basis of inhibitory profiles.

Kinetically stable proteins are of considerable industrial interest as they are resistant to denaturation and inactivation. Further, they can unravel the code of protein stability. While sustaining studies on bromelain, a plant cysteine protease of medical importance, we have developed a protocol for screening kinetically stable proteins based on their resistant to SDS binding. SDS treated proteins were passed through Extracti-Gel, a detergent remover. Bound SDS was quantified by a fluorescent dye Rhodamine B. In the snake venom studies, earlier we have reported characterization of L-amino acid oxidases from Russell's viper venom. It is a FAD dependent enzyme. Currently we are trying to synthesize its transition-state based inhibitors.



Proposed model of conversion of E_1 to E_4. (Scheme 1)

Scheme 1 : E_1, epimerase containing one 5'-UMP per dimer bound as isolated (native epimerase); $[E_2]$, an intermediate of the conversion where the unoccupied 5'-UMP-binding site of E_1 is occupied by the added 5'-UMP (the bracket indicates its transient character); E_3, stable intermediate where the 5'-UMP bound *ex vivo* to E_1 is replaced allosterically by the added 5'-UMP; E_4, epimerase where both the 5'-UMP binding sites are occupied by added 5'-UMP; $[E_{2A}]$, product of reductive inhibition of $[E_2]$ with L(+)-arabinose (the bracket indicates uncertainty about its existence); E_{3A}, product of reductive inhibition of $[E_3]$ with L(+)-arabinose. The two lobes in all the structures indicate homodimeric epimerase; the flange at the middle of each lobe separates the epimerase (upper) and mutarotase (lower) domains of a monomer; the rectangular denting of the upper domains of each lobe indicates the binding site of 5'-UMP *ex vivo*; the shaded rectangle indicates 5'-UMP bound as isolated; the open rectangle indicates added 5'-UMP; •, NAD, NADH, o, arginine at the active site; o over the 5'-UMP binding site indicates protection against trypsinization; circumference of the lobe next to the site indicates susceptibility to the protease; +UMP and -UMP indicate its association and dissociation; the arrow on the top of the scheme indicates the direction of 5'-UMP-dependent conversion of epimerase. The symmetrical pattern of the dimeric enzyme as shown is a working model only.

Characterization of the drug 'Placentrex', a drug-house sponsored project has completed its 10 years term (1999-2009). It is a hot and cold aqueous extract of human placenta that is used as a wound healer. The manufacturing process also includes stringent sterilization since the drug is injectable. We are surprised to see that the drug retains proteolytic activity probably from reversible thermal denaturation. This is of significance as regulation of proteolysis is an indispensable part in fast and proper wound healing without scar formation. Probably small peptide/s are the causative agents as larger proteins usually undergo irreversible thermal denaturation. The component has been identified but additional evidences are required to prove its existence.

Dr. Saumen Datta and group

Structural investigations of macromolecules and their complexes by X-ray diffraction methods

A) Structural investigation of proteins related to Type-III secretion system (TTSS) from Pseudomonas aeruginosa

Pseudomonas aeruginosa a gram negative pathogenic bacteria causes mild to severe infections to immunocompromised people and is a major cause of mortality world wide for cystic fibrosis patients. Like many other pathogens it also armed with TTSS for its virulence. TTSS comprises of a needle like complex called injectosome, effector proteins, translocator proteins, and associated chaperones. One of the research focus of this laboratory is to structural characterization of translocator proteins.

Overexpression, refolding, purification of PopB, PopD and PcrH

Current literature reveals three proteins PopB, PopD and PcrH involved in translocation of *Psedumonas aeruginosa's* virulent proteins. DNA fragments encoding all three proteins were PCR amplified from genomic DNA of *Pseudomonas aeruginosa* (ATCC, catalogue # 39324). All the fragments were inserted in petDUET1 vectors and were then overexpressed in *Escherichia coli* BL21(DE3). Fig. 19 shows the successful overexpression of PopB (with N-terminal His-Tag is ≈ 42 KD) and PopD (with N-terminal His-Tag is ≈ 32 KD).

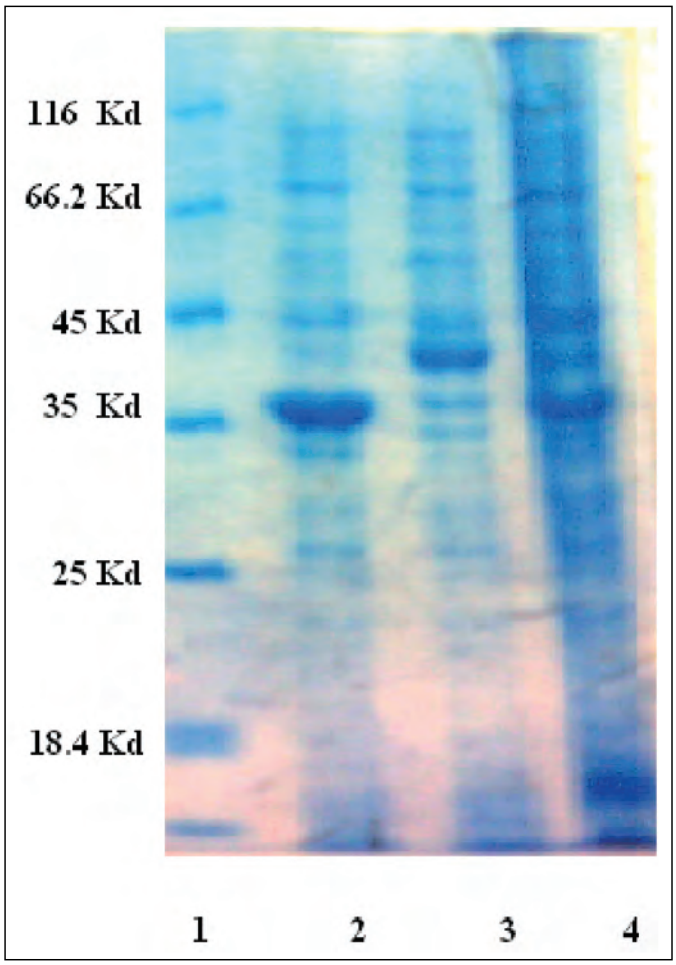


Fig. 19 : Expression of recombinant PopB and PopD at 37°C. Lane 1: Protein Marker, Lane 2: PopD N-terminal His-tag induced, Lane 3: PopB N-terminal His-tag induced, Lane 4: Uninduced cells (PopD).

Overexpreesed PopB and PopD behaved very similarly and were found in the inclusion bodies. Although, parallel experiments were performed for both the proteins, here results will be discussed for PopD only. A detail experiments were performed (Fig. 20) to understand specific localization of PopD/PopB to extract them from the inclusion bodies.

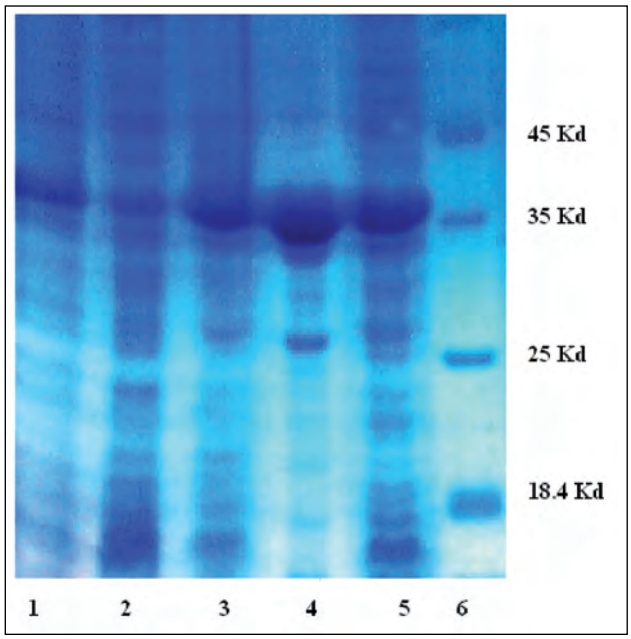


Fig. 20 : Localization of overexpressed PopB and PopD proteins in *E. Coli* cells. Lane 1: induced PopD, Lane 2: PopD in supernatant, Lane 3: PopD in cell debris, Lane 4: PopD in inclusion bodies 1, Lane 5: PopD in inclusion bodies 2, Lane 6: protein marker.

PopD/PopB were extracted from inclusion bodies in denatured state and were refolded. Refolded proteins were purified with Ni-NTA resin using 6xHis tag. Refolded and purified PopD/PopB were analyzed on SDS-PAGE as shown in Fig. 21.

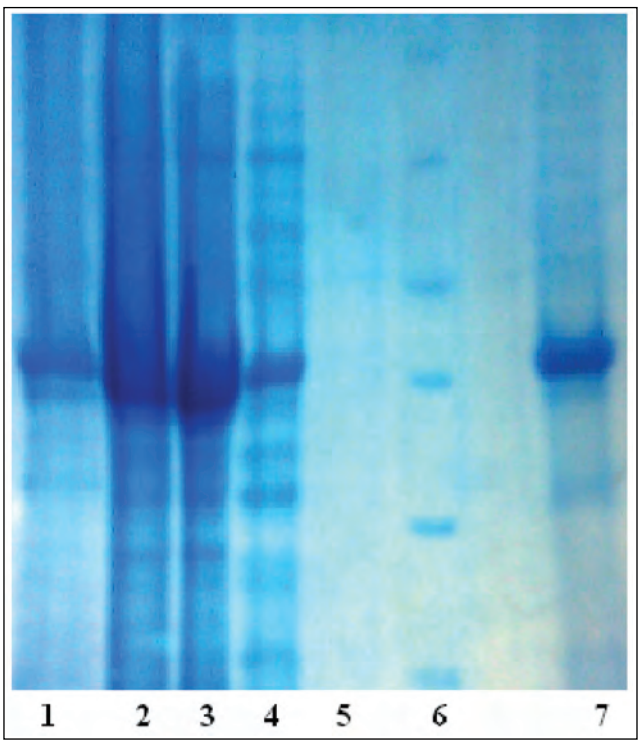


Fig. 21 : Refolding and purification of N-terminal his-tagged PopD from inclusion bodies [treated with 6M guanidine hydrochloride] by affinity chromatography using Ni-NTA resin. (Lane 1: PopD Induced, Lane 2: PopD refolded in solution, Lane 3: Unbound PopD after passing through Ni-NTA column, Lane 4 and 5 show wash-1, wash-2 respectively of Ni-NTA column with buffer. Lane 6: Protein marker, Lane 7: refolded PopD eluted from Ni-NTA).

To ensure proper refolding, a binding assaya was performed for PopB/PopD with recombinantly expressed PcrH. PcrH a well known TTSS chaperone for both and was successfully overexpressed in soluble form. To do the assay following experiments were performed. Refolded and purified His-PopB/PopD were passed through Ni-NTA column followed by PcrH (with out His tag). After extensive washing Ni-NTA column was then eluted with elution buffer. The fractions from different experimentals steps were collected and analysed on a SDS-PAGE (Fig. 22). From lane 8 and 9 of Fig. 22 it is evident that both PopB, PopD were eluted out from the column in complex with PcrH.

B) Characterization of Type-III secretion system proteins from Y. enterocolitica

Yersinia enterocolitica is a gram-negative, coccobacillus-shaped pathogenic bacterium. It belongs to Enterobacteriaceae family and causes mild to severe gastroenteritis and mesenteric lymphadenitis utilizing TTSS. It posses two type III secretion systems, the plasmid-encoded Ysc-Yop system and the chromosomal encoded system Ysa-Ysp system. The research focus is structural characterization of the proteins encoded in *lcrGVsycDyopBD* operon of *Yersinia enterocolitica* (ATCC, catalogue # 51871).

Recombinanat SycD, when overexpressed at 27°C, was found in solution. The substrate of SycD, translocator proteins, YopB and YopD could not be overexpressed individually. YopB cloned with SycD in petDUET1 also did not show any overexpression. Whereas, YopD/SycD in petDUET1 shows some expression (Fig. 23). A strong induction band of SycD as shown in fugure 5 was found to be in the soluble form (lane 3), but a negligible amount of expression of YopD was noticed in cell debris (lane 2).

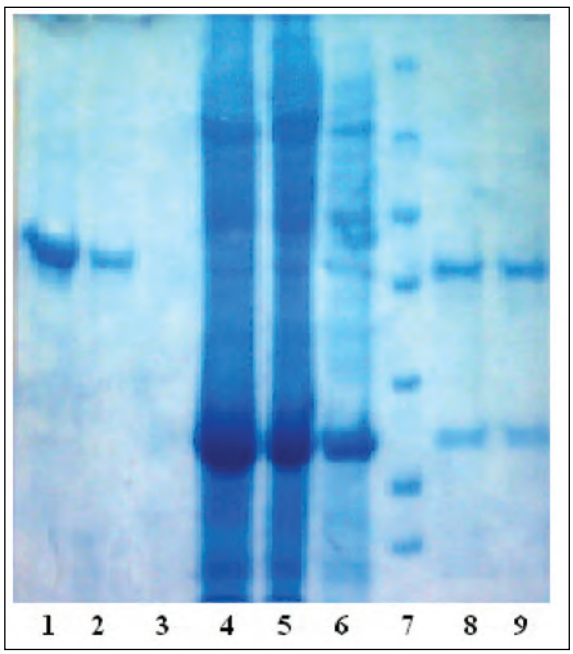


Fig. 22 : Expression and purification of PopD/PcrH complex (Lane 1: refolded PopD before passing through Ni-NTA column, Lane 2: PopD collected from flow through, Lane 3: PopD collected in column wash, Lane 4: PcrH supernatant, Lane 5: PcrH coolected from flow through, Lane 6: PcrH wash, Lane 7: Protein marker, Lane 8: PopD/PcrH elution-1, Lane 9: PopD/PcrH elution-2).

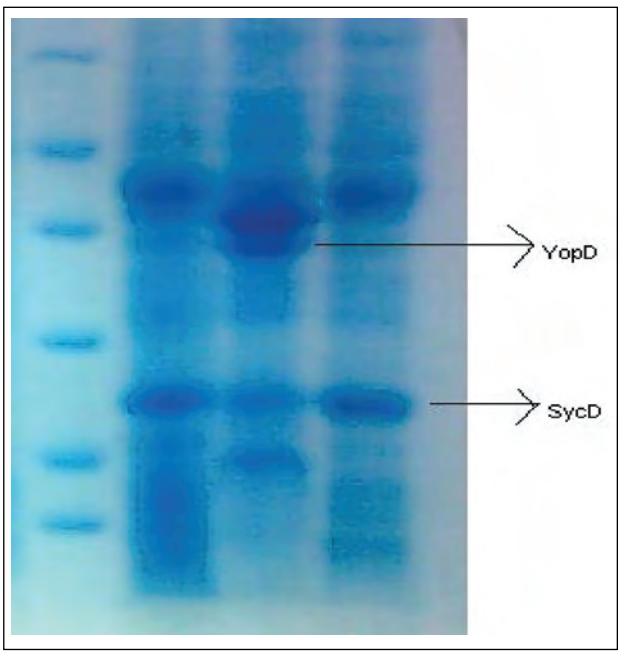


Fig. 23 : Expression of YopD and SycD (complex in separate operon). Lane 1: Molecular weight marker. Lane2: Shows the induction bands of YopD and SycD. Lane3: Shows the expression of YopD and SycD in Pellet. Lane4: Shows the expression of only SycD in supernetant but no band for YopD

Expression and Purification of LcrG-LcrV complex:

The LcrG-LcrV complex in pETDuet-1 vector was expressed in *Escherichia coli* BL21(DE3). The post-sonicated supernatant was purified by Ni-NTA column (Fig. 24). This purified LcrG-LcrV complex was then dialysed against dialysis buffer and concentrated. Further purification was carried out by Sephacryl S-200 gel filtration column (Fig. 25) and initial crystallization trials were set up.

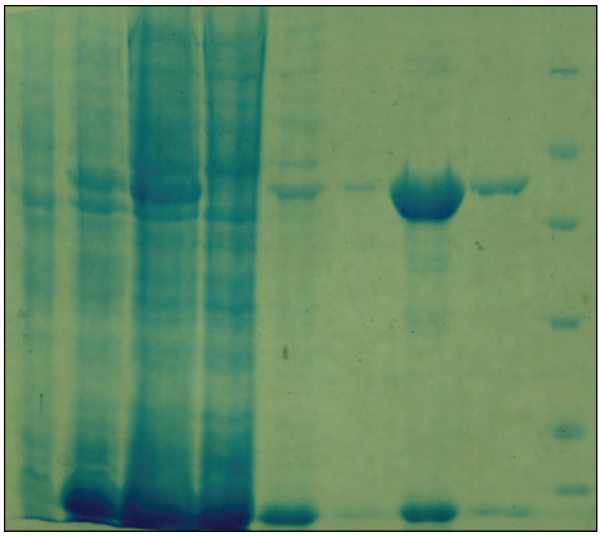


Fig. 24 : Expression of LcrG-LcrV (LcrV with His-tag) in BL-21(DE3). Lane1-Uninduced Bl21(DE3)expressing LcrG-LcrV in pETDuet-1, Lane2- Induced Bl21(DE3)expressing LcrG-LcrV in pETDuet1,Lane3-Post sonicated supernatant, Lane4-flow through from Ni-NTA column, Lane5-First wash from Ni-NTA column, Lane6-Second wash from Ni-NTA column, Lane7-First elution of LcrG-LcrV complex from Ni-NTA column, Lane8-Second elution of LcrG-LcrV complex from Ni-NTA column, Lane9-Marker(116kd, 66.2kd, 45kd, 35kd, 25kd, 18.4kd, 14.4kd from top).

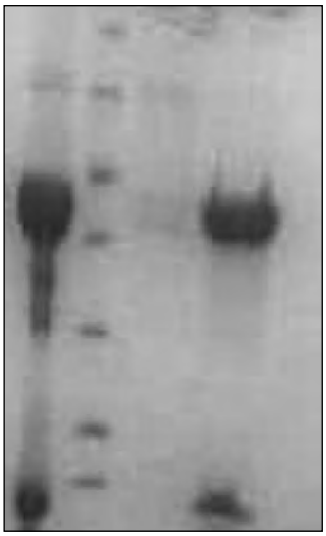
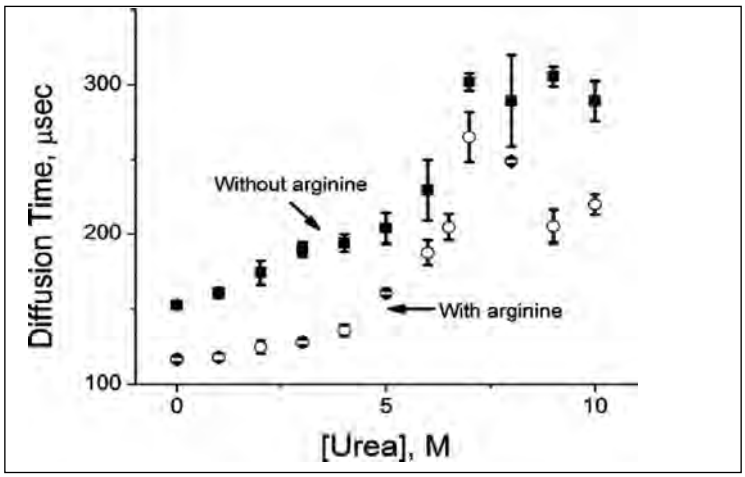


Fig. 25 : Further purification of LcrG-LcrV by Sephacryl S-200 gel filtration column. Lane1-LcrG-LcrV complex before gel filtration, Lane2- Marker (116kd, 66.2kd, 45kd, 35kd, 25kd, 18.4kd, 14.4kd from top), Lane3- LcrG-LcrV complex after gel filtration.

Dr Krishnananda Chattopadhyay and group

Effect of arginine and other stabilizers on protein aggregation using fluorescence correlation spectroscopy and other biophysical methods

We have been studying protein conformation, dynamics and aggregation using different biophysical methods including Fluorescence correlation spectroscopy (FCS). FCS is an important technique to measure the diffusional and conformational fluctuations of fluorescently labeled molecules at single molecular resolution. These fluctuations could be analyzed by using suitable correlation functions yielding useful information regarding the shape and/or conformational dynamics of a protein. In a recent study, we have shown by a number of orthogonal techniques including analytical ultracentrifugation, dynamic light scattering and native gel electrophoresis that aggregation of bovine serum albumin can be minimized by using high concentration of arginine. Urea induced unfolding transition of bovine serum albumin has been studied by FCS. Formation of an intermediate state has been detected. Addition of arginine has been shown to inhibit formation of that intermediate. The hydrodynamic radii of the protein in its native, unfolded, and intermediate states have been determined using FCS.



Dr. Subrata Adak and group

Biochemistry of a novel plant like ascorbate peroxidase from Leishmania major

Leishmaniasis continues to be a major health problem globally. The situation is becoming alarming due to the lack of an effective vaccine or cost-effective drug. Most available drugs are costly, require long treatment regimes and are becoming more and more ineffective necessitating the discovery of new drugs. Heme peroxidases are a class of multifunctional redox-active proteins found in all organisms. We recently cloned, expressed, and characterized an ascorbate peroxidase from *Leishmania major* (LmAPX) that was capable of detoxifying hydrogen peroxide. Localization studies using green fluorescent protein fusions revealed that LmAPX was localized within the mitochondria by its N-terminal signal sequence. Subcellular fractionation analysis of the cell homogenate by the Percoll density-gradient method and subsequentWestern blot analysis with anti-LmAPX antibody further confirmed the mitochondrial localization of mature LmAPX. Submitochondrial fractionation analysis showed that the mature enzyme (~3.6 kDa shorter than the theoretical value of the whole gene) was present in the intermembrane space side of the inner membrane. Moreover, expression of the LmAPX gene was increased by treatment with exogenous H_2O_2, indicating that LmAPX was induced by oxidative stress. To investigate the biological role of LmAPX we generated *Leishmania* cells overexpressing LmAPX in the mitochondria. Flow-cytometric analysis, thin-layer chromatography, and IC50 measurements suggested that overexpression of LmAPX caused depletion of the mitochondrial ROS burden and conferred a protection against mitochondrial cardiolipin oxidation and increased tolerance to H_2O_2. These results suggest that the single-copy LmAPX gene plays a protective role against oxidative damage. Although the plant APX has been extensively characterized and shown to be responsive to several environmental stresses, almost nothing is known about the physiological function of LmAPX. It is therefore important to understand what the exact function of LmAPX is.

Dr. Jayati Sengupta and group

Cryo-electron microscopy studies of biological macromolecules

Our aim is to determine the structures of biological macromolecules using 3D cryo-electron microscopy. We have been purifying bacterial ribosomes, a very suitable and well studied macromolecule for cryo-

EM studies, in order to standardize the cryo-EM sample preparation, and microscopy. Preliminary negative-stain experiments are being carried out.

Simultaneously, we are putting active effort to establish a state-of-the-art cryo-EM facility, first of its kind in India, at IICB, Kolkata, with the help and support from the Director, IICB.

Technical Staff

Mr. Samir Roy, Dr. (Mrs.) Aparna Laskar, Dr. Subhagata Ghosh, Mr. Prosenjit Gangopadhyay, Mr. Mohanlal Jana, Mr. Jishu Mandal.

Pool Officers, RAs, Research Fellows

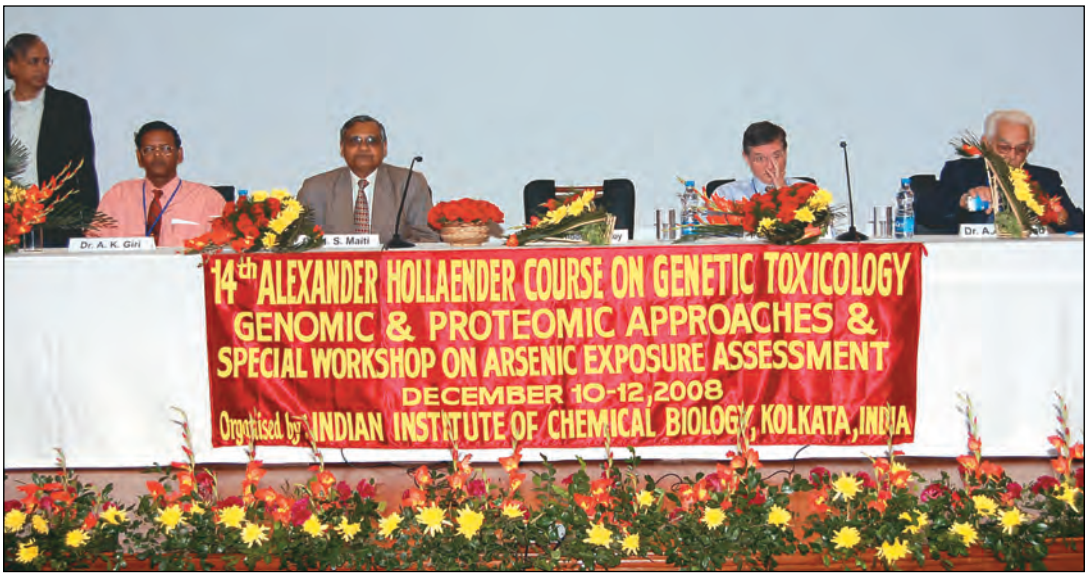
Dr.Shampa Mallick, Dr.Rajesh Saha, Neeladri Shaker Roy, Avishek Majumder, Prasenjit Chakraborty, Gitashri Naiya, Israr Ahmed, Piya Ghosh, Payel Ghosh, Sisir Nandi, Anirban Dutta, Munmun Sarkar, Aranyak Goswami, Savita Bhutoria, Nahren Manuel, R.Vijayan, Prabu. M., Indrani Bera, Lakshmi Maganti, Dr Reema Bhattacharya, Debashree De, Nupur Banerjee, Debratna Saha, Sangeeta Dutta, Jyotirmoy Mitra, Payel Bhattacharjee, Anwesha Majumder, Supratim Das, Urmisha Das, Atanu Das, Abhishek Basu, Rakesh Chatterjee, Dr. Rina Shaha, Subhankar Dolai; Rajesh Yadav; Swati Pal; Moumita Bose; Supratim Mukherjee, Sumit Sen santara, Jayasree Roy, Sunny Sharma, Ranendu Ghosh, Shubhasis Haldar, Sujit Basak, Nidhi Joshi, Manidip Shasmal

Summer Trainees

Ballari Das, Sangita Saha, Deblina Patra, Soumen Chakraborty, Mitul Bhattacharya, Lakshmi Maganti, Sanjit Das, Sweta Khanna, Manoj Damale,

Sitting on the podium from left Prof. S. Roy, Prof. S.K.Brahmachari and Dr. Hiroaki Kitano in mini-symposium on "Systems Biology and Proteomics in Biomedical sciences" was held at Kolkata from 27-29 March 2009

Celebration of National Science Day at IICB



The inaugural session [From Left: Dr. Siddhartha Roy (Director, IICB), Dr. A. K. Giri (Organizing-Secretary, 14th AHC), Dr. H. S. Maiti (Director, CGCRI), Dr. David DeMarini (President, IAEMS) and Dr. A. B. Prasad (President, EMSI)]

Network Project

ELEVENTH FIVE-YEAR PLAN (2007-12) PROJECTS

In Eleventh Five Year Plan, IICB is involved in **16** projects of which four **(4)** are **Nodal Network Projects** and twelve (**12**) are **Partner Network Projects**. In Partner Network Projects, there are two **(2) extension Projects of Tenth five-year Plan** namely **In-silico Biology** and **Bioactive**.

All the projects are mainly from **Biology & Biotechnology sector** except one (**1**) nodal network project **(Asthma)** which is from **Pharmaceuticals, Healthcare & Drugs sector**. The projects are mentioned hereunder with the names of Nodal Scientists of IICB.

No.	Project Title & Short Name	Proj. Code	Type of Project	Nodal Lab.	Nodal Scientist of IICB
1.	Evaluation and correction of mitochondrial dysfunction in disease **(Mitochondria)**	**SIP-007**	Supra-institutional	IICB	Dr. Samit Adhya
2.	Engineering peptides and proteins for new generation therapies **(Protein Engineering)**	**NWP-005**	Nodal Network	IICB	Dr. Anil K. Ghosh
3.	Development of diagnostics and target-based molecular medicines against allergy, bronchial asthma and chronic obstructive pulmonary disease **(Asthma)**	**NWP-033**	Nodal Network	IICB	Dr. Arun Bandyopadhyay
4.	New insights in cancer biology: Identification of novel targets and development of target based molecular medicine **(Cancer)**	**IAP-001**	Nodal Inter-agency	IICB	Dr. Susanta Roychoudhury
5.	Plasma Proteomics in health, environment and disease (**Plasma Proteomics**)	**NWP-004**	Partner – Network	CCMB	Dr. Rukhsana Chowdhury
6.	Nanomateials and nano-devices for application in health and disease **(Nanomaterials)**	**NWP-035**	Partner – Network	CCMB	Dr. Arindam Banerjee
7.	Pathway engineering and system biology approach towards homologous and heterologous expression of high-value phytoceuticals **(Pathway Engineering)**	**NWP-008**	Partner – Network	CIMAP	Dr. Debasish Bhattacharya
8.	Biological and chemical transformation of plant compounds for production of value added products of therapeutic/aroma value **(Aroma Value)**	**NWP-009**	Partner – Network	CIMAP	Dr. Sibabrata Mukhopadhyay
9.	Identification and validation of drug targets for selected pathogens of national importance (**Drug Target**)	**NWP-038**	Partner – Network	CDRI	Dr. Pijush K. Das
10.	*Diabetes mellitus* – New drug discovery R&D, molecular mechanisms and genetic and epidemiological factors **(Diabetes)**	**NWP-032**	Partner – Network	CDRI	Dr. Sibsankar Roy

No.	Project Title & Short Name	Proj. Code	Type of Project	Nodal Lab.	Nodal Scientist of IICB
11.	Zero Emmision Research Initiative **(Zero Emission)**	**NWP-044**	Partner – Network	CLRI	Dr. Suman Khowala
12.	Exploitation of India's rich microbial diversity **(Metagenomics)**	**NWP-006**	Partner – Network	IMT	Dr. Tushar Chakraborty
13.	Comparative genomics and biology of non-coding RNA in human genome **(Micro-RNA)**	**NWP-036**	Partner – Network	IGIB	Dr. G. Suresh Kumar
14.	Drug Target Development using In-silico Biology (**In-silico Biology**)	**CMM-017**	Partner – Network	IGIB	Dr. Chitra Dutta
15.	Discovery, Development and Commercialization of New Bioactives and Traditional Preparations **(Bioactive)**	**COR-023**	Partner – Network	CSIR-HQ	Dr. Pratap K. Das/Dr. HK Majumder
16.	Integrated Analysis for Impact, Mitigation and Sustainability (IAIMS): Regional Climate Modelling at Decadal Scale **(Climate Change)**	**NWP-052**	Partner – Network	CMMACS, Bangalore	Dr. A.K. Giri

NODAL PROJECTS

1. Title: Evaluation and Correction of Mitochondrial Dysfunction in Disease

Project: Supra-institutional [SIP-007]

Objectives:

- To investigate alterations in mitochondrial genes and proteins in primary open angle glaucoma (POAG), using POAG DNA samples and ocular cell models.
- To investigate mutations in the mitochondrial genome and abnormalities of mitochondrial function in relation to the diverse phenotypes among patients with Wilson's disease.
- To investigate mitochondrial gene expression and oxidative stress in hypertrophic heart induced by hyperthyroidism excess of anti-inflammatory drugs.
- To test whether neurodegeneration and mitochondrial decline are correlated in human patients and in animal models of Parkinson's disease.
- To investigate mitochondrial dysfunction in diabetes type 2 with special emphasis on the role of PGC1 and uncoupling proteins.
- To investigate mitochondria of eukaryotic pathogens as possible targets for correctional measures.
- To study the role of mitochondrial Reactive Oxygen Species in cancer cell apoptosis and drug resistance.
- To examine mitochondrial functions in ischemic brain (rat model of neurodegenerative diseases) and delivery of correctional complexes and nanoparticles to such brains.

- To develop strategies to correct the effects of disease-causing mitochondrial tRNA mutations (e.g., the tRNALys mutation in Myclonic Epilepsy with Ragged Red Fibers) using a tRNA import complex in patient-derived cybrid models, to develop methods for RNA delivery to mitochondria, and to study the pathways of the intracellular uptake and targeting of such complexes to mitochondria.
- To study the role of *Plasmodium falciparum* mitochondria for the parasite growth and liver mitochondrial dysfunction and associated apoptosis during host-parasite (malaria) interaction.
- To study mitochondrial disorder on the development of *Helicobacter pylori* mediated and non-mediated gastropathy.

Significant achievements made during the second year (2008-2009):

- We have collected blood samples from 150 primary open angle glaucoma patients and 100 control subjects with detail clinical characterization. The genomic DNA has been prepared from the samples.
- The downregulation of mitochondrial mRNAs in mammalian cells was achieved by the delivery of antisense RNA using the Leishmania RNA Import Complex A rat model for antisense mediated mitochondrial dysfunction was developed.
- Mitochondrial membrane fluidity was measured by fluorescence anisotropy changes of the lipophilic probe 1,6-diphenyl-1,3,5-hexatriene (DPH). The anisotropic value was decreased in the mitochondrial membrane when treated with STZ and in hypothyroid condition; Superoxide dismutase (SOD) activity in the muscle of STZ-induced diabetic animals was decreased compared to normal; mitochondrial membrane potential has been increased in hyperinsulinemia and hyperglycemia, whereas, the metformin-treated cells showed no change in the membrane potential; mitochondrial DNA from 48 POAG patients sequenced for abnormalities; myocilin mutants generated; in dexamethasone induced cardiac hypertrophy, there was increased collagen deposition, lipid peroxidation, expression of hypoxia-inducible factor, SOD, and heat shock protein 70, and decreased O_2 consumption, catalase activity, and PGC1 alpha expression; cerebral ischemia- reperfusion induced mitochondrial damage was noticed in rat brain, treatment with polylactide co-glycolide nanocapsulated quercetin restored the biochemical functions, extended a significant protection to mitochondria against the oxidative attack and simultaneously restored the mitochondrial function and its membrane integrity.
- Lansoprazole was found to protect and heal gastric mucosa from non-steroidal anti-inflammatory drug (NSAID)-induced gastropathy by inhibiting mitochondrial as well as Fas-mediated death pathway with concurrent induction of mucosal cell renewal; scavenging ROS was found to enhance efficacy of imatinib, the small molecule inhibitor of Bcr-Abl kinase and a successful drug for chronic myeloid leukemia.
- Positive modulation of intracellular cAMP resulted in blockage of cell cycle progression and induction of resistance against oxidative damage; phosphodiesterase A (pde A), the soluble isoform is differentially regulated and responsible for the elevated levels of cAMP in differentiation condition.
- Carrier complexes R6 and R8 were prepared by in vitro reconstitution of the active tRNA import complex from 6 or 8 bacterially expressed subunits, and shown to be active in delivering RNA to human cells.

R&D Outputs during the second year (2008-2009):

Patents: 1 (one)

Total Number of Publications: 7 (seven)

2. **Title:** Engineering Peptides & Proteins for New Generation Therapies.

   Project: Nodal Net Work [NWP-005]

   Nodal Laboratory: Indian Institute of Chemical Biology (IICB), Kolkata

   Participating CSIR Institutes:

   Institute of Microbial Technology (IMT), Chandigarh

   Institute of Genomics and Integrative Biology (IGIB), Delhi

   Centre for Cellular and Molecular Biology (CCMB), Hyderabad

   Central Drug Research Institute (CDRI), Lucknow

Objectives:

- To engineer defensins of lesser complexity and enhanced anti-microbial properties.
- Designing and development of some novel small anti-microbial peptides with reduced toxicity.
- Development of peptidomimetics to block protein-protein interaction at the same time membrane penetration capability and increasing bioavailability.
- To study protein mis-folding and aggregation through engineering protein that does not mis-fold and aggregate.
- To engineer small peptides, which are equivalent to larger transcription factor-with Protein Transduction Domains for cell entry.
- Designing and development of recombinant proteins with much more stability and reduced toxicity, which can be used to cure certain life threatening diseases.
- New engineering techniques will be developed to produce proteins with new activities: implication in vaccine developments.
- To develop process for production of engineering protein.
- To engineer streptokinase having weaker immune response towards increasing their utility.

Significant achievements made during the second year (2008 – 09):

- Two enzymes, commercially available Alcohol Dehydrogenase and Acid Trehalase, purified in laboratory from *S. cerevisiae* were utilized for this study. Heat induced inactivation of Acid Trehalase showed a higher rate of deamidation and isoaspartyl formation than Alcohol Dehydrogenase. Amino acid analysis of both the enzymes showed a higher percentage of Aspartic acids residues in Acid Trehalase than Alcohol Deydrogenase leading to such an observation.

- Design of a novel catalyst for the biofuels area: Designed and produced a novel cellulase incorporating (in the form of a fusion protein) the catalytic domains of a 224 amino acids long endoglucanase from *Rhodothermus marinus*, a 643 amino acids long exoglucanase from *Cellulomonas fimi*, and a 479 amino acids long beta-glucosidase from *Streptomyces sp*. QM-B814, along with a cellulose-binding domain (CDB) of one the cellulases of C. fimi. Potential Biofuel catalyst.

- Produced and characterized three microbial tetrahedral (TET) aminopeptidases: the previously-uncharacterized *Bacillus subtilis* aminopeptidase (BsuAP), a Pyrococcus furiosus aminopeptidase (PfuAP), and a protein-engineered PfuAP-derived 'designer' aminopeptidase (MutAP) in which the entire active site of PfuAP is replaced with that of BsuAP through the making of 9 non-contiguous structure-guided mutations. The results provide tentative evidence that 'structure-guided transplantation' of active sites between proteins can help in recombining enzyme characteristics in interesting and unanticipated ways, to help create novel enzymes.

- Amplified three genes namely ribB, ribH and ribF, which encodes for 3,4-dihydroxy-2-butanone-4-phosphate synthase, Lumazine synthase and bifunctional RFK/ FAD synthetase respectively, from the genomic DNA of Salmonella.

  All the three genes were successfully cloned into pET28C vector and the sequence was verified by DNA sequencing. This constructs will express the protein with N-terminal His-tag fusion to help in protein purification by affinity chromatography.

  Three genes were transformed into BL21(DE3) and checked the expression of the protein individually.

  Further studies related to structure determination by X-ray crystallography are in progress.

- Preliminary protein engineering experiments on the design and expression of Streptokinase-EGF chimeras- Epidermal growth factor (EGF) 456 domain of thrombomodulin was isolated by using gene-specific primers, and fusion constructs with full-length (414 residues) or partially truncated regions of SK at either/and N-terminal (EGF-SK) and C-terminal (SK-EGF) ends by overlap extension PCR method was carried out. The PCR products were cloned in pET 23-(d) vector under the control of the RNA polymerase promoter itself in a IPTG inducible lac promoter system, and their expression in BL21 (DE 3) cells was thereby obtained. Studies on optimizing expression in both *E. coli*, as well as obtaining biologically active chimeras in pure form, are under progress.

- Cloned the gene encoding interferon beta into *E.coli*. The following assay systems were standardized, which are required for analyzing the immunogenic potential of different IFN-beta peptide fragments by examining their effect on APC functions of dendritic cells and naïve T cell stimulation: Flowcytometry to analyze surface phenotype of dendritic cell, ELSA (IL-12p70, TNF-α, IL-10) using culture supernatants of T cells and dendritic cells, syngenic and allogenic mixed lymphocyte reaction (MLR). During the year, efforts were directed to transfect and express recombinant human proteins in CHO cell line, which are having therapeutic potential, including interferon beta.

  Designed a peptideomimetic based on annulment of electrostatic repulsion between phosphorylated Thr-18 and Asp-21 on p53 transactivation domain. Replacement of Asp-21 with lysine and Thr-

18 with glutamate or phosphothreonine results in a peptide with high affinity for Mdm2. Affinity is further enhanced by substitution of helicogenic □-aminoisobutyric acid in non-interacting positions. This latter peptide, with a cell penetrating tag, was tested for its effect on one melanoma cell line with wild-type p53 status (SK-Mel-5). It has been observed that the synthesized peptides cause massive apoptosis with about IC_{50} value of 10-15 μM. Upon attachment of a nuclear localization signal, the IC_{50} value dropped several fold indicating that targeting of nuclear pool of Mdm2 is most crucial for pro-apoptotic effect.

- Design of human defensin analogs with disulfide linkages similar to those found in conotoxins. Human β-defensins:Engineered C-terminal analogs were synthesized with one disulfide bridge and without a disulfide bridge. Defensins have been engineered such that attenuation of activity at high NaCl and KCl is absent. The engineered peptides also facilitate in-depth investigations on the mechanism of bacterial killing.
- A number of novel analogs of several naturally occurring antimicrobial peptides have been designed, synthesized and characterized. From these studies three manuscripts are under submission and one more manuscript will be re-submitted after revision.
- Generation of antibody against constrained epitope: Immunological studies were performed with AMA-1 sequence of *Plasmodium falciparum* and *Plasmodium yoelii*. The indicated AMA-1 sequence maintains α-helix conformation and it is presumed that this conformation is important for parasite invasion in host cells. To maintain α-helical conformation of the peptide three unnatural amino acid (AIB, amino isobutyric acid) were introduced into the peptide sequence which conferred stable α-helical conformation. The specific AMA-1 sequence of both the species was coupled to immunodominant T-cell epitope of ovalbumin with two lysine linkers. BALB/c mice were immunized and anti AMA-1 peptide specific antibody was measured by ELISA. Our study showed that there is a strong immune response against AMA-1 sequence in BALB/c mice upon immunization with the conjugate but not with AMA-1 peptide alone.
- A serine protease was purified from *Epicoccum fungus* that enhances allergic inflammation in lungs. A ~28 kDa allergen was purified from cockroach extract (Per a 10) showing protease acivity. Fragment of Alt a 13 (1-50 amino acid) shows maximum IgE reactivity. Double mutation at residues 21 and 27 in Alt a 13 abrogates IgE binding without affecting T cell reactivity.Mutated GST treatment reduces airway inflammation as compared to GST and has potential for asthma management. Bioinformatics and immunologic investigation of B and T cell epitopes of Cur l 3, a major allergen of Curvularia lunata. Cur l 3 Peptide 6 has maximum IgE binding with T cell proliferation capacity.

R & D Outputs during the second year (2007-2008):

Total Number of Publications: 18 (eighteen)

Patents with reference: 1 (one)

3. Title: Development of diagnostics and target-based molecular medicines against allergy, bronchial asthma and chronic obstructive pulmonary disease

Project: Nodal Net Work [NWP-033]

Nodal Laboratory: Indian Institute of Chemical Biology (IICB), Kolkata

Participating CSIR Institutes:

Institute of Genomics and Integrative Biology (IGIB), Delhi

Indian Institute of Chemical Technology (IICT), Hyderabad

Industrial Toxicology Research Centre (ITRC), Lucknow

Indian Institute of Integrative Medicine (IIIM), Jammu

Objectives:

- Development of animal model for asthma for evaluation of lead molecules in vivo.
- Testing 2-3 lead molecules for anti-asthma activity
- To synthesize NCEs for the biological evaluation as PDE-4 inhibitors.
- Toxicological and safety evaluation of lead molecules with anti-asthmatic activity; and evaluation of drug efficacy by plethysmography
- Basic research on the role of Stat3 and Socs3 in asthma pathogenesis.
- Determination of Pharmacokinetics, Absorption/ Transport, Biotransformation, and Distribution studies.

Significant Achievements made during the second year (2008-2009):

- Mouse model of asthma has been developed in IICB.
- ICB-11-D8 is found to be PDE 4 inhibitor and it inhibits asthma in mouse model.
- Toxicity of ICB-11-D8 is completed
- Pharmacokinetics of ICB-11-D8 is completed.
- ICT TA 49 significantly inhibits PDE 4 activity
- In vivo efficacy test with ICT-TA-49 has been initiated.
- New plant sources have been identified for finding out potential leads: ICB-25/A001, ICB 26/A001 showed significant inhibition of PDE 4 activity.
- ICB-18, ICB-24, ICB-25, ICB-26 are found to be potential for inhibiting cytokine profile in vitro.
- Development of new leads from several herbal sources as described above has been initiated.
- Pharmacokinetics of ICT-TA-49 has been initiated.
- Evaluated the efficacy of IICT-TA-67 for its inhibition of cell adhesion molecules on human endothelial cells. It inhibited TNF-α induced ICAM-1 (IC_{50}=10.6 µg/ml) and VCAM-1 (IC_{50}=16.6 µg/ml) expression on HUVECs. It also significantly inhibited the adhesion of human neutrophils onto endothelial cells with an IC_{50} of 12.02 µg/ml.

R & D Outputs during the second year (2008-2009):

Total published paper during this tenure: 9 (nine)

No. of Project Assistants engaged: 30 (thirty)

4. Title: New Insights in Cancer Biology: Identification of Novel Targets and Development of Target Based Molecular Medicine.

Project: Inter Agency [IAP-001]

Nodal Laboratory: Indian Institute of Chemical Biology (IICB), Kolkata.

Participating CSIR Institutes:

Indian Institute of Chemical Technology (IICT), Hyderabad

Centre for Cellular and Molecular Biology (CCMB), Hyderabad

Central Drug Research Institute (CDRI), Lucknow

Institute of Genomics and Integrative Biology (IGIB), Delhi

Central Glass & Ceramic Research Institute (CGCRI), Kolkata

National Inst. for Interdisciplinary Science & Tech. (NIST), Thiruvananthapuram.

Participating Non-CSIR Institute:

National Center for Cell Sciences (NCCS), Pune.

Objectives:

- Identification of new lead molecules from herbal and synthetic sources against specific cellular targets using high throughput approaches.
- Identification of novel anticancer targets based on the knowledge gained from molecular analysis of tumorigenic processes.
- Generation of library of small molecules by diversity-oriented chemistry.
- Deciphering the regulation of expression of target genes in normal and cancer cells.
- Understanding the molecular interactions between target proteins and their partners.
- Nano-structered calcium phosphate-based ceramics as drug carrier for the treatment of hepatocellular carcinoma in animal model.
- Multi-agent-based simulations of collective cell behaviors with application to cancer.

Significant achievements made during the second year (2008 – 2009):

Objectives 1 & 3

Eighteen plant extracts were tested for anti-cell proliferation activity in nine different cancer cell lines. Six of them exhibited good activity (10-25 ug/ml). Activity guided fractionation of these extracts resulted four fractions with good activity (5-20 ug/ml). From these promising fractions one pure molecule has been identified with good activity (5 ug/ml). Two more pure compounds were also tested for the activity. (IICB)

Seventeen compounds were isolated from plant sources. Seven of them tested for anti-cell proliferation activity. One of them showed promising anti-cell proliferation activity <5 ug/ml). (IICT)

147 compounds of CDRI were screened for anti-cancer activity in vitro using SRB assay in four different cancer cell lines. Compounds with IC50 values ≤ 10 µg/ml were considered as 'hits' and categorized according to their selective cytotoxicity. Out of 147 compounds, 84 did not show any growth inhibitory activity, 9 showed IC50 value of > 10 µg/ml (considered inactive) and one showed IC50 value at ≤ 10 µg/ml against all the cell lines (generally cytotoxic). Screening of the remaining 53 compounds is being done at serial dilutions.

Objectives 2, 4 & 5

proMMP-9 and TIMP-1 could be novel prognostic marker for endometriosis.

Neu5m 9AC2-GPs and their antibodies could be useful in understanding childhood ALL.

Target for NM23-H2 tumour suppressor gene were identified by ChIP on chip assay. Global gene expression profiling using oligonucleotide microarrays following siRNA based targeted depletion of NM23-H2 in lung adenocarcinoma cells provides further insights into metastasis regulation. The differentially expressed genes control various biological pathways related to apoptosis, cell cycle progression, cell differentiation and tumor invasion. Intriguingly, this analysis further indicated involvement of factors involved in actin assembly, which could be critical in understanding the metastatic process.

Staurosporine (STS) is a protein kinase-C inhibitor from Streptomyces sp. Results suggest that STS induces mitochondria-mediated KB cell apoptosis at G2/M phase by altering cell cytoskeletal network. (CDRI)

C/EBP family of proteins is reported to be down-regulated in breast cancer patients. We have shown that overexpression of human C/EBPs, in particular hC/EBPα, induces apoptosis in breast cancer cells via extrinsic pathway. Based on our data, we hypothesize that during breast tumor development C/EBP proteins are down-regulated in order to evade apoptosis.

Objective 6

Synthesis of Hydroxyapatite nano particles were standardised and quality of the particles were checked.

Objective 7

ABM Framework completed.

A basic immune system simulation developed using the ABM Framework.

R & D Outputs during the second year (2007-2008):

Total Number of Publications: 15 (fifteen)

No. of Project Assistants engaged: 17 (seventeen)

PARTNER NETWORK PROJECTS OF IICB

Partner Network Projects	Objectives
Discovery, development and commercialization of new bioactives and traditional preparations (COR-023)	, To revisit Indian biodiversity and Indian Systems of Medicine in the light of current day knowledge in search of therapeutic principle(s) under four disease areas of national importance, namely, Leishmaniasis, Gastric ulcer, Immunomodulation, and Parkinson's disease.
Drug target development using in-silico biology (CMM-017)	, *In silico* analysis of genome/proteome architectures of various pathogenic bacteria, parasites and fungi for identification of virulence determinants , Studies on mouse and human genome characteristics in an attempt to detect the host factors regulating or regulated by the pathogen invasion.Clustering of some host-parasite interaction pathways with a view to identify some of the networks crucial for the host-parasite interplay. , Development of novel software/algorithms relevant to the study
Comparative genomics and biology of non-coding RNA in human genome (NWP-036)	, To investigate posttranslational control mechanisms involving such RNAs, , To identify co-regulated gene networks using siRNA, , To develop new RNA-based methods for influencing gene expression in subcellular compartments such as mitochondria, and to investigate the structural basis of the interactions between non-coding RNAs and their protein targets.
Exploitation of India's rich microbial diversity (NWP-006)	, To develop state-of-the-art molecular genetics approach to address the relationship between metal microenvironment and microbial communities.
Zero emission research initiative (NWP-044)	, To identify & scale up of technology and their extension for minimizing environmental risks from leather sector to near zero values.
Diabetes mellitus – New drug discovery R&D, molecular (NWP-032)	, To understand the basic mechanism of insulin resistance and defect in signaling of type 2 Diabetes. , To identify possible drug targets. , To develop drug against those targets.

Partner Network Projects	Objectives
Identification and validation of drug targets for selected pathogens of national importance (NWP-038)	, Identification of pathogen-specific, differentially-expressed proteins of *Leishmania donovani.* , Validation of identified protein as drug targets. , Development of target-specific assays and screening of available synthetic/natural libraries.
Biological and chemical transformation of plant compounds for production of value added products of therapeutic / aroma value (NWP-0009)	, Up-scaled isolation of parent anti-cancer molecules targeted for chemical and biological transformation , Chemical transformation of selected phyto-molecules for value addition.
Pathway engineering and system biology approach towards homologous and heterologous expression of high-value phytoceuticals (NWP-008)	, Elucidation of the naturally occurring pathways of podophyllotoxin biosynthesis. , Metabolic engineering of podophyllotoxin pathway in a suitable host , Metabolic engineering of isoflavone biosynthesis pathway , Reprogramming of reprogramming of these metabolic pathways in the selected host perhaps using synthetic transcription factors , Creation of novel genetic switches for use in synthetic biology. , Standardization of purification of the compound from metabolically engineered organism
Nanomaterials and nano-devices for application in health and disease (NWP-035)	, To synthesize, purify, characterize and study suitable linear and denditric peptides for producing and stabilizing metal nanoparticles and cadmium sulfide (CdS) nanoparticles (semiconductor quantum dots). , To examine the cell entry of peptide capped cadmium sulfide (CdS) quantum dots using selective cell lines like normal cell lines (ordinary T-lymphocyte) and diseased cell line (fibroblast T-lymphocyte) and to check the locations of the quantum dots inside the cell, if the nanoconjugate (i.e. peptide capped CdS quantum dots).To explore self-assembling synthetic peptide based new nanoporous materials and to vary the pore size by varying the peptide based molecular building blocks for achieving the selective gas adsorption properties from a mixture of gases of different molecular dimensions.

Partner Network Projects	Objectives
	, To check the biodegradability of these peptide based nanoporous materials. , To fabricate pseudopeptide based nanofibers by peptide capped gold and silver nanoparticles and to study the important electrical and other material properties of these nano-materials. To study the self-assembling synthetic peptide based various nanostructures like nanofibrils, nanorods and nanotubes and to use these peptide nano-structures as templates for the production of gold/silver nanowires and nanocrystals.
Plasma proteomics in health, environment and disease (NWP-004)	, To identify disease specific biomarkers in easily accessible body fluids, which would constitute safe, effective and non-invasive methods for development of new diagnostic and prognostic approaches. , Plasma proteome profiling in the areas of Arsenicosis, Leishmaniasis, Cardiac diseases and ALL will be undertaken.
Integrated Analysis for Impact, Mitigation and Sustainability (IAIMS): Regional Climate Modeling at Decadal Scale (NWP-052)	, To study the change in arsenic concentration in soil and groundwater trend affected by change of climate - flood or drought and/or land-management practices. , To determine the different rice varieties dependence on bioaccumulation of arsenic under different cultivation methods to combat the crisis of arsenic contamination of rice under severe environmental conditions like flood or drought. , The effect of environmental parameters associated with climate change on the relative activities of the arsenic transforming microbes will be investigated. Specifically, (a) Isolation and identification of bacteria from aquifers (b) Identification of genes associated with arsenic oxidation/ reduction/ detoxification and other processes. (c) Regulation of expression of relevant genes by environmental parameters.

PUBLICATION & INFORMATION AND PLANNING, MONITORING & EVALUATION

Dr. Pijush K. Das, Dr. K. P. Mohanakumar, Dr. Aparesh Bhattacharya, Dr. Uday S. Chowdhury, Dr. Moonmoon Bhaumik, Dr. Tanmoy Mukherjee, Dr. Prasanta Chakraborty, Dr. Siddhartha Majumder, Arupesh Majumder, Sekhar Mukherjee, Swadesh K. Sahoo, Binayak Pal, Nikhil K. Das, Pratima Banerjee, Lily Das, Sukhendu Biswas, Gopal C. Sarkar, Pallab Mukherjee, Nishikanta Naskar, Bideshi Nayak

The scientific administration, supervision and thus management of different R&D activities of the institute are the primary foci of this division. The activities of this division are carried out by seven major sections, *e.g.* [a] Publication & Information; [b] Planning, Monitoring & Evaluation; [c] Art & Photography; [d] ISTAD-IICB; [e] Intellectual Property Management Cell; [f] Business Development Group; and [g] Human Resource Group. Therefore the success of this division mostly depends upon strong interrelation among these sections and excellent communication with R&D departments. Thorough interactions and proper attention in execution of the time-bound tasks facilitated successful management of this division. The details of the scientific management activities of the individual sections are given below separately for the reporting year.

PUBLICATION & INFORMATION SECTION

Dr. Tanmoy Mukherjee and group

This section deals with diverse informational activities, publication and monitoring of reports and dissemination of information in electronic and printed forms. The major contribution of this section lies in assisting scientists in day to day maintenance of the institute activities and innovations, project profiles, publication records and research utilization data. The section was involved in the following wide spectrum of programmes during the report year.

- Management of Eleventh Five-Year Plan (2007 – 2012).
- Preparation of Annual Plan (2009-10) and Budget.
- Preparation of IICB Annual Report (2007-08) and half-yearly reports.
- Preparation of documents released during events.
- Dissemination of information to scientific milieu on relevant subjects.
- Documents on IICB inputs for “CSIR Annual Report” and “CSIR Research Output 2008”.
- Assistance to scientists, fellows and staff members for participation in seminars, symposia and conferences.
- Preparation of minutes of RC meetings and other task force meetings to enable the members to follow the guidelines and proposals for future directions.
- Maintenance of database for testing and calibration.
- Total management of all technical queries.

- Public relations, advertisement and news and views forum.
- Organization display of exhibition and science news dissemination.
- Advice and comments for management of parliament queries and other related crucial matters of institute.
- Organization of 'OPEN HOUSE' and active help for 'CPYLS-2008' programmes.

Management of Exhibition

Like preceding years, P&I Section has participated in eleven (11) exhibitions during 2008-09 in and around Kolkata and also outside Kolkata organized by various organizations. IICB has a mandate to carry out basic and applied research in health problems of the country. The main objective of this section is to present recent scientific developments of the institute to the common people. The successful presentation of scientific works and developments of IICB brought in a number of awards through these exhibitions. Mr. Sekhar Mukherjee, a senior member of this section, looks after the exhibition cell. He also arranged one exhibition at IICB premises on the occasion of CPYLS-2008 programme. List of exhibitions is given below.

EXHIBITIONS PARTICIPATED

Date	Theme	Organized By
12 - 20 April, 2008	Science Exhibition	Institute of Social Studies held at Central Park, Salt Lake, Kolkata.
22 - 30 April, 2008	Science Exhibition	Rashtriya Pragati Mela, 2008 held at Howrah Dalmia Park Stadium, West Bengal.
5 - 10 September, 2008	12th National Science Expo., Theme : Preparing India as an Advanced Nation	"Central Calcutta Science Culture Organisation for Youth", held at Central Park, Salt Lake -1. Kolkata - 17.
12 - 14 December, 2008	60th PHARMACEUTICAL EXPO – 2008	Federation of Indian Chambers of Commerce & Industry (FICCI) at Dwarika, New Delhi.
16 - 21 December, 2008	3rd World Ayurveda Congress & Arogya – 2008	Department of AYUSH, Ministry of Health & Family Welfare, Govt. of India. Held at Jaipur.
20 - 29 December, 2008	Sundarban Kristi Mela-O-Loko Sanskriti Utsab – 08	Milontirtha Society at Kultali, Basanti, 24-Pgs(S).
27 - 30 December, 2008	State Science Fair to Mark the 150th Birth Anniversary of Acharya Jagadish Ch. Bose	Committee for celebration of 150th Birth Anniversary of Acharya Jagadish Chandra Bose and Sports & Youth Services Department, Govt. of West Bengal.
23 - 30 January, 2009	14th Agriculture & Science Fair	Contai Palpara Saradadevi Mahila Mondal held at Purba Midnapore.
21 - 28 February, 2009	Science Exhibition & Fair (Subhas Mela 2009)	Taldi Netaji Sangha, South 24-Pgs.
28 February & 01 March, 2009	Science Exhibition	16th W.B. State Science & Technology Congress and The University of Burdwan, Burdwan.
02 - 10 March, 2009	Science Exhibition	Rashtriya Pragati Mela, 2009 organised by Bagnan Pratyasha held at Howrah Corporation Stadium Complex, Howrah.

EXHIBITIONS ARRANGED

No.	Date	Theme	Organized by
1.	Dec. 29 - 30, 2008	CPYLS – 2008	IICB & CGCRI

Management of Laboratory Visit for Students

With active participation and help of the members of this section IICB celebrated CSIR Foundation Day (2008) and an 'OPEN HOUSE' programme where students from various schools/colleges/universities within and around Kolkata visited IICB. A large number of students from about fifteen schools and colleges with their teachers visited various laboratories and interacted with the scientists expressing great interest and enthusiasm. Members of this section also arranged the laboratory visit for students of different colleges and universities outside Kolkata. A total of eight (8) numbers of visits were organized throughout the year (2008-09) as listed below.

Sl. No.	Date	Deptt. & Name of the Institute
1.	16.06.2008	Deptt. of Zoology, Guwahati University, Assam.
2.	23.06.2008	JBNSTS students from all over India.
3.	09.07.2008	Cotton College, Department of Zoology, Guwahati.
4.	04.09.2008	D. M. College of Science, Imphal. Manipur.
5.	18.11.2008	College of Biotechnology, Birsa Agricultural University, Ranchi, Jharkhand.
6.	15.12.2008	Deptt. of Zoology, Handizm College, Guwahati.
7.	22.01.2009	Biotechnology Department, Dibrugarh University.
8.	24.02.2009	Bhabha Atomic Research Centre, Mumbai.

Scientist Visit & Events

The P&I Section is also responsible for the announcement and arrangement of seminars for the national and international scientists who often visit the institute and like to share their research activities with IICB faculties. A list of 'Scientist Visitors' is given in a separate page.

The Institute also organized several significant events with the assistance of this section and 'List of Events' is also shown separately for the reporting year.

Sectional Members

Dr. Uday S. Chowdhury, Mr. Arupesh Majumdar, Mr. Sekhar Mukherjee, Mr. Nikhil K. Das, Mr. Pallab Mukherjee

PROJECT MONITORING & EVALUATION SECTION

Dr. Prasanta Chakraborty and group

PME is basically involved in the management of the institute's Network as well as externally funded R & D Projects. There are fourteen numbers of Network projects and quite a few numbers of externally funded projects at IICB. Proper management of all these may lead to successful completion of those projects and steady growth of the institute. PME is also supposed to be the leading information centre of any CSIR laboratory regarding projects and therefore, PME of IICB like other CSIR laboratories is actively involved on the following activities:

Preparation of databases for all extramural research projects (EMR) and calculation of ECF.

Data/Information provided for unstarred Rajya Sabha questions regarding External Cash Flow (2008-09).

Data/Information provided for Parliament question (2008-09).

Data/Information provided for creating database by RDPD at CSIR Hq.(2008-09).

Dissemination of information regarding call for National & International research project proposal/ awards/fellowship and correspondences with National & International project sponsors.

Guiding new scientists for project proposal submission.

Provide information regarding new scheme related to research work. i.e. CSIR Innovation Scheme (CIS).

Provide information to develop a database of CSIR scientists doing high end consultancy.

Make awareness among scientists regarding terms & conditions of funding agency.

Catering to different Scientific Audit queries.

Data/Information provided to the Principal Director of Audit, Scientific Deptt., Kolkata Branch (2008-09).

Data/Information provided to Internal Audit Cell (CSIR Hq.)(2008-09).

Participation in institute's annual plan, budget preparation.

To provide information regarding externally funding agencies to generate a database by RDPD, CSIR.

On-line information generate for ongoing project funded by (DST, DBT, ICMR, NTRF) in Create format of TNBD (CSIR Hq).

Sectional Members: Mr. Sukhendu Biswas

ART & PHOTOGRAPHY SECTION

Dr. Tanmoy Mukherjee and group

Art Section under the supervision of Mr. S. K. Sahoo has rendered full support to all the staff members during scientific seminars/symposia and all national events by preparing displays, illustrations, posters, exhibits, and slides. Diagrams, charts, graphs for publication in national and international journals

are prepared in this section. They are working in collaboration with the Photography Section for making each exhibition a great success to highlight the institute's achievement. The section also participated in preparing artwork and cover design for Hindi Day and Hindi Report. This section has also carried out work for decoration of floor & institute during various scientific and official programmes. Art Section provided following art works to the Institute during the reporting period.

	Jobs Done	Numbers
1.	Numerous illustrations, charts, graphs and structures.	181
2.	Various posters for annual functions and official purposes.	75
3.	Certificate preparation for Training programmes, Ph.D. Course work and staff retirement etc.	130
4.	Name plate preparation for committee meetings, conferences and various functions of the Institute.	85
5.	Memento and medal design.	8
6.	Several slides preparation for presentation, IICB brochure design, News Letter design for IICB website and Index page design for IICB website both in Hindi and Bengali.	—
7.	Assistance provided for IICB exhibition stall in and outside Kolkata several times.	—

Photography Section under the able guidance of Mr. Binayak Pal has been successful in procuring a digital camera for coverage of most of the events taking place in the institute. The section is continuously supplying all the photos for publications, Annual Reports, Journals and other related documents. Besides these they are also assisting the scientists of the institute. Apart from that they also handled photographs of scientific activities and experiment slides for publication in different international journals.

Sectional Members

Mr. Swadesh K. Sahoo, Mr. Binayak Pal, Mr. Nishikanta Naskar

ISTAD SECTION

Diverse activities of this section were personally supervised by the Head of the Division, Dr. Pijush K. Das with the active help of Dr. Samir K. Dutta.

INTELLECTUAL PROPERTY MANAGEMENT CELL

Dr. Tanmoy Mukherjee and group

Intellectual Property Management (IPM) cell in IICB in close association with Business Development Group (BDG), IICB and Intellectual Property Management Division (IPMD), CSIR is engaged throughout the year in different activities to protect intellectual property and achieve intellectual property rights for the scientific developments in IICB. With the help of a new Comprehensive Patent Database prepared by this cell, now any information about a patent filed by IICB, since 1990 is just a click away.

This cell has continuously maintained liaison with Scientists of IICB and IPMD, CSIR to protect Intellectual Properties of IICB/CSIR. The IPM cell, IICB gave every support to the scientists in preparing patent applications and provided all information, clarifications, explanations and reports to IPMD, CSIR regarding new patent applications, patent applications under consideration in different countries, granted patents and renewal or lapsing of existing patents in consultation with concerned inventors within corresponding time-limit. During the reporting period, a large number of correspondences were made with IPMD, CSIR, a significant amount of responses were sent for different patent applications and a considerable number of communications were made with IICB scientists regarding patent queries to provide necessary information to IPMD, CSIR to obtain fruitful results. The IPM Cell always extended co-operation to the scientists, IICB in writing and filing patent applications. This cell has prepared, maintained and disseminated all information regarding patent application, status of the application, renewal etc as, when and where it was required. IPM cell, IICB has provided all necessary information to Business Development Group of IICB for licensed out patents; sent information on patent and technology transfer to IPMD, CSIR regarding Parliamentary Question; prepared necessary documents on patents licensed out by IICB; prepared yearwise documents on total Patents of IICB filed and granted; prepared Commercial Working Report of IICB Patents for IPMD, CSIR; approved a number of Declaration forms for non patentability of publication and sent Renewal / Lapse recommendations of IICB patents for 2008-09 to IPMD, CSIR.

During the reporting period 10 International Patents and 5 National Patents were filed by IPM Cell, IICB while 6 International Patents and 5 national patents were granted throughout the year.

PATENTS FILED ABROAD

Sl. No.	Title	Inventors	Country	Comp Filing Date
1.	Leishmanicidal Activity of Night Jasmine leaf extract containing Calceolarioside against Chronic Visceral Leishmaniasis	Sharmila Chattopadhyay, Basudeb Achari, Avijit Poddar, Akhilesh Kumar	Brazil	10/04/2008
2.	"Acaciaside-b: A Prophylactic Contraceptive for Human Immunodeficiency Virus Infection/ Acquired Immune Deficiency Syndrome"	Syed Nazrul Kabir, Heramba Nanda Ray, Bikash C. Pal, Debashis Mitra	World	27/05/2008
3.	"Acaciaside-b: A Prophylactic Contraceptive for Human Immunodeficiency Virus Infection/ Acquired Immune Deficiency Syndrome"	Syed Nazrul Kabir, Heramba Nanda Ray, Bikash C. Pal, Debashis Mitra	USA	27/05/2008
4.	Bioactive Fraction from Plant Woodfordia Fructicosa	Sukdeb Banerjee, Pratap K. Das, Suchandra Goswami, C. Annalakshmi, Nilendu Panda, Niranjan Prasad Sahu, Basudeb Achari	Europe	08/08/2008

Sl. No.	Title	Inventors	Country	Comp Filing Date
5.	Bioactive Fraction from plant Woodfordia Fructicosa	Sukdeb Banerjee, Pratap K. Das, Suchandra Goswami, C. Annalakshmi, Nilendu Panda, Niranjan Prasad Sahu, Basudeb Achari	Brazil	11/08/2008
6.	Bioactive Fraction from plant Woodfordia Fructicosa	Sukdeb Banerjee, Pratap K. Das, Suchandra Goswami, C. Annalakshmi, Nilendu Panda, Niranjan Prasad Sahu, Basudeb Achari	Japan	20/08/2008
7.	Bioactive Fraction from plant Woodfordia Fructicosa	Sukdeb Banerjee, Pratap K. Das, Suchandra Goswami, C. Annalakshmi, Nilendu Panda, Niranjan Prasad Sahu, Basudeb Achari	Australia	03/09/2008
8.	Bioactive Fraction from plant Woodfordia Fructicosa	Sukdeb Banerjee, Pratap K. Das, Suchandra Goswami, C. Annalakshmi, Nilendu Panda, Niranjan Prasad Sahu, Basudeb Achari	China	28/09/2008
9.	Methanolic Extract of Piper Betel Leaves for the treatment of Human Malignancies by Inducing Oxidative Stress	Santu Bandyopadhyay, Bikas Chandra Pal, Jayashree Bagchi Chakraborty, Srabanti Rakshit, Labanya Mandal, Kausik Paul, Nabendu Biswas, Anirban Manna,	World	02/12/2008
10.	Elisa and Dipstick Based Immunoassay for Field Diagnosis of Visceral Leishmaniasis (Kala- Azar) and Pkdl.	Ali Nahad, Saha Samiran	World	17/04/2009

PATENTS FILED IN INDIA

Sl. No.	Title	Inventors	Filing Date
1.	A Non-recombinant Membrane Antigen and Diagnostic Kit Thereof for Detection of Visceral Leishmaniasis and PKDL	Nahid Ali, Samiran Saha	23/04/2008
2.	Compositions and Methods for Delivery of Protein-coding RNAs to Correct Mitochondrial Dysfunction	Samit Adhya	28/08/2008
3.	A low Molecular Weight Polypeptide with Hydrolysing Activity on Beta-d-fructofuranosyl-alpha-d-glucopyranoside	Suman Khowala, Sudeshna Chowdhury	24/11/2008
4.	Inhibitors of Phosphatidylinositol-3-Kinase (PI3) and Inducers of Nitric Oxide (NO)	Santu Bandyopadhyay, Bikas Chandra Pal, Parasuraman Jaisankar, Siddhartha Roy, Jayashree Bagchi Chakraborty, Indrani Choudhury Mukherjee, Sanjit Kumar Mahato, Aditya Konar, Srabanti Rakshit, Labanya Mandal, Dipyaman Ganguly, Kausik Paul, Anirban Manna, Jayaraman Vinayagam, Churala Pal	12/01/2009

Sl. No.	Title	Inventors	Filing Date
5.	Development of a Bifunctional Molecule 5-Hydroxy-2-Phenyl-7-(6-Piperidin-1-Yl-Hexyloxy)-4H-Benzpyran-4-One as anti Helicobacter Pylori and Gastric Antisecretory Agent	Pratap Kumar Das, Suchandra Goswami, Annalakshmi Chinniah, Janaswamy Madhusudana Rao, Katragadda Suresh Babu	27/02/2009

PATENTS GRANTED ABROAD

Sl. No.	Title	Country	Inventors	Grant Date	Patent No.
1.	Use of betel leaf extract to Induce IFN-gamma production from Human Peripheral Blood T Cells and as a TH1 Type Immunomodulator	China	Santu Bandyopadhyay, Bikash Pal, Samir Bhattacharya, Mitali Ray, Keshab Chandra Roy	28/05/2008	ZL00820077.7
2.	Coelomic Fluid Extract from Pheretima Posthuma for Providing Sperm Immotility	China	Mohua Mukherjee, Shampa Biswas, Malabika Datta, Samir Bhattacharya, Ranjan Bhadra, Alok Pal	30/07/2008	ZL01112435.0
3.	Two Novel Gnrhs from Indian Murrel Brain: Highly Potential Molecules for Induced Breeding of fish	Europe	Abhijit Chatterjee, Partha Ray, Subrata Dasgupta, Samir Bhattacharya	20/08/2008	EP1470153
4.	Two Novel Gnrhs from Indian Murrel Brain: Highly Potential Molecules for Induced Breeding of Fish	Australia	Abhijit Chatterjee, Partha Ray, Subrata Dasgupta, Samir Bhattacharya	06/11/2008	2003202800
5.	Process for Preparation of a Biomarker Specific for O-acety-lated Sialic Acid useful for Diagnosing, Monitoring Treatment Outcome, and Predicting Relapse of Lymphoblastic Leukemia	Europe	Chitra Mandal, Santanu Pal, Mitali Chatterjee	26/11/2008	1083181
6.	A Herbal Extract and Herein a Lupinoside as Potential Anti-diabetic Type II Drug from Pueraria Tuberosa	Europe	Prof Samir Bhattacharya, Dr. B. C. Pal, Dr. Arun Bandopadhyay, Dr. Sib Sankar Roy, Mr. Swapan Kr. Mandal, Mr. B. B. Giri, MS.	11/03/2009	1715878

PATENTS GRANTED IN INDIA

S. No.	NF No	Lab	Title	Inventors	Grant Date	Patent No.
1.	0365NF2000/IN	IICB	A highly cost-effective analytical device for Performing Immunoassays with ultra high sensitivity	T. K. Dhar, A. Pal	06/05/2008	219446
2.	0405NF2001/IN	IICB	Development of Vaginal Contraceptive with Clove Oil	A. K. Bhattacharyya, A. Pal, S. Bhattacharya	13/06/2008	221050
3.	0414NF2003/IN	IICB	A herbal based Composition for Treating Acute and Chronic Myeloid Leukemia	Santu Bandyopadhyay, Bikas Chandra Pal, Samir Bhattacharya, Tanusree Biswas, Mitali Ray, Keshab Chandra Roy, Gautam Bandyopadhyay	05/11/2008	225222
4.	0258NF2002/IN	IICB	Anti Peptic Ulcer Activity of an Extract of a Plant Flower	Pratap K. Das, N.P. Sahu, Sukdeb Banerjee, S. Sett, S. Goswami	20/03/2009	232610
5.	0343NF2002/IN	IICB	A Herbal Molecule as Potential anti-Leukemic Drug	Santu Bandyopadhyay, Bikas Chandra Pal, Samir Bhattacharya, Keshab Chandra Roy, Gautam Bandyopadhyay	30/03/2009	233542

Sectional Members

Mr. Arupesh Majumdar, Mr. Nikhil K. Das

BUSINESS DEVELOPMENT GROUP

Dr. Asish K. Sen (Jr.) and group

Major Activities of the group:

1. Liaison with private Industries/ R&D Institutes/ Academic Institutions/ other potential clients
2. Negotiating Business Plans with Industries and drawing agreements and MOUs
3. Matters related to Service Tax (registration and filing returns)
4. Customer Satisfaction Evaluation activities
5. Conducting meetings (Industry-Institute meet; Introduction of new schemes, Arrangement of visitors and their interactions with scientists, *etc*.)
6. Parliamentary related matters – Responses to Parliamentary questions, *etc*.

7. Responses to Audit queries.
8. Distribution of money earned under royalties.
9. Periodic preparation of lists of knowledgebase/products available, dissemination of information on technologies, *etc*.

Dr. A. K. Sen & Dr. T. Mukherjee attended 3-day programme on 'IPR & Technology Transfer' from 13th to 16th April, 2008 at Ooty organized by Society for Technology Management.

HUMAN RESOURCE GROUP

Dr. Siddhartha Majumdar and group

Human Resource Group (HRG) of IICB has been set up in April 2005 to promote professional Human Resources Management in this institute by evolving and implementing HR development plan.

Activities, Guidance and Initiatives:

To define, assess and develop institute's specific training needs.

To coordinate the academic & administrative affairs concerning Research Fellows/ Associates and linkages with other organization/Agencies/Institutes.

To collect and disseminate comprehensive data and information assisting in strategic planning for IICB & CSIR.

To advance the academic mission of the institute, the office of HRG provides leadership for continuous improvement in academic programme, training and services.

To maintain and update the databases of Research Fellows.

To organise IICB Summer Training Programme for the P.G. students of different Universities, Institutions and Colleges for partial fulfilment of their degrees.

Coordinates the in-house Ph.D. Course Work for the IICB Research Fellows as a part of the Academic Affairs of the Institute.

Organises different innovative Training Programme / Workshop of consistently high stands for IICB members, Research Fellows & Research Associates.

Extends training to the external students/faculty through demonstration of methodology/ techniques used in IICB as well as through practical courses, workshops and conferences.

Recommends name of suitable Scientists/Officers for their nomination in different R&D training programme /workshop organized by CSIR, HRDC and other national level institutes/organizations.

Programs: Guidelines, Information & Initiative

Ph.D. Programme

Objective: IICB offers exciting opportunities to highly motivated and talented students with a keen

sense of scientific enquiry for pursuing advanced career for research in the frontier areas of Chemical Biology, Modern Biology or Chemistry leading to Ph.D. on a specific topic.

The major objective of the programme is to generate adequate human resources in the different fields of Biology, Chemistry and related research areas. The duration of this programme is generally five years.

Eligibility Criteria: CSIR-NET qualified candidates / UGC-NET/ ICMR Fellows/ DBT Fellows.

Junior Research Fellowship for GATE qualified engineering graduates (CSIR-JRF-GATE): CSIR has introduced a new research fellowship in 2002 for the GATE qualified candidates with B.Tech. / B.Pharm / degree to pursue research leading to Ph.D. Each CSIR laboratory engaged in biological/biochemical research can have maximum 10 such JRF-GATE Fellows.

Besides the adhoc fellowship, IICB advertises for recruiting research fellows to work in grant-in-aid projects and different research schemes.

At a Glance: Research Fellow/ Associates

Number of existing **(Up to March 2009**) Research Fellows/Associates

Funding Agency	JRF & SRF	RA
CSIR	130	10
UGC	23	0
DST	21	01
DBT	10	04
ICMR	10	05
CLP	03	0
ESP	02	01
NMITLI	04	0

Learning and instructional support: Course Work / Training

Ph.D. Course Work

To educate and train in multidisciplinary areas, IICB offers a mandatory two-semester courses Ph.D. course work for the Research Fellows in their first year, taught by faculty members of in-house as well as from other Institutes/Universities. The main objective of these courses is to make the students acquainted with modern Biological Sciences, Chemistry and Chemical Biology.

The existing IICB Ph.D. course-work programme constitutes basic and advanced courses. The basic course is for bridging the gap between M.Sc. and Ph.D. The advanced course comprises of frontline areas of research and covers research methodology and review of current literature. Trainings are also provided for development of effective communication and writing skill (scientific) and on bioethics & laboratory bio-safety.

The course comprises of two major disciplines, namely **Basic Course** with [a] Computer Applications; [b] Instrumental Analysis; [c] Statistical Analysis; [d] Basic Biology (for Chemistry students); and [e] Basic Chemistry (for Biological Sciences students); and **Advanced Course** with [a] Advanced Biology (for students engaged in Biological Sciences Laboratory) and [b] Advanced Chemistry (for students engaged in Chemical research). In addition to this, introduction to some interdisciplinary topics viz. System Biology; Synthetic Biology; Cell Tissue Engineering; Chemical Biology etc. are also taught in advanced courses.

Incentives to students: Depending on the academic performance several incentives are offered to meritorious students. These including cash awards to the Ph.D. course work students based on marks, best thesis award etc.

Number of IICB Ph.D. Course work (2009) Students: 64

Summer Training / Project Work / Dissertation Work

As per CSIR mandate, IICB provides an excellent environment for training the next generation of researchers towards partial fulfillment of postgraduate degrees. Its mission is to provide students with opportunities to acquire hands on knowledge in biological/chemical sciences and chemical biology research.

IICB has imparted training in the state-of -the-art techniques to several summer students from different Universities & Institutes. The aim is to let young minds feel the thrill and excitement of science by working on a project requiring application and critical appreciation of scientific principles. It also aims at active participation in the learning process through experimentation and putting into practice the knowledge acquired in the classrooms.

The summer program is primarily designed to encourage students from first-generation college/university students by providing them the opportunity to do basic research in a top-notch research institution, in a supportive learning environment with plenty of interaction with graduate students and faculty. The programme provides a unique opportunity for students who do not have access to top-notch research facilities at their own institution to conduct supervised research in state-of-the-art research facilities. Besides, we also try to accommodate students from disadvantaged backgrounds pursue a career in research.

Guidelines: Detailed guidelines can be available in IICB website at HRG site. Under this programme the Institute conducts training of short duration in various disciplines and is absolutely free of any cost. The courses comprise both lectures and practical with emphasis on practical R&D aspects in a particular discipline. The duration of this training programme / Project Work is generally two- three months and maximum six months duration during March and August every year.

Number of Summer Trainee/Project Trainee (2008-09): 102

Other Activities and initiatives: Nomination in Training & Workshop

To assist in the process for nominating Scientists and Officers by the Director, IICB in different training programme/workshop [viz. R&D Management, Leadership Development and personal skills upgradation programmes etc. organized by CSIR, HRDC.

Participants in different Training programme:

Sri Asoke Sardar, Helper, Gr-1(1) has been nominated for his participation in "Laboratory Animal Science at CDRI, Lucknow held during 28th April to 23rd May 2008.

Mr. A. K. Jha, S.O(F&A) has been nominated for his participation in the "Science Audit for senior Scientists & senior Administrators Symposium by the Dept. of S&T ,Govt of India, New Delhi during May 26-30, 2008.

Dr. Asoke Kr. Dasgupta, Technical Officer III (5), Computer division participated in the "First Advanced Training Programme on Cyber Laws, Information Security and Computers for Scientists and Technologists" during June 9-15, 2008 at New Delhi, S&T Departments of Govt. of India.

Mr. Susanta Roy, Asstt. Executive has been nominated for his participation in training programme on **"Environment Impact Assessment"** held at IIPM, Kolkata during 07-11 July 2008.

Mr. Susanta Roy, Asstt. Executive has been nominated for his participation in training programme on **"Contract Labour (regulation & abolition) Act**" organized by the HRDC, CSIR during 22-24 September, 2008 at Ghaziabad (U.P.).

Dr. Snehasikta Swarnakar, Scientist has been nominated for her participation in the "Work life balance for women scientists" held at HRDC, Ghaziabad during 23-25 October. 2008.

Mr. U. S. Das, SPO has been nominated for his participation in the CSIR Leadership Programme (LDP) organized by the HRDC, CSIR during Oct, 2008 at Ghaziabad.

Dr. Siddhartha Majumdar, Head, HRG has been nominated to participate in Workshop on "Dimensions of Nanotechnology: Science, Technology, Business and Society" organized by National Institute of Advanced Studies, Indian Institute of Science, Bangalore during 9-13 February 2009.

Demonstration of laboratory-instruments for a group of Trainee Scientific Officers & HBN1 students(Biosciences) from BARC, Trombay, Mumbai 4800085 was organized on 24th February 2009.

A four-day **Workshop** on "**Effective Communication & Scientific Writing Skill Development**" was organized by HRG, IICB at IICB during 26th February to 3rd March, 2009.The workshop was conducted by ***The Center for Personal Transformation***, Kolkata- 31. About thirty Research Fellows and Research Associates of IICB participated in this workshop.

A lecturer on "**Effective Scientific writing skill"** was organized for IICB Research Fellows & Associates. Speaker: **Dr. Samit Adhya**, Scientist-G.

Sectional Members

Ms. Lily Das, Ms. Pratima Banerjee, Sri. B. Nayak

Scientist Visitors

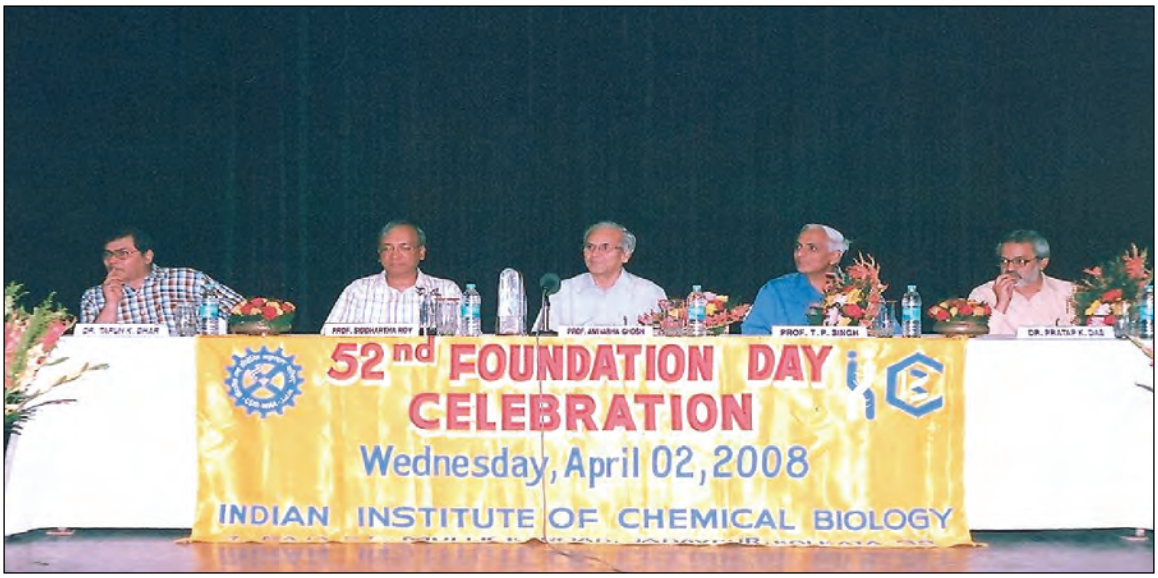
No.	Date	Speaker	Title of Seminar
1.	03.04.2008	Dr. Suvarn Kulkarni, University of California, USA	One-Pot methods for glycomics
2.	04.04.2008	Dr. Sanjay K Banerjee, University of Pittsburgh, USA	Genetics of cardiovascular diseases from PRKAG2 mutations to glycogen storage cardiomyopathy
3.	07.04.2008	Dr. Lal Mohan Kundu, RIKEN, Japan	Modified nucleic acid probes for DNA damage, repair and mutational studies
4.	08.04.2008	Prof. Staffan Johansson, Uppsala University, Sweden	Integrin signalling via PI3 Kinase
5.	29.05.2008	Dr. Madhusudan Dey, NIH, USA	Mechanistic link between PKR dimerization, auto-phosphorylation and self-substrate phosphorylation
6.	13.06.2008	Dr. Akhilesh Pandey, Institute of Bioinformatics, Bangalore	Quantitative proteomics : From therapeutic targets to biomarkers
7.	24.06.2008	Dr. Nilanjan Roy, NIPER, Mohali, Punjab, India	Structure-function analysis of *Leishmania Sirtuin* : An ensemble of In Silico and biochemical studies
8.	07.07.2008	Arup Indra, Oregon State University, USA	Nuclear receptor signalling in skin tumor micro-environment
9.	07.08.2008	Dr. Kamal Uddin Saikh, Principal Research Scientist, USAMRIID, USA	Attenuation of pathogenic consequences of septic shock by disrupting MyD88 pathway
10.	06.11.2008	Dr. Partha P. Datta, Albany, USA	Exploring macromolecular structural dynamics through cryo-electron microscopy : The ribosome as an example
11.	02.12.2008	Prof. Alessandro Desideri, University of Rome, Italy	Dynamics function correlation on human topoisomerase I mutants displaying resistance against the camptothecin antitumor drug
12.	03.12.2008	Prof. Marek Zaidlewicz, Nicolaus Copernicus University, Poland	Asymmetric synthesis of β-amino alcohols and N-hydroxyurea-5-lipoxygenase inhibitor
13.	10.12.2008	Dr. Samrat Mukhopadhyay, Scripps Research Institute, USA	Prying into a self-replicating prion amyloid
14.	11.12.2008	Dr. Jyotirmoy Nandi, Upstate Medical Centre, New York	Mechanism of gastric acid secretion : Role of cyclo-oxygenase

No.	Date	Speaker	Title of Seminar
15.	17.12.2008	Dr. Gautam Panda, CDRI, Lucknow	Synthesis of natural products and natural products-like privileged molecules from amino acids and syno-2,3-dihydroxy esters in drug discovery research
16.	18.12.2008	Dr. Surajit Dhara, John Hopkins University, USA	Hedge-Hog pathway inhibition in cancer : Questions and concerns
17.	22.12.2008	Dr. Manidipa Banerjee	Biological and structural studies of non-enveloped virus entry
18.	05.01.2009	Prof. Dipankar Sen	Many lives of DNA
19.	07.01.2009	Smita Mohanty, Auburn University, USA	Pheromone perception : Structure and function of pheromone binding
20.	12.01.2009	Prof. Dipak K. Banerjee, University of Puerto Rico, USA	Mannosylphospho Dolichol Synthase (DPMS) : Activator of angiogenic switch
21.	15.01.2009	Dr. Asima Bhattacharyya, University of Virginia, USA	Acetylation of apurinic / apyrimidinic endonuclease-1 regulates Helicobacter pylori-mediated gastric epithelial cell apoptosis
22.	29.01.2009	Dr. Bartira Rossi-Bergmann, Brazil	Using the mucosal route as a new strategy for vaccination against Leishmaniasis
23.	04.02.2009	Dr. Soumen Basak, UCSD, USA	Cross-talk between inflammatory and developmental signalling via the NF-KappaB system
24.	05.02.2009	Professor P.V. Bharatam, NIPER, Mohali, Punjab, India	Pharmacoinformatics in the design of novel anti-diabetic agents
25.	09.02.2009	Dr. George Shimer, TCG Lifesciences	Discovery of new antibacterial drugs
26.	11.02.2009	Dr. Peter Schlossmacher, FEI Company, Netherlands	Transmission electron microscopy in biological science
27.	11.02.2009	Dr. Debaraj Mukherjee, IIIM, Jammu & Kashmir	Studies towards synthesis of biologically significant compounds from carbohydrate and natural product precursors
28.	13.02.2009	Dr. Malancha Ta, Manipal Institute, Bangalore	A peek at the stem cells of the umbilical cord
29.	20.02.2009	Dr. Kailash Chand Pandey, Department of Medicine, UCSF, USA	Structure-function analysis of malarial cysteine proteases-Falcipains
30.	16.03.2009	Dr. Koushik Mukherjee, MIT, USA	Polymers, polyelectrolyte multilayers (PEMS) and amphiphiles in applied biotechnology
31.	20.03.2009	Prof. Anuradha Lohia, Welcome Trust-DBT India	Biomedical research career programs in India for research scholars and faculty members

Events 2008-2009

Date	Salient Details
April 02, 2008	IICB Foundation Day was celebrated. Prof. Amitabha Ghosh, Honorary Distinguished Professor, Bengal Engineering & Science University, Howrah & Ex-Director, IIT Kharagpur was the Chief Guest. Prof. T.P. Singh, Distinguished Biotechnologist, Dept. of Biophysics, All India Institute of Medical Sciences, New Delhi delivered the XXIst J.C. Ray Memorial Lecture. A popular lecture in Bengali given by Dr. Arindam Banerjee, Scientist, IICB. Topic was *"Nanotechnology : Projucktir Ek Nutan Diganta"*.
September 14, 2008	Hindi Day was celebrated. Chief Guest was Mrs. Keshar Jha, Deputy Director, Hindi Teaching Scheme, Ministry of Home, Govt. of India. Nizam Palace, Kolkata,
September 20-21, 2008	Indian Institute of Chemical Biology (IICB) and Calcutta National Medical College & Hospital (CNMCH) jointly organized an exceptional neuroscience conference, Neuroupdate 2008. Dr. Surya Kanta Misra, Hon'ble Minister of Health, Panchayat & Rural Development, Govt. of West Bengal, inaugurated the two-day conference. The conference also saw the felicitation of three noted scientists of Kolkata, namely Prof. J.J. Ghosh, a renowed Neurochemist and Centenary Professor of Neuroscience; Prof. K.L. Mukherjee, an eminent teacher and Clinical Biochemist; and Prof. Shyamal Sen, a well known doctor of Neuromedicine.
September 25-26, 2008	HUGO satellite meeting: Indian Institute of Chemical Biology along with other research institutes of Kolkata (i.e. Indian Statistical Institute, Chittaranjan National Cancer Institute & Saha Institute of Nuclear Physics) organized a symposium on "Complex Diseases: Approaches to Gene Identification and Therapeutic Management".
September 26, 2008	CSIR Foundation Day was celebrated. Welcome address was presented by Prof. Siddhartha Ray, Director, IICB. Inaugural Address was delivered by Prof. Sibaji Raha, Director, Bose Institute, Kolkata. Foundation Day Lecture was given by Prof. V. Nagaraja, Deptt. of Microbiology & Cell Biology, Indian Institute of Science, Bangalore. The title of the talk was *"Mechanistic and functional insights into various DNA Transaction processes"*.

Date	Salient Details
December 10-12, 2008	"14th Alexander Hollaender Course on Genetic Toxicology: Genomic and Proteomic Approaches" and a Special Workshop on "Arsenic Exposure Assessment".
December 29-30, 2008	CSIR Programme on Youth for Leadership in Science (CPYLS – 2008) was celebrated. Prof. Dhrubajyoti Chattopadhyay, Pro-Vice-Chancellor, Calcutta University was the Guest-in-Chief.
February 28, 2009	To observe 'National Science Day', IICB organised a series of lectures by eminent scientists in its premises along with an exhibition on recent achievements of IICB in basic science and healthcare. IICB also jointly organised 'National Science Day Programme' at Meghnad Saha Auditorium, CGCRI with Science Association of Bengal, CGCRI and Indian Association for the Cultivation of Science. Moreover, IICB actively participated in a two-day Science Exhibition at Burdwan University campus with a number of exhibits relating to the contribution and role of IICB in Healthcare Sciences.
March 27 – 29, 2009	A two-day mini-symposium on "Systems Biology and Proteomics in Biomedical sciences" was held at Kolkata to discuss the scope of these emerging areas and possible areas of cooperation between CSIR, India and Systems Biology Institute (SBI), Japan. Prof. Samir Kumar Brahmachari, DG, CSIR and Prof.Hiroaki Kitano, President, SBI were also present in the programme.



Foundation Day Celebration at IICB. Seated on dias (from left) are: Dr. T.K.Dhar, Prof. S.Roy, Prof. A.Ghosh, Prof.T.P.Singh and Dr. P.K.Das

Sitting on Dias (from left): Dr.T.K.Dan, Prof.H.S.Maiti, Prof.D.J.Chattopadhyay, Prof.S.Roy and Dr.A.K.Sen

Computer Division

Dr. Asoke Kr. Dasgupta, Mr. Sujit Kr. Majumdar, Mr. Pralhad Das

Scientific Activities

A unique computer based instrumental system SPERMA, sperm motility analyzer has been developed for the first time to determine sperm motility (velocity), using a spectrophotometer for clinical and biological applications.

The main purpose of this new project is to calibrate and standardize this unique instrumental system, and correlate the vertical motility parameters experimentally with fertilizing ability of the spermatozoa. The other purpose of this project is to upgrade the SPERMA by incorporating multi-cuvette (multi-sample) and multi-height exposures of the spermatozoa sample in the present instrumental system to make it more user friendly and market friendly. In order to acquire the intellectual property right, this unique work has already been filed for National (1605DEL2004) and International (WO-PCT/IB05/02541-26/08/2005) Patents.

Proposed instrumental upgradation will develop a simple but unique device for objective assessment of sperm motility. It provides both qualitative as well as quantitative assessment of spermatozoa. As sperm motility is essential for the fertilization efficiency of the male gametes, this equipment will be extremely beneficial for determining the fertility status of human males as well as bulls of various species. Consequently, this equipment has a great market potential for the human infertility clinics as well as in the animal / cattle breeding centres all over the world. This instrumental system will be useful in laboratories that are engaged in conservation of endangered species of animals. Further, this instrumental system may be useful in various other fields of basic sciences. It is also expected that several other applications will be relieved, once this instrumental system gets National and International exposures.

Technical Support

[i] Upgradation of I.T. Facilities

The IICB computer division has been marked with the remarkable change in IT facilities like installation and monitoring of Radius Server, web mail, Bandwidth Manager, RFID, UTM, NMS Open View etc. Besides these, 500 Desktop PCs, Laptops and Printers have been installed among the staff members including Scientists and Technical Officers. The WIFI Technology has been introduced at IICB Campus as well as at NIPER Office and NIPER Hostel with 6.8 GHz RF link. About 350 users are having the facility of using WIFI technology throughout its range. More than 14 high end CISCO Switches and POE switches have been installed for IICB Network and WIFI Network. The bandwidth of IICB network has been upgraded from 4MBPS to 25MBPS for fast data communication.

[ii] In-House Maintenance

The division supervises various types of problems related to hardware, software and Network. Special effort has been introduced to upgrade the IICB Internet/intranet website on regular basis. Apart from the day-to-day work, the division also monitors the network facility management system at IICB campus and NIPER campus.

Academic Activities

[i] Dr. Asoke Kumar Das Gupta has been nominated as a Member of the NIPER, Kolkata Advisory Committee.

[ii] Dr. Asoke Kumar Das Gupta has been nominated as a faculty member in IICB Ph.D. Course Work for the 2008-2009.

Research Associate & Research Fellow

Dr. Sudipto Saha* (Research Associate, CSIR) and Ms. Abhi Das* (Junior Research Fellow, DST)

Library & Documentation Division

Mr. N. C. Ghosh, Mrs. P. Chatterjee, Mr. S. Bhakta, Mr. S. K. Naskar, Mrs. S. Ganguly, Mr. P. K. Das, Mr. T. K. Mukherjee, Mr. M. Halder, Mr. S. Nath, Mr. Asoke Ram, Dr. B. K. Ghosh

The Library & Documentation Division was rechristened in 2008 as S&T Knowledge Resource Centre (KRC) which was approved in the 169th meeting of GB, CSIR. During the period under review, the division has been able to maintain its steady growth in respect of collection, systems, facilities and services. A central air-conditioning project is under way and a thorough renovation work will also be undertaken gradually to provide a right ambience to its users. The division provides critical library information support to the S&T personnel, research scholars and outsiders constantly using both the archival print documents and contemporary digital resources. In line with the increasing demands for information it has been developing steadily its holdings containing books (texts & reference), journals (print & online), serials, monographs, technical reports *etc*. It has also been developing a very good collection in Hindi. ADONIS, (CD-ROM databases) containing about 743 scholarly journals in full text almost from 1991 to 2002 in the biomedical, chemical and pharmaceutical disciplines.

CSIR E-Journal Consortium is a CSIR Network Project under 10th Five Year Plan being implemented by NISCAIR providing access about more than 4500 world class STM Journals and online databases like Web of Science, DII, DELPHION to the CSIR family including the Knowledge Resource Centre, IICB.

The collection includes major publishers like Thomson Reuters, RSC, ACS, Wiley Blackwell, Springer, OUP, CUP, Emerald, Sage, NPG, Taylor & Francis and others.

Services:

It is a special Library, primarily meant for the use of its research staff *i.e*. Scientists, technical officers, research scholars and staff of the Institute. It is also frequently used by the faculty members and research scholars of other Institutes and Universities located in Kolkata and West Bengal and sometimes from other institutions from eastern region of the country during the period under review.

The **Reading Room** of the division is fully air-conditioned. During this period a good number of readers visited the reading room for consulting daily newspapers and printed journals and other

technical reports. The division undertook **Literature Search** for the Scientists, Research Fellows and outside library users on the subjects of their interest and delivered a good amount of output of that nature. A good number of articles were searched and print outs were supplied to the internal users according to their requirement submitted to the division from the offline database **ADONIS**. During the period under review a good number of documents (2400 nos.) were issued /returned by the internal users through the **Circulation** desk of the division. Within this period about 150 nos. of articles have been brought from other CSIR laboratories to fulfill the requirement of IICB Scientists and Research scholars and reciprocated to others delivering the articles (136 nos.) according to their needs through JCCC.

The library has the LIBSYS 4.5 software for management of library services with the unlimited access to web OPAC (Online Public Access Catalogue). The software is working on Linux Red Hat Enterprise edition. During this period the usage of OPAC internally and from outside the Institute was very satisfactory. The OPAC is available through *www.iicb.res.in/library.html/opac* or *http://203.197.125.70:8080/webopac/html/SearchForm*

Programmes (3 nos.) on users' awareness-cum-training on various information resources available in the division have been conducted during the period under review to maximize the use up to the highest level.

A good number of internal and outside users availed reference and referral services rendered by the division. Though the photocopies demanded by the users during this period were a little less, till the total copies delivered were quite high.

IICB is the mentor of NIPER, Kolkata. NIPER- Knowledge Resource Centre has also been functioning in the library premises. During this period, a good number of books (text & references) on Medicinal Chemistry, Pharmaco-informatics and Natural Products have been added to its collection. Online access to SciFinder (single user) has also been subscribed by the centre during the period under review.

Central Instrumentation

Dr. S. K. Dana, Shri T. K. Mukherjee, Shri K. M. Dutta, Shri S. M. Roy, Shri A. K. Pramanik, Shri T. P. Nandi

Vision

The division supported in-house operation and maintenance of various sophisticated scientific instruments, video-conferencing system and audio-visual systems. Central instrumentation facilities consist of Electron Microscopes (Transmission and Scanning), NMR 300 MHz (Bruker) and NMR 600MHz, Mass Spectrometer. The division has facilitied for UV/IR Spectrophotometers, Ultra Centrifuges and Super Speed Refrigerated Centrifuges. The division attempts to develop simple instruments for biological research like a cell fusion apparatus. In addition, the division carries out basic research in the field of nonlinear dynamics and explores application of synchronization in chaotic electronic circuits, synthetic genetic networks. The division attempted modeling drug-addiction in mice/rat using EEG measurement in collaboration with the neurobiology group. The division also takes care of the central instrumentation facility to external users mainly from different universities and research institutes in India.

Publications

Journals

1. Amitabha Nandi, Sourav K. Bhowmick, Syamal K. Dana, and Ram Ramaswamy. Design strategies for the creation of aperiodic nonchaotic attractors. *Chaos* 19:033116, 2009.
2. Ioan Grosu, Ranjib Banerjee, Prodyot K. Roy, and Syamal K. Dana. Design of coupling for synchronization of chaotic oscillators. *Phy. Rev*. E80:016212, 2009.

Book

S. K. Dana, P. K. Roy, J. Kurths (Eds.), Complex Dynamics in Physiological Systems: From Heart to Brain, Understanding Complexity Series, Springer, 2009.

Research Fellows, Project Assistants

Ranjib Banerjee, Sourav K. Bhowmick, Chittaranjan Hens

Animal House

Dr. A. Konar, Dr. H. Ray, Mr. S. S. Verma, Mr. A. Das, Mr. R. K. Sarkar, Mr. A. Sardar. Mr. J. Middya, Mr. P. Middya, Mr. T. Sarkar

Research in bio-medical science is required for the improvement of quality of human life. A major part of this improvement stems in from progress of research on laboratory animals for the enlargement of our understanding the complex and intricately connected biological systems of human as well as animal physiology and its disorders. So research with living animals is vital to continue progress in many areas of clinical and basic research. Though there are alternatives in the form of cell and tissue culture, lower animal study or computer simulation, the use of whole animal is irreplaceable.

The animal facility in IICB is registered with CPCSEA (Registration No. 147/1999/CPCSEA). It caters the scientists for their need of laboratory animals like Mouse (Balb/C), Rat (Sprague Dawley), Hamster (Syrian), Rabbit (New Zealand) and Guinea Pig (English), as per their requirements. During the period of reporting, animals have been supplied from the in-house breeding colony for about sixty research projects. Only a few special strains of mouse were purchaed from outside (Table 1). At any given point of time, the facility maintains (comprising of both experimental and breeding stock) about 4000 rats, 4500 mice, 2200 hamsters, 225 rabbits and small colony of English Guinea Pigs. The facility has provision for research in "Nude animals". Moreover, it also provides different services to other research organizations on their specific requests.

Hygiene in the animal facility is considered as a matter of prime importance. All possible measures are taken to maintain it. Daily sanitation and sterilization of premises, sterilization of animal cages and bedding materials, periodical use of pesticides for vermin and pest control and aseptic process of animal carcasses disposal, are practiced in the facility. All prepared feed and bottled drinking water are sterilized daily. Monitoring of water-hardness (from Department of Water Resources Engineering, JU), checking for *E. coli* contamination (with a kit from MERCK) are performed periodically. The quality of indigenously prepared balanced animal diet is ensured by the use of best quality ingredients, highly pure vitamins and minerals. The periodical analysis of this food is done by the Department of Nutrition, WBUFAS. The house-keeping of the facility received high appreciation not only from the scientists but also from the representatives of CPCSEA, representatives of different NGOs and private entrepreneurs, visiting scientists and students.

Animals, especially of the breeding colony are always under health surveillance. Routine tests are performed in this regard. The genetic monitoring of mouse and rat is performed periodically to be sure about the quality of the stock.

A steady environment of the animals' rooms is maintained throughout the year. The parameters are as follows:

- Room Temp. 24±2°C; relative humidity 55-60%; light and dark schedule 12:12 hrs; illumination 350-400 lux at 1 mt above the floor, and 10-12 air-cycles/hr.

The animal carcasses and other biological wastes, used syringes and needles, etc. are disposed through

a Pollution Control Board (Govt. of India) approved agency. This procedure has been proved to be user friendly, hygienic as well as cost effective.

The proper utilization of animals is strictly monitored. Technical knowhow on experimental surgery and procedures, animal restraint and handling, animal anaesthesia, pre- and post- surgical care, bleeding techniques *etc.* are shared with the new researchers when they ask for. An account of animal produced/supplied from the animal house in the year 2008-09 is given in the following table:

Species	Stock on 1st April 2008	No. of animals		Total (A)	No. of animals				Total (B)	Stock (A-B) on 31st March, 2009
		Produced	Purchased		Produced	Purchased	Died in stock	Supplied to other R&D Organi-zations		
Mouse	2240	5425	190	7855	5490	190	0	60	5740	2115
Rat	2452	2266	0	4718	3556	0	0	65	3621	1097
Hamster	531	778	0	1309	759	0	53	0	812	497
Rabbit	111	16	0	127	31	0	0	16	47	80
Guinea Pig	35	10	0	45	0	0	10	0	10	35

(Stock = Number of animals only in the breeding colony)

Essential Services Unit

Dr. J. Rajan Vedasiromoni, Mr. C. Debdas, Mr. U. K. Barua, Mr. S. Saha, Mr. S. Ray, Mr. B. Jayakumar, Mrs. N. Bage, Mr. U. B. Sarkar, Mr. D. Banik, Mr. S. Basak, Mr. M. B. Malakar, Mr. G. Malik, Mr. D. K. Ghosh, Mr. S. N. Mondal, Mr. S. Pradhan, Mr. S. Biswas, Mr. S. R. Tudu, Mr. S. Nath, Mr. S. Mazumder, Mr. D. Banik, Mr. A. Pal, Mr. U. Roy, Mr. B. Das.

Essential Services Unit (ESU) is comprised of three sections, *viz.* Electrical Engineering Section, Air-conditioning & Refrigeration Section and Civil Engineering Section.

Electrical Engineering Section

The Electrical Engineering Section under Essential Services Unit (ESU) renders essential services and infrastructure support to R&D activities and other public utilities of the institute. Also the section in turn maintains and supplies steady power supply through 2MVA power sub-station of the institute and monitors for uninterrupted power supply system from CESC source as well as emergency power through available source of DG-Sets including its operation and maintenance.

List of major works carried out during the year **:**

- Internal Electrification works for newly proposed NIPER Hostel at SIRPA Complex, Kolkata -700045
- Renovation of LT power distribution system of sub-station under IRR at IICB
- Renovation of Electrical installations of Room Nos. 17, 239, 235, 206, library *etc*.
- AMC for internal & external electrification works of Electrical installations
- Procurement of 2x500 KVA new DG-sets for Emergency power at IICB
- Feeder connections of LT cubicle panels and other allied works of power substation
- Provision of power source for emergency line in different labs at IICB
- Renovation of existing old electrical installations of Room Nos. 17 (west), 201 (E & B), 215, 320, old cold room beside P&I Section *etc*. at IICB.

The works that are under progress**:**

- Erection & commissioning of 2x500 KVA DG- Sets
- Renovation of existing old electrical installations of Room Nos. 17 (West), 201 (E&B), 215, 320, old cold room beside P&I Section *etc*. at IICB
- Supply and installation of 2x600 KVA Capacitor bank at power sub-station of IICB
- Renovation of electrical installations of Room Nos. 19 & 23 at IICB
- AMC for internal & external electrification works of Electrical installations
- Maintenance & service overhauling of 6.6 KV HT power supply system at IICB, Kolkata

- Documentation of existing electrical distribution system of IICB including layout and schematic diagrams
- Installation testing and commissioning of existing 1x62.5 KVA silent type DG Set at Scientist apartment cum NIPER hostel campus.

Air-conditioning and Refrigeration Section

This section looks after the AC facility in all the laboratories, library, auditorium, administrative wings and most importantly the animal house. It also takes care of the refrigerators and deep freezers in the laboratories, maintains the cold rooms and constant temperature rooms and is responsible for the maintenance of the lifts.

***List of major works in the past one year*:**

- Annual maintenance of window and split AC units
- Annual maintenance of 2x80 TR AC plant for animal house
- Installation of two modular cold rooms and two constant temperature rooms
- Modernization of passenger lift near the canteen

***The following works are in progress or in proposal stage*:**

- Renovation and refurbishing of the central AC plant is in progress to cater for the library and auditorium.
- Work has been taken up for making a clean room for installation of Protein Micro Array facility.
- Proposal for providing 24 hrs AC facilities for the server in library
- Maintenance of cold and constant rooms

Civil Engineering Section

The Civil Engineering Section renders services in broad areas of infrastructure development, renovation of laboratories and common facilities, maintenance of campus, sewerage and drainage systems, cleaning and house-keeping work.

List of major works carried out during this period:

- Repair, renovation and upgradation of different laboratories and officer
- Construction of Central AC Plant Room
- Repair of water proofing treatment of roofs of auditorium, library
- Structural repair of overhead water tank
- Replacement of barbed wire fencing
- Repair and renovation of instrument rooms
- Repair and renovation of buildings and services (AMC)

- Repair, renovation and upgradation of CSIR hostels at Prince Anwar Shah Road
- Renovation of Library
- Renovation of lift machine room and lift well for Lift No. 2
- General cleaning and house-keeping work
- Tendering process for development of new campus at Salt Lake

The following works are in progress or in proposal stage:

- Renovation of auditorium
- Installation of modular furniture in different laboratories
- Expansion of IICB laboratory building and construction of new Animal House
- Repair and renovation of buildings and services (AMC)
- Repair and maintenance of CSIR Scientists' Apartment Complex at Prince Anwar Shah Road
- General cleaning and house-keeping of CSIR Scientists' Apartment Complex at Prince Anwar Shah Road.

Seated on dias (from left) are : Dr. J. R. Vedasiromani, Prof. S. Roy, Prof. Sibaji Raha and Mr. S. K. Chaudhuri

Administration

GENERAL ADMINISTRATION

General Administration includes a wide range of functionalities catering to the life cycle of an Officer of the Scientific, Administrative and Technical Cadre encompassing manpower planning, cadre management, recruitment, role definition / allocation, skill assessment, workplace learning, career advancement, transfer, employee benefits, retirement, performance assessment *etc*. In addition, Administration is also responsible for arrangement of all logistics and managing the day-to-day affairs of the Institute.

Officers in General Administration

- „ Dr. S. R. Sarkar, Controller of Administration
- „ Mr. S. K. Chaudhuri, Administrative Officer
- „ Mr. K. Bhattacharjee, Section Officer
- „ Mr. Siddhartha Dey, Section Officer
- „ Ms. Shampoo Sengupta, Section Officer
- „ Mr. P. K. Saha, Section Officer
- „ Mr. Ashok Putatunda, Section Officer

COA's Secretariat

- „ Mr. Sudip Ghosh, Jr. Stenographer

Sections in General Administration & Associated Staff

[i] *Recruitment, Committee & CR*

- „ Mr. Siddhartha Dey, Section Officer
- „ Ms. Anjana Mandi, Asstt. (G) Gr. I
- „ Ms. Indira Kundu, Asstt. (G) Gr. I
- „ Mr. Tapan Das, Tech. Gr. II (2)
- „ Mr. Raju Pal, Asstt. (G) Gr. III
- „ Mr. Ranjit Debnath, Asstt. (G) Gr. III

[ii] *Establishment*

- „ Ms. Shampoo Sengupta, Section Officer
- „ Mr. Kanu Mondal, Asstt. (G) Gr. I
- „ Mr. Ratan Bage, Asstt. (G) Gr. I
- „ Ms. Ratnabali Adhikari, Asstt. (G) Gr. I
- „ Ms. Sanhita Ganguli, Asstt. (G) Gr. I
- „ Mr. R. N. Hansda, Asstt. (G) Gr. I

„ Mr. Jayanta Pal, Asstt. (G) Gr. III
„ Mr. T. K. Sinha Roy, Asstt. (G) Gr. III
„ Ms. China Devi Nayek

[iii] *Bill & Cash*

„ Mr. K. Bhattacharjee, Section Officer
„ Mr. Phelaram Dhank, Tech., Gr. II (4)
„ Mr. D. K. Kisku, Asstt. (G) Gr. I
„ Mr. Prem Singh, Asstt. (G) Gr. I
„ Mr. Tarun Dutta, Asstt Manager-cum-Store Keeper
„ Mr. Alok Ray, Asstt. (G) Gr. II
„ Mr. Atanu Moitra, Gr. II (2)
„ Mr. Paresh Sarkar, Gr. II (2)
„ Mr. Saugata Das, Asstt. (G) Gr. III
„ Mr. Suresh Balmiki
„ Mr. Kailash Nayek

[iv] *General*

„ Mr. P. K. Saha, Section Officer
„ Mr. D. R. Chakrabarty, Asstt. (G) Gr. I
„ Mr. Nandalal Routh

[v] *Receipt & Issue*

„ Mr. A. Patatunda, Section Officer
„ Mr. Saibal Giri, Sr. Stenographer
„ Mr. Brihashpati Das

FINANCE & ACCOUNTS

Finance & Accounts wing is mainly concerned with keeping record of budgetary requirements and preparing budget for the Institute, which is about Rs. 65-70 crores per annum, and is keeping track of progressive expenditure of budget for every month, keeping financial records for 17 Networked Projects, externally funded projects, disbursement of pension to pensioners, accounting and auditing files routed through Establishment, purchase and other scientific decisions, seeking grant from outside bodies, *i.e.* UGC, ICMR, DBI *etc.*, monthly remittance of P. Tax, I. Tax, Service Tax, *etc.*, incorporating entire vouchers of the Institute in IMPACT software. Through IMPACT entry, our Annual Accounts is maintained and Balance Sheet is generated.

Functional hierarchy of Finance & Accounts wing is as follows:

„ Shri S. K. Das, F&A Officer
„ Shri A. K. Jha, S.O. (F&A)

- Shri A. K. Tiwary, S. O. (F&A)
- Shri Sanjoy Mukhopadhyay, Asstt. (F&A) Gr. I
- Shri Anil K. Chanda, Asstt. (F&A) Gr. I
- Smt. Banani Dutta, Asstt. (F&A) Gr. I
- Smt. P. L. Saha, Asstt. (F&A) Gr. I
- Shri Asit Kr. Roy, Asstt. (F&A) Gr. II
- Shri Mihir Kr. Dutta, Asstt. (F&A) Gr. II
- Shri Vishal Agarwal, Asstt. (F&A) Gr. III

STORES & PURCHASE

The Stores & Purchase Division caters to the research and other requirement of IICB. The annual procurement budget of IICB is about Rs. 500 million comprising of research consumables like chemicals, glasswares, plasticwares *etc.* and various capital items. After successful implementation of online procurement and stores systems during the last year, the division has introduced web based ordering system for Sigma products, Vendor Managed Inventory program, stock of consumable of companies like Fisher, SRL, Spectrochem, Merck, RFCL, JT Baker, Tarson, Axygen, BD falcon, Invitrogen, Takara-clontech, MN, Gilson & Eppendorf Pipettes, Computer cartridges of HP, Corning and so on. The division assists scientists and other users to utilise their budget grant within the project deadlines. The division also undertakes the issue of total logistic chain of items from anywhere in the world to IICB that are either purchased by IICB or being sent as free gifts. It also undertakes customs clearance with concessional customs duty within demurrage free clearing time from Kolkata Airport and Sea port. Adjustment of OB, replies to audit and other statutory authorities, assistance to accounts for bank re-conciliation are other activities performed by the division.

The division is manned by the following personnel:

- Shri U. S. Das, Stores & Purchase Officer
- Shri T. K. Mitra, Assistant (S&P) Gr. I
- Shri P. Naskar, Assistant (S&P) Gr. I
- Shri A. B. S. Roy, Assistant (S&P) Gr. I
- Shri R. Roy, Assistant (S&P) Gr. I
- Shri B. Das, Assistant (S&P) Gr. I
- Shri B. Pal, Assistant (S&P) Gr. II
- Shri A. Sen, Assistant (S&P) Gr. II
- Shri P. Sarkar, Assistant (S&P) Gr. III
- Shri R. P. Gorh, Technician

Official Language Activities of the Institute

The Institute saw various activities of the Official Language. Many administrative staff members use Hindi in their day-to-day work and were duly awarded for the same.

Throughout the year, Hindi workshops were organized for Hindi passed employees as well as all officers of administration who need Hindi for their day-to-day work.

The Hindi Week of this year was observed from September 11 – 15, 2008. Many written competitions like essay, noting & drafting, poetry and extempore competitions were held during the week. Workshop relating to "Rajbhasha Puraskar Yojna Rajbhasa Rules & Regulations, Noting & Drafting" was also held on September 12, 2008 on the eve of Hindi Day celebration on September 15, 2008. The Chief Guest for this occasion was Smt. Kesar Jahan, Assistant Director, Hindi Teaching Scheme, Home Ministry, Kolkata.

Apart from these activities, bilingual softwares were installed in the computers of the Institute for the implementation of the Official Language.

Extramural Activities

INFECTIOUS DISEASES AND IMMUNOLOGY

Invited Lectures

Dr. H. K. Majumder

Topic : A journey towards unraveling mystery of DNA toposiomerases of *Leishmania*
Venue : Symposium on Microbial proteomics at IIAR, Ahmedabad
Date : 2-3 May, 2008

Topic : DIM as a therapeutic agent for visceral leishmaniasis (kala-azar)
Venue : Department of Chemistry, Calcutta University
Date : 1-3 August, 2008

Topic : Development of DNA topoisomerase targeted therapeutics against Leishmaniasis
Venue : Dept. of Biophysics and Molecular Biology, Calcutta University
Date : 20 Nov, 2008

Topic : Molecular Biology of Leishmania
Venue : Refresher course at Department of Physiology, Calcutta University
Date : 22 Nov, 2008

Topic : Programmed cell death in *Leishmania* induced by baicalein, a potent DNA topoisomerase IB inhibitor of *leishmnaia*
Venue : Brazilian Academy of Sciences, Rio de Janeiro, Brazil
Date : 3-5 Nov, 2008

Topic : Structure and function of unusual bi-subunit topoisomerase IB of the protozoan parasite Leishmania
Venue : University of Rome Tor Vergata, Rome, Italy, Department of Biology
Date : September 23, 2008

Topic : A novel DNA Topoisomerase IA from *Leishmania*
Venue : CDRI WorldLeish 4, World Congress on Leishmaniasis (WL4) held at Central Drug Research Institute, Lucknow
Date : Feb 3-7, 2009

Topic : In memoriam
Venue : CDRI WorldLeish 4, World Congress on Leishmaniasis (WL4) held at Central Drug Research Institute, Lucknow
Date : Feb 3-7, 2009

Dr. Pijush K. Das

Topic : Role of cAMP in *Leishmania* resistance against macrophage oxidative damage
Venue : Indian Institute of Technology, Kharagpur, Department of Biotechnology & Biochemical Engineering
Date : May 09, 2008

Topic : Immunomodulator of natural origin for macrophage-associated diseases
Venue : University of Rome Tor Vergata, Rome, Italy, Department of Biology
Date : September 23, 2008

Topic : Role of intracellular cAMP in differentiation coupled induction of resistance against oxidative damage in *Leishmania donovani*
Venue : Guha Research Conference, Gangtok, Sikkim
Date : October 18-23, 2008

Topic : Macrophage biology in relation to disease pathogenesis
Venue : University of Delhi South Campus, Dept. of Biochemistry, Delhi
Date : March 11, 2009

Dr. Chitra Mandal

Topic : Glycoproteomics of *Pseudomonas aeruginosa*, an opportunistic Pathogen
Venue : Symposium of the 4th Asian and Oceania Human Proteome Organization (AOHUPO) and the 2nd Pacific-Rim International Conference on Protein Science (PRICPS), at Cairns, Queensland, Australia
Date : 22-26 June, 2008

Topic : Haematopoietic stem cells in childhood acute lymphoblastic leukaemia
Venue : International Symposium on "Perspectives of Cell Signaling and Molecular Medicine" at Bose Institute
Date : November 27-29, 2008

Topic : 9-*O*-acetylated sialic acids, the deleterious sprite in childhood acute lymphoblastic leukemia: mysteries of this 'third language of life' unveiled
Venue : 35th Annual meeting of The Society, held at Bhubaneswar
Date : Dec 12-14, 2008

Topic : Visceral leishmaniasis: an easy gateway for opportunistic pathogens via sialic acid-specific recognition
Venue : 4th World Congress on Leishmaniasis (WL4) held at Central Drug Research Institute, Lucknow
Date : 03-07 Feb 2009

Title : "9-*O*-acetylated sialoglycoconjugates: its consequences in VL-associated anemia".
Venue : Indo-Brazil Symposium on Leishmaniasis at IICB
Date : February 09, 2009

Title : Glycoproteomics of immune cells of visceral leishmaniasis and their association to pathogen through sialic acid-siglec specific recognition
Venue : Mini symposium on 'System biology and Proteomics in Biomedical Science' at Kolkata
Date : 27-29 March, 2009

Dr. Syamal Roy

Topic : Inhibition of ABC Transporters abolishes antimony resistance in Leishmania infection.
Venue : British Society of Parasitology, New Castle University, UK
Date : March 31 - April 02, 2008

Topic : Membrane Biology of Leishmania infection
Venue : Dept. of Biology, The University of York, Heslington, York Y0105DD
Date : April 3, 2008

Topic : Membrane Biology of Leishmania infection
Venue : Sir William Dunn School of Pathology, University of Oxford, UK
Date : April 8, 2008

Topic : Increased membrane fluidity of *Leishmania donovani* infected macrophages specifies poor stability of peptide – MHC complex
Venue : 4th World Congress of Leishmaniasis, Lucknow
Date : Feb 3-7, 2009

Dr. Nahid Ali

Topic : Approach towards antigen selection for optimum protection against visceral leishmaniasis
Venue : International Symposium on Leishmaniasis Vaccine, Recife, Brazil
Date : 9-11 March, 2009

Chairing a session:

Dr. H. K. Majumder

Dr. Chitra Mandal

Chaired a session in the conference "4th World Congress on Leishmaniasis (WL4)" held at Central Drug Research Institute, Lucknow during 3-7 Feb, 2009.

Dr. Syamal Roy

Session on "Dendritic cells : Function / Antigen Presentation", 4th World Congress on Leishmaniasis, 3-7 Feb, 2009.

Dr. Mridula Misra

Chaired a session on "Radiopharmacy" at 9th Asia Oceania Congress of Nuclear Medicine and Biology, New Delhi, India on 3rd November, 2008.

Academic performance: Teaching, examining and training

Dr. H. K. Majumder

Guest Professor, Department of Biophysics, Molecular Biology and Genetics, Calcutta University, Lectures and Examinations at NIPER, Kolkata.

Dr. Pijush K. Das

Guest Professor, M.Sc. (Biophys & Mol. Biol), M.Sc. (Biotechnology), M.Sc. (Microbiology), M.Sc. (Genetics) of Calcutta University, M.Tech (Biotech) of Jadavpur University and M.Tech (Biotech) of West Bengal University of Technical Education for teaching Biochemistry and Cell Biology.

Examiner in the M.Sc. (Biochemistry), M.Sc. (Biophysics & Molecular Biology), M.Sc.(Biotechnology), M.Sc. (Microbiology), M.Sc. (Genetics) at Calcutta University and M.Tech. (Biotech) at Jadavpur University.

Dr. Chitra Mandal

Teaching at NIPER, Kolkata, as a Guest faculty member.

Teaching Immunology (Stem cells) in the course work offered to PhD student of IICB, Kolkata.

Teaching a course on Biochemistry and Glycoconjugates for M.Phill students of West Bengal University of Technology.

Examiner of Ph.D thesis, Jadavpur University, Kolkata; J.N.U, New Delhi; PGIMER, Chandigarh

Member of Project review committee of ICMR

Reviewer of MERIEUX research grant proposal

Reviewer of project proposals submitted for funding to CSIR, DST, DBT, ICMR.

Dr. Syamal Roy

Guest faculty, Dept. of Life Science and Bioengineering, Jadavpur University, Kolkata- 700032

Dr. Nahid Ali

Teaching immunology in the course work offered to Ph.D. students of IICB.

Evaluated three project proposals submitted to DST, CSIR and Wellcome trust, and one SRF final report submitted to ICMR.

Supervised five students (Tanwee Das, Calcutta University; Sudeshna Banerjee, Calcutta University; Debosmita Roy, Calcutta University; Arghya Kusum Medda, West Bengal University of Technology; Subhalina Roy, Vellore Institute of Technology) in the mandatory project work as part fulfilment of their various degrees like M.Sc. and M.Tech.

Dr. Rukhsana Chowdhury

Examiner, Shyama Prasad Mukherjee Fellowship interview, CSIR

Examiner, M.Sc. (Biotechnology), M.Sc., (Microbiology) Calcutta University
Member of Ph.D. committee, West Bengal University of Health Sciences

Reviewer for Nucleic Acids Research, BBA-Proteins and Proteomics, FEBS Lett. PLoS Neglected diseases etc.

Dr. Rupak Bhadra

Acted as an external examiner of Ph.D. viva voce examination of Jadavpur University, Kolkata.

Served as an M.Sc. examiner of Department of Microbiology, Bijoygarh College.

Evaluated research proposals submitted to DST, DBT, CSIR etc. for funding.

Acted as a reviewer for Elsevier, SGM publications etc.

Dr. Tripti De

Examiner - M.Sc. Part II , Department of Biochemistry and Biophysics, University of Kalyani

Dr. Mridula Misra

Academic performance: Teaching, examining and training: External Examiner in the Department of Nuclear Medicine at the Indira Gandhi Post Graduate Institute of Medical Sciences, Patna in the month of October, 2008.

Deputation Abroad

Dr. H. K. Majumder

Visited University of Rome Tor Vergata, Italy during September 21-27, 2008 in connection with developing a collaborative programme between Indian Institute of Chemical Biology and University of Rome on infectious diseases.

Visited Brazilian Academy of Sciences, Rio de Janeiro, Brazil from 3-5 Nov, 2008.

Dr. Pijush K. Das

Visited University of Rome Tor Vergata, Italy during September 21-27, 2008 in connection with developing a collaborative programme between Indian Institute of Chemical Biology and University of Rome on infectious diseases.

Dr. Chitra Mandal

Attended the Joint Symposium of the 4th Asian and Oceania Human Proteome Organization (AOHUPO) and the 2nd Pacific-Rim International Conference on Protein Science (PRICPS) during 22-26 June, 2008 at Cairns, Queensland, Australia and delivered an invited talk.

Dr. Syamal Roy

Attended the Meeting of the British Society of Parasitology, New Castle University, UK on March 28-April 2, 2008.

Dr. Rupak Bhadra

To deliver a lecture on ‘Probable functions of bacterial essential GTP-binding-protein CgtA’ at IPR Retreat 2008 conference held during December 16-17, 2008 at Kobe Seminar House, Kobe, Japan.

To deliver a lecture on 'Molecular dissection of stringent response in *Vibrio cholerae*' on December 18, 2008 at Institute for Protein Research, Osaka University, Osaka, Japan.

To deliver a lecture on 'Diverse CTX phages and evolution of epidemic *Vibrio cholerae* clones' on December 19, 2008 at Osaka Prefecture University, Sakai, Osaka, Japan.

Papers/abstract presented in the conference

Dr. Chitra Mandal

Sajal Samanta, Angana Ghoshal, Chitra Mandal 'Sialylation of spectrin and its proteolysis in erythrocytes of patients: a cause for altered membrane characteristics and anemia in visceral leishmaniasis.'

Biswajit Khatua, Angana Ghoshal and Chitra Mandal "A glycoproteomic approach for identification and characterization of novel sialylated immunostimulatory proteins of Leishmania donovani."

Dr. Nahid Ali

Bhowmick, S., Mazumder, T., De, M. and Ali, N. Vaccination route that induces TGF-β production fails to elicit protective immunity against *Leishmania donovani* infection. 4th Worldleish Congress on Leishmaniasis, Lucknow, February 3-7, 2009.

Mazumder, S., Maji, M. and Ali, N. Monophosphoryl lipid A in association with rgp63 entrapped into cationic lipid vehicle increased immunogenicity against visceral leishmaniasis. 4th Worldleish Congress on Leishmaniasis, Lucknow, February 3-7, 2009.

Ghose, J., Sinha, R. and Ali, N. Therapy with pentavalent antimonials in stearylamine bearing liposomes confers cure against antimonial-resistant *Leishmania donovani* infection. 4th Worldleish Congress on Leishmaniasis, Lucknow, February 3-7, 2009.

Mondal, S., Bhattacharya, P., Rahaman, M., Goswami, R.P. and Ali, N. Optimization of short course liposomal amphotericin B treatment and its immunological evaluation to correlate the success of therapy in kala-azar. 4th Worldleish Congress on Leishmaniasis, Lucknow, February 3-7, 2009.

Ravindran, R., Das, A., Bhowmick, S. and Ali, N. A comparative study of BCG, MPL and vesicle based adjuvant systems against experimental visceral leishmaniasis. 4th Worldleish Congress on Leishmaniasis, Lucknow, February 3-7, 2009.

Palit, P., Ali, N., Paira, P., Hazra, A., Banerjee, S., Mondal, N.B., Vijayan, R.S.K., Prabu, M. and Ghosal, N. Orally effective 4-amino quinaldine analogues induce apoptosis via targeting dihydrofolate-reductase in *Leishmania*. 4th Worldleish Congress on Leishmaniasis, Lucknow, February 3-7, 2009.

Dr. Rupak Bhadra

Ritesh Ranjan Pal, Bhabatosh Das and Rupak K. Bhadra on 'Mutational analysis of *dksA* gene function in *Vibrio cholerae*' at the 'Recent Advances in Biological Sciences' held during August 22-24, 2008 at Digha, West Bengal, India.

Rupak K. Bhadra, Bhabatosh Das, Sangita Shah, Ritesh Ranjan Pal, Satyabrata Bag, Kalpataru Halder and Joubert Banjo Kharlyngdoh on 'Molecular basis of evolution and survival of choleragenic *Vibrio cholerae*' at 1st Training Mission in Cholera, Collaborative Research and Case Management held during September 7-14, 2008 at National Institute of Cholera & Enteric Diseases, Kolkata, India.

Rupak K. Bhadra on 'Probable functions of bacterial essential GTP-binding-protein CgtA' at IPR Retreat 2008 held during December 16-17, 2008 at Kobe Seminar House, Kobe, Japan.

Rupak K. Bhadra attended International Symposium on Systems Biology and proteomics in Biomedical Science held during 27-29 March 2009 at Vedic Village, Kolkata, India.

Dr. Mridula Misra

Evaluation of a new peptide radiopharmaceutical 99mTc-PhePheCys for organ imaging. Susmita Chandra, Kakali De, Bharat Sarkar, Santanu Ganguly, Mridula Misra. Indian Journal of Nuclear Medicine, Abstract issue. 2008; 23: 59-60. (Oral presentation at 9th Asia Oceania Congress of Nuclear Medicine and Biology, New Delhi, India).

Biodistribution and Scintigraphy Imaging Studies of 99mTc Labeled 3,4-dihydropyrimidinones Kakali De, Susmita Chandra, Bharat Sarkar, Santanu Ganguly, Mridula Misra1. Indian Journal of Nuclear Medicine, Abstract issue. 2008; 23: (Oral presentation at 9th Asia Oceania Congress of Nuclear Medicine and Biology, New Delhi, India).

Dr. Mita Chatterjee Debnath

M. Chatterjee Debnath, Kamal Krishna Halder and Dilip Kumar Midya. Evaluation of 99mTc-tricarbonyl ciprofloxacin in staphylococcus aureus infection in rat model, 9th Asia Oceania Congress of Nuclear Medicine and Biology, New Delhi, Oct 31st to 4th Nov (2008).

Conference / Symposia / Workshops Organized

Dr. Mridula Misra

As convener of Radioactive, Chemical Safety and Bio-Safety Committee a "Training Programme and Workshop on Laboratory Safety" (Chemical Safety, Radioactive Safety and Bio-Safety) has been organized on 18th September, 2008 for the students and staff of IICB, Kolkata.

Academic performance: Teaching, examining and training: External Examiner in the Department of Nuclear Medicine at the Indira Gandhi Post Graduate Institute of Medical Sciences, Patna in the month of October, 2008.

Major Infrastructural facilities

Dr. Chitra Mandal

Helped in developing Proteomic center.

Dr. Rupak Bhadra

BSL-3 laboratory facility.
Maintenance of Scanning Electron Microscope (Tescan, Model VEGA II LSU) facility.

CELL BIOLOGY & PHYSIOLOGY

Invited Lectures

Dr. K. P. Mohanakumar

Topic : Neurochemistry of Autism
Venue : Institute of Communicative & Cognitive Neurosciences (ICCONS), Shornur, Kerala
Date : April 8-10, 2008

Topic : Stem cells: How they are projected for use in transplantation recovery in Parkinson's disease
Venue : Dept. of Biotechnology, SRM University, Chennai
Date : September 16, 2008

Topic : Neurobiology of Parkinson's disease. "NeuroUpdate"
Venue : CGCRI Auditorium, Kolkata
Date : September 29, 2008

Topic : Recovery following transplantation of ESC differentiated dopaminergic neurons in Parkinson's disease
Venue : Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram
Date : October 7, 2008

Topic : Mitochondrial electron transport chain functions in Parkinson's disease postmortem brains, cybrids and animal models
Venue : Society for Neurochemistry (India) Annual Meet at Guru Nanak Dev University, Amritsar
Date : November 27-29, 2008

Topic : Parkinson's disease: Present Scenario
Venue : NASI, Kolkata Chapter, Bose Institute, Kolkata
Date : November 12, 2008

Topic : Oxidative pathways in dopaminergic neurodegeneration
Venue : Redox Regulation and Brain Disorders during the International Conference on Advances in Neurosciences & XXVI Annual Meeting of Indian Academy of Neurosciences at Center for Neuroscience, Department of Biotechnology, CUSAT, Cochin
Date : December 12, 2008

Topic : Differentiation of stem cells into dopaminergic neurons
Venue : DST sponsored 'Workshop for Young Scientists on Live Cell Functional Imaging and Neurotransmitters Receptors Functional Regulation Using Confocal Microscopy, Gene Expression Studies Using Real Time PCR', Cochin
Date : December 17, 2008

Topic : Transplantation recovery in Parkinson's disease
Venue : DST sponsored Workshop for Young Scientists on Live Cell functional imaging and neurotransmitters receptors functional regulation using Confocal Microscopy, Gene Expression studies using Real Time PCR. Center for Neuroscience, Department of Biotechnology, CUSAT, Cochin
Date : December 17, 2008

Topic : Mitochondrial basis of Parkinson's disease: Relationship with postmortem brain samples and cybrids, and rotenone effects
Venue : Science City, Kolkata
Date : February 8-10, 2009

Topic : Animal models for pre-clinical trials of drug-candidates for Parkinson's disease
Venue : Asian Oceanian Parkinson's Disease and Movement Disorders Congress (AOPDD) & APPA-2009, Stein Auditorium in India Habitat Centre, New Delhi
Date : February 17, 2009

Topic : Natural Products: Drug screening in relation to Parkinson's disease
Venue : UGC Refresher Course, Pharmacy Department, Jadavpur University
Date : December 2008

Topic : ·OH & NO· in rotenone-induced dopaminergic neurodegeneration
Venue : Nitric Oxide Symposium, Patel Chest Institute, Delhi University Campus, New Delhi
Date : January 12, 2009

Topic : Parkinson's disease: Animal models
Venue : Neurocon-2009, Neuroscience Workshop for the Neuroscientists, (IPGMER/IICB), Kolkata
Date : February 7, 2009

Topic : Mitochondrial basis of Parkinson's disease: Relationship with postmortem brain samples and cybrids, and rotenone effects
Venue : Neurocon-2009, Science City, IPGMER/IICB, Kolkata
Date : February 8, 2009

Topic : Differentiation of stem cells into dopaminergic neurons, and their implantation recovery program in neurodegenerative disease
Venue : UGC Refresher Course, Department of Biochemistry, Kerala University, Thiruvananthapuram, Kerala
Date : January 31, 2009

Topic : Mitochondrial genes: Are they involved in neurodegenerative disease pathophysiology?
Venue : UGC Refresher Course, Biotechnology Department, Annamalai University
Date : March 7, 2009

Topic : Mitochondrial involvement in Parkinson's disease pathophysiology
Venue : UGC Refresher Course, Department of Zoology, Kerala University, Thiruvananthapuram
Date : 20 March, 2009

Dr. S. N. Kabir

Topic : A close look into the pathogenesis of premature ovarian failure under experimental galactosemia" delivered at National Symposium on Recent Advances in Female Reproductive Health Research
Venue : CDRI, Lucknow
Date : December 11-12, 2008

Topic : The size of ovarian follicular pool inversely modulates the rate of follicle attrition
Venue : 20th Annual Conference of Physiological Society of India organized by Tripura University
Date : December12-14, 2008

Topic : A close look into the pathogenesis of premature ovarian failure under experimental galactosemia
Venue : Symposium on Current Trend in Human Physiology Research: its Contemporary Relevance, organized by Department of Physiology, Presidency College, Kolkata
Date : December 19, 2008

Topic : Female reproductive aging is master-planned at the level of ovary
Venue : 19th Annual Meeting of the Indian Society for the Study of Reproduction & Fertility held at IISc, Bangalore
Date : 22-24 January, 2009

Topic : Microbicidal spermicides: women's weapon against HIV infection & unintended pregnancies
Venue : Delivered as Prof. N. M. Basu Memorial Oration at the National Seminar on Current Trends in Research in Health & Diseases, organized by Department of Physiology, Vidyasagar University, Medinipur
Date : March 30, 2009

Dr. Sib Sankar Roy

Topic : Transcriptional regulation in metabolic disorders
Venue : Physiology Department, Calcutta University
Date : December 03, 2008

Dr. Tuli Biswas

Topic : ROS mediated apoptotic death of erythrocytes:A possible cause for the differential behavior of red cells from the two phenotypic forms of Eβ thalassemia
Venue : International Conference on Advances in Free Radical Research: Natural Products, Antioxidants and Radioprotectors (AFRR 2009), March 2009, Lucknow
Date : March 19-21, 2009

Charing session :

Dr. K. P. Mohanakumar

Acted as Co-Chairman in a session on "Neurodegenerative diseases". "NeuroUpdate" (IICB), CGCRI Auditorium, Kolkata, 29 Sept., 2008.

Chaired 'Young Scientists Award competitive session', Society for Neurochemistry (India) Annual Meet, Guru Nanak Dev University, Amritsar, Nov. 28, 2008.

Chaired "Redox Regulation and Brain Disorders" Symposium at the International Conference on Advances in Neurosciences & XXVI Annual Meeting of Indian Academy of Neurosciences at Center for Neuroscience, Department of Biotechnology, CUSAT, Cochin, December 12, 2008.

Acted as Anchorperson: Panel discussion by young scientists: Progenitor Cells, Stem Cells in Neurodegenerative Diseases. Neurocon (IPGMER/IICB), Kolkata, Feb. 8, 2009.

Chaired a session: 'Neurodegenerative Disorders: Clinical Perspectives & Laboratory Diagnosis', Neurocon (IICB), Kolkata, Feb. 10, 2009.

Chaired a session on "Animal model's of PD" at the Asian Oceanian Parkinson's Disease and Movement Disorders Congress & APPA-2009, 17th Feb, 2009.

Dr. S. N. Kabir

Chaired a session on Molecular aspects of female reproduction at National Symposium on Recent Advances in Female Reproductive Health Research, held at CDRI, Lucknow, December 11-12, 2008.

Chaired a session in the Recent advances in Biological Sciences, organized by Society of Biological Chemists (India), Kolkata Chapter held at Digha, WB, 22-24 August 2008.

Chaired a session in the 20th Annual Conference of Physiological Society of India organized by Tripura University, 12-14 December, 2008.

Chaired a session in the National Seminar on "Current Trends in Research in Health & Diseases" organized by Department of Physiology, Vidyasagar University, Medinipur, 30 March, 2009.

Dr. Tuli Biswas

Chaired a session on "Current trend in human physiology: Its contemporary relevance" at UGC sponsored National Seminar, Presidency College, Kolkata on December 19, 2008.

Academic Performance: Teaching, examining and training

Dr. K. P. Mohanakumar

Lectures and Examinations at NIPER, Kolkata.

Appointed as the external examiner to conduct the viva voce examination in respect of the research scholar, Mr. K. S. Vinaykumar of Centre for Research, Anna University, Chennai.

Invited by Controller of Examinations, Annamalai University, Annamalai to conduct the viva voce examination of A. Rajeswari.

On Deputation to IISER, Thiruvananthapuram for 4 months and taught Biochemistry for one semester, conducted examinations, and labs for 2nd semester students.

Projects Evaluated

Prof. T. K. Das and Prof. T. S. Roy "Study of the expression of BDNF and synaptic proteins in amyloid β(1-42)-induced Alzheimer's rat model: A molecular approach in understanding the pathogenesis of AD". Submitted to CSIR.

Name withheld: The role of α-synuclein in dopamine-induced damage to SH-SY5Y human neuroblastoma cells with implications in sporadic Parkinson's disease: an experimental study. Submitted to ICMR.

Manjunatha J R Studies on synthesis of selected water soluble curcumin derivatives, nano-curcumin and to understand their anti-aggregating property of a synuclein: Relevance to Parkinson's disease. Submitted to ICMR.

Manuscripts Reviewed

Yang L, et al., Mitochondria targeted peptides protect against 1-methyl-4-phenyl-1, 2, 3, 6-tetrahydropyridine neurotoxicity. *Antioxidants & Redox Signaling.*

Joseph A et al., Enhanced NMDAR1, NMDA2B and mGluR5 receptors gene expression in the cerebellum of insulin induced hypoglycaemic and streptozotocin induced diabetic rats. *J Neurosci Res.*

Krishnakumar A et al., Down regulation of 5-HT2C receptor in the cerebellum of pilocarpine induced epileptic rats: Therapeutic role of Bacopa monnieri extract. *J Neuurol Sci.*

Chathu F et al., Glutamate toxicity in the cerebral cortex of hypoxia induced neonatal rats: Effects of glucose, oxygen and epinephrine. *Neurotoxicology.*

Alcaraz-García MJ et al., Aspirin attenuates alterations in the growth of type II pneumocytes in the RL-6TN rat provoked by high glucose concentrations. *J Diabet Complic.*

Zhang M-Y et al., Sensitive and Selective Liquid Chromatography/Tandem Mass Spectrometry Methods for the Quantitation of 1-Methyl-4-Phenyl Pyridinium (MPP+) in Mouse Striatal Tissue. *J Chromat B.*

Paulose CS et al., Spinal Cord Regeneration and Functional Recovery: Neurotransmitters Combination and Bone Marrow Cells Supplementation. *Curr Sci.*

Navidpour L et al., Effects of compound 11g, 1-(4-bromophenyl)-5-(4-methylsulfonyl phenyl)-2-methylthioimidazole as selective COX-2 inhibitor on movement disorders in a rat model of Parkinson's disease. *Neurosci Res.*

Dr. Sumantra Das

Dr. S. Das delivered a course of lectures on Neurobiology as part of curriculum (Special paper) for second year M. Sc. students of the Department of Biochemistry as well as first year M. Sc. students of the Department of Neuroscience, Calcutta University.

Lecturer and Examiner of NIPER , Kolkata.

External examiner & Question setter for M. Sc. / Ph.D in Neuroscience at the National Brain Research Centre, Manesar, Haryana.

Supervised the project work of two M. Sc. students working as Summer Trainee.

Dr. Mrinal K. Ghosh

Teaching on "Cell Signaling and Protein Degradation" in the course work offered to Ph. D. students of IICB, Kolkata.

Lecturer and Examiner of NIPER, Kolkata.

External examiner of project for M. Sc., Biotechnology, University of Calcutta.

External examiner & Question paper setter for M. Sc. in Microbiology, BRSC, University of Calcutta.

Dr. Padma Das

Supervised the project work of one student from Seemanta Institute of pharmaceutical sciences, Jharpokharia, Mayurbhanj (Orissa) April 2007- July, 2008 and one student from Department of Microbiology, University of Kalyani, worked as summer trainee during May-June, 2008.

Dr. Syed N. Kabir

Guest lecturer and Examiner, M.Sc., Physiology, Calcutta University for the session 2008-2009.

Guest lecturer and Examiner, M.Sc., Physiology, Vidyasagar University for the session 2008-2009.

Guest lecturer, M.Sc., Physiology, Krishnath College, Murshidabad for the session 2008-2009

Guest lecturer, M.Sc., Physiology, Kalyani University, Kalyani for the session 2008-2009.

Member of the expert committee, M.Sc., Physiology, Rammohan College, Kolkata.

Guest lecturer and member of the Board of Examiners in Zoology M.Sc. Part II, Moulana Azad College, Kolkata for the session 2008-2009.

Member of the Board of Examiners in Physiology M.Sc. Part II, Presidency College, for evaluation of Theoretical papers, Project & Seminar papers and viva-voce tests, 2008-2009.

Dr. Sib Sankar Roy

UGC visiting teacher at Tripura University, Agartala to teach a course in Molecular Biology and Genetics for M.Sc. students.

Teacher of course-work for the PhD students in IICB, Kolkata.

Examiner in the M.Sc. (Biochemistry), M.Sc. (Microbiology) at Calcutta University.

Acted as external examiner for the Ph.D. (Sc.) Viva Voce examination of Jadavpur University.

Training of one JBNSTS Scholar, who worked in my laboratory in 'diabetes' project for 4 months.

Summer training of one student of M.Tech Biotechnology, University of Poona, Pune, for three months.

Dr. Tuli Biswas

Teaching of Physiology in the Coursework offered to Ph.D. students of IICB, Kolkata.

External examiner of Ph.D. thesis and viva-voce of Jadavpur University.

Supervised the project work of three students (Mr. Rahul Kumar, Kalyani University; Mr. Sourav Ghosh, Calcutta University; Ms. Pinki Barick, Rishi Bankim Chandra College), for the submission of dissertations in connection to their M.Sc. degrees.

Deputation abroad

Dr. Arun Bandyopadhyay

Attended *The Endocrine Society's 90th Annual meeting*. San fransisco, USA, *June 15-18 2008.*
Attended 53rd Annual meeting of the Biophysical Society, USA. Boston, *February 28-March 4, 2009.*

Dr. Sib Sankar Roy

Attended and presented data in the "International Congress of Endocrine Society" (ENDO-08), during June 14-16, 2008, held at San Francisco, USA.

Conference/ Symposium/Workshop

Dr. K. P. Mohanakumar

Joint Organizing Secretary, "NeuroUpdate-2008" First Congress of Neurobiologists & Neurologists, CGCRI Auditorium, 28-29 Sept, 2008.

Organizing Secretary, International Brain Research Organization (IBRO), Neuroscience School, 29th December 2008 to 8th January, 2009.

Joint Organizing Secretary, "Neurocon-2009", Science City, Feb 8-9, 2009, Kolkata.

Joint Organizing Secretary, "Neurocon-2009: Neuroscience Workshop for the Neuroscientists". IPGMER, Feb 2-7, 2009, IPGMER, Kolkata.

Dr. S. R. Dungdung

Das S., Majumder G. C. and Dungdung S.R. (2008) Purification and characterization of sperm motility inhibiting protein from goat epididymal plasma. In International Conference: Emerging Trends in Biological Sciences on October 24-25, at School of Biotechnology, KIIT University, Bhubaneswar, Orissa.

Saha S., Paul D., Mukherjee A., Banerjee S., Dungdung S. R., Majumder G. C. (2008): Computer based spectrophotometric "vertical velocity" measurement: A new dimension in cell motility research. (Abstract): In International Conference: Emerging Trends in Biological Sciences on October 24-25, at School of Biotechnology, KIIT University, Bhubaneswar, Orissa.

Saha S., Paul D., Mukherjee A., Banerjee S., Dungdung S. R., Majumder G. C. (2008): Computer based spectrophotometric "vertical velocity" measurement: A new dimension in sperm motility research. (Abstract): In Ranbaxy Science Scholars 2008 - Young Scientist Award Seminar, 4th December, Raman Conference Hall, Ranbaxy Research Laboratories, Gurgaon.

Maiti A., Nath D., Dungdung S. R., Majumder G. C. (2008) Sperm ecto-protein kinase and its protein substrate: Novel regulators of membrane fusion during acrosome reaction. In International Conference on "Cell Signaling and Molecular Medicine" at Bose Institute, Kolkata, on 27-29th November.

Saha S., Paul D., Mukherjee A., Banerjee S., Dungdung S. R., Majumder G. C. (2009): Measurement and analysis of vertical velocity of spermatozoa by developing a novel computerized spectrophotometric instrumental system. (Abstract): In BioAsia Innovation Award 2009, 2-4th February, Hyderabad International Convention Centre, Hyderabad.

Dr. Mrinal K. Ghosh

Treasurer/Member of the organizing committee of the International Symposium on "Complex Diseases: Approaches to Gene Identification and Therapeutic Management" HGM 2008 Satellite Symposium at SINP, Kolkata during 25-26th September 2008.

Member: International Conference on "System Biology and Proteomic Research", Vedic Village, Kolkata.

Dr. S. N. Kabir

"Hands on training on sperm function tests", organized as a part of the 35th National Conference of Association of Clinical Biochemists of India. 19-21st December, 2008.

Papers/Abstract presented in the conference

K. P. Mohanakumar

Ayodele S. O., Saravanan K. S., Sindhu K. M., Mohanakumar K. P. Rotenone-induced neurodegeneration: protective role of salicylic acid. Society for Neurochemistry (India) Annual Meet, Guru Nanak Dev University, Amritsar, Nov 28-29, 2008.

Borah A., Gangopaydhayay P. K. and Mohanakumar K. P. L-DOPA treatment causes increases in plasma homocysteine levels in Parkinson's disease patients, and in the plasma and brains of parkinsonian rats. Society for Neurochemistry (India) Annual Meet, Guru Nanak Dev University, Amritsar, Nov 28-29, 2008.

Chakraborty J., Pandey M., Mohanakumar K. P. Differentially expressed genes in 3-nitropropionic acid-induced animal model of Huntington's disease. Society for Neurochemistry (India) Annual Meet, Guru Nanak Dev University, Amritsar, Nov 28-29, 2008.

Chandra G., Sreetama S., Navneet A. K., Busselberg D., Mohanakumar K. P. Disruption of intraneuronal calcium homeostasis by neurolathyrogen, β-N-oxalyl amino-L-alanine (L-BOAA). Society for Neurochemistry (India) Annual Meet, Guru Nanak Dev University, Amritsar, Nov 28-29, 2008.

Debasmita T., Haobam R. and Mohanakumar K.P. Characterization of mouse-embryonic stem cell derived neurons. Society for Neurochemistry (India) Annual Meet, Guru Nanak Dev University, Amritsar, Nov 28-29, 2008.

Haobam R., Navneet A.K., Lenka N. Mishra G.C., Mohanakumar K.P. Characterization of dopaminergic neurons derived from mouse ES cells using serum free medium and functional assessment of the transplants in a hemiparkinsonian model. Society for Neurochemistry (India) Annual Meet, Guru Nanak Dev University, Amritsar, Nov 28-29, 2008.

Pandey M., Borah A., Varghese M., Barman P.K., Mohanakumar K.P. and Usha R. Dopamine contributes to the neurodegeneration caused by 3-nitropropionic acid, a neurotoxin causing Huntington's disease in rats. Society for Neurochemistry (India) Annual Meet, Guru Nanak Dev University, Amritsar, Nov 28-29, 2008.

Samanta, A. Gangopadhyay P.K. and Mohanakumar K.P. Serotonin, but not dopamine turnover is increased along with increase in plasma homocysteine and serum ammonia of rats with fulminant hepatic encephalopathy. Society for Neurochemistry (India) Annual Meet, Guru Nanak Dev University, Amritsar, Nov 28-29, 2008.

Sreetama S., Chandra G., Pandey M., Mohanakumar K.P., Usha R. Sustained calpain activation, nuclear condensation and DNA breakage in the striatum following 3-nitropropionic administration in rats. Society for Neurochemistry (India) Annual Meet, Guru Nanak Dev University, Amritsar, Nov 28-29, 2008.

Appukuttan T.A., Navneet A.K., Banerjee R., Mohanakumar K.P. Vitamin D3 scavenges hydroxyl radicals and attenuates MPP+-induced neurotoxicity in rats. Neurocon IPGMER/IICB, Science City, Kolkata, Feb 8-10, 2009.

Chakraborty J., Pandey M., Navneet A.K., Appukuttan T.A., Varghese M., Usha R. and Mohanakumar K.P. Inhibition of succinate dehydrogenase in brain leads to behavioral alterations and expression changes in profilin mRNA: implications for Huntington disease. Neurocon IPGMER/IICB, Science City, Feb 8-10, 2009.

Debasmita T., Haobam R. and Mohanakumar K.P. Differentiation of murine embryonic stem cells into neurons and their characterization. Neurocon IPGMER/IICB, Science City, Feb 8-10, 2009.

Pandey M., Varghese M., Sindhu K.M., Sreetama S., Mohanakumar K.P. and Usha R. Inhibition of mitochondrial Complex II leads to inhibition in Complex I and state 3 respiration and dopamine(DA) dependent loss of striatal neurons in the rats, Neurocon IPGMER/IICB, Science City, Feb 8-10, 2009.

Samanta A., Borah A., Gangopadhyay P.K., Mohanakumar K.P. Elevated plasma homocysteine levels in-patient with or without hepatic encephalopathy but not in thioacetamide-induced animal model. Neurocon IPGMER/IICB, Science City, Feb 8-10, 2009.

Sengupta T. and Mohanakumar K.P. Prolonged administration of 2-phenylethylamine, a constituent of chocolate, causes striatal serotonin and dopamine depletion leading to depression and motor dysfunction in Balb/c mice, Neurocon IPGMER/IICB, Science City, Feb 8-10, 2009.

Sreetama S., Chandra G., Banerjee R., Mohanakumar K.P., Usha R. Involvement of apoptosis inducing factor in calpain-mediated apoptosis in 3-nitropropionic acid-induced Huntington's disease in Sprague Dawley rats. Neurocon IPGMER/IICB, Science City, Feb 8-10, 2009.

Dr. Arun Bandyopadhyay

Bandyopadhyay A., Ghose Roy S., De P., Chander V. Mechanism of glucocorticoiod induced malfunction in Rat. The Endocrine Society's 90th Annual meeting. San fransisco, USA, June 15-18 2008.

Bandyopadhyay A., Ghose Roy S., De P., Chander V., Kar D. Gene expression profile in glucocorticoid-induced hypertrophied heart in rat. Human Genome meeting,Hyderabad, India , September 27-30, 2008.

Bandyopadhyay A., Sumita Mishra, Do Han Kim. Interaction of Annexin A6 with Cytoskeletal Protein in Cardiomyocytes. 53rd Annual meeting of the Biophysical Society, Boston, USA. *February 28-March 4, 2009.*

Dr. Padma Das

Abhijit Chakraborty, Deepak Kumar, Padma Das. Methanolic extracts of Sesbania grandiflora flower possess potential estrogenic activity, presented at the National Symposium on Recent Advances in Female Reproductive Health Research, at Lucknow, December 11-12, 2008.

Dr. Syed N. Kabir

"The rate of follicular atresia inversely correlates with the size of ovarian follicular reserve" presented at the 11th Congress on Controversies in Obstetrics, Gynecology and Infertility at Paris, France during 27-30 November, 2008.

"Evaluation of contragestative effect of puerarin, a phytoestrogen from *Pueraria tuberosa*" presented at 19th Annual Meeting of the Indian Society for the Study of Reproduction & Fertility held at IISc, Bangalore during 22-24 January, 2009.

"Evaluation of spermicidal and anti-HIV potential of Acaciaside-B-enriched fraction of *Acacia auriculiformis* seed isolates" presented at National Symposium on Recent Advances in Female Reproductive Health Research, held at CDRI, Lucknow, December 11-12, 2008.

"Experimentally induced polycystic ovary in rats: metabolic and ovarian response to some targeted therapies" presented at National Symposium on Recent Advances in Female Reproductive Health Research, held at CDRI, Lucknow, December 11-12, 2008.

Dr. Tuli Biswas

Sen, G., Mukhopadhyay, S., Biswas, T. Quercetin exerts leishmanicidal activity by down regulating ribonucleotide reductase in *Leishmania donovani* under *in vivo* condition. Fourth World Congress on Leishmaniasis (WL4), Lucknow, February 03-07, 2009.

MOLECULAR & HUMAN GENETICS

Invited lectures:

Dr Keya Chaudhuri

Topic : Participation in high quality science, technology, and innovation- the IICB experience & future challenges
Venue : Conference Hall, DFG India Office, New Delhi; 2nd Deliberations on Research Policy organized by National Institute of Science Technology & Development Studies (CSIR) and German Research Foundation
Date : Oct 17-18, 2008

Topic : Carcinogenic impact of heavy metals and its putative remediation
Venue : Meghnad Saha Auditorium at CGCRI on the occasion of National Science Day Celebration jointly organized by The Science Association of Bengal and The Central Glass and Ceramic Research Institute
Date : February 28, 2009

Dr. Kunal Ray

Topic : DNA-based Molecular Diagnosis of Genetic Diseases: Pros and Cons
Venue : NEUROUPDATE 2008 at CGCRI, Kolkata
Date : September 21, 2008

Topic : Human Genome Project & Beyond…. [Debidas Bhattacharya Centenary Lecture]
Venue : Zoology Department, Visva-Bharati University, Shantiniketan
Date : November 9, 2008

Topic : Pharmacogenomics: Medicine and The New Face of Genetics
Venue : UG Sponsored National Level Seminar on Recent Advances in Genetics & Molecular Biology, Biotechnology and Bioinformatics at Vidyasagar College, Kolkata
Date : November 22, 2008

Topic : Molecular Pathogenesis and Genotype-Phenotype Correlation in Indian Wilson Disease Patients [RN Chatterjee Oration Lecture]
Venue : Annual Conference of Association of Neuroscientists of Eastern India at Patna
Date : November 30, 2008

Topic : Prenatal Diagnosis in Haemophilia: A Geneticist's Perspective
Venue : CME on Haemophilia at the Institute of Haematology & Transfusion Medicine, Medical College, Kolkata
Date : December 17, 2008

Topic : Pursuit of Knowledge through Research
Venue : CPYLS 2008 at CGCRI, Kolkata
Date : December 29, 2008

Topic : Genetic Polymorphism & Neurological Diseases
Venue : IBRO Workshop at IICB, Kolkata
Date : January 3, 2009

Dr. Ashok Giri

Topic : Health Effects, Genetic Damage and Genetic Variants in the Population Exposed to Arsenic Through Drinking Water in West Bengal, India
Venue : PRAMA International Workshop at the University of Manchester, U.K
Date : June 22-25, 2008

Topic : Antimutagenic and Anticancer Activities of Black Tea Polyphenols Theaflavins and Thearubigins in Multiple Test Systems
Venue : The 8th. International Conference on Anticancer Research, Kos Island, Greece
Date : October 17 – 22, 2008

Dr. Susanta Roychoudhury

Topic : Effect of IL1B promoter polymorphism on down regulation of gastrin through signaling intermediates NFkB and SMAD7
Venue : HGM 2008, 13th International Meeting on Human Genome (HUGO), Hyderabad
Date : September 27 -30, 2008

Topic : Mechanistic insight into Spindle assembly checkpoint defects causing chromosomal instability in human cancer
Venue : 28th Annual Convention of Indian Association for Cancer Research, Indian Institute of Science, Bangalore
Date : February 21-24, 2009

Topic : In search of the susceptibility genes in the development of oral cancer
Venue : ISHG 2009: International symposium on ‘Ethics, culture, and population genomics” and 34th Annual Conference of the Indian Society of Human Genetics, New Delhi
Date : March 17-20, 2009

Topic : A system based approach to understand chromosomal instability in human cancer: a proposal
Venue : International symposium on system biology and proteomics in biomedical science, Kolkata
Date : March 27-29, 2009

Chairing Sessions

Keya Chaudhuri chaired a session in the Annual Meeting of the Indian Eye Research Group on July 27 at Arvind Eye Hospital, Madurai, (July 26-29, 2008).

Keya Chaudhuri chaired a workshop on "Genomics of Complex Disorders" on September 30, 2008 at the Human Genome Meeting 2008 at Hyderabad (Sept 27-30).

Kunal Ray chaired a session in the Annual Meeting of the Indian Eye Research Group on July 27 at Arvind Eye Hospital, Madurai, (July 26-29, 2008).

Kunal Ray chaired a workshop on "Genomics of Complex Disorders" on September 30, 2008 at the Human Genome Meeting 2008 at Hyderabad (Sept 27-30).

Papers/Abstract presented in the conference

Rajdeep Chowdhury, Raghunath Chatterjee, Ashik K. Giri, Chitra Mandal and Keya Chaudhuri. Arsenic-induced alterations in gene expression profile in human peripheral lymphocytes and its association with carcinogenesis, Poster # 353, HUGO Human Genome Meeting 2008, Hyderabad India, 27th-30th September 2008.

Sanjit Mukherjee, Keya Chaudhuri. Association of DNA repair gene XRCC1 polymorphism at codon Arg194Trp and Arg399Gln with oral submucous fibrosis in population of eastern India in a symposium organized by the Society of Biological Chemists (India)-Kolkata Chapter at Digha, West Bengal, held on 22-24 August, 2008.

Banerjee, Nilanjana, Banerjee, Mayukh and Giri Ashok K. (2008) Chronic arsenic exposure impairs macrophage functions and alters inflammatory cytokine profile. Poster presented in International symposium, 13th Human Genome Meeting at Hyderabad from September 27-30, 2008.

Ghosh, Pritha, Harrys Kishore, C. J., Pandey, Akhilesh and Ashok K. Giri (2008) Gene Expression Profiling in Lymphocytes of Arsenic Exposed Individuals. Poster presented in International symposium, 13th Human Genome Meeting at Hyderabad from September 27-30, 2008.

Bhattacharya, Udayan, Halder, Babli, Mukhopadhayay, Sibabrata and Ashok K. Giri (2008) Mechanism of Black Tea Polyphenols Theaflavins and Thearubigins Induced Apoptosis in Human Skin Cancer Cells: Involvement of Oxidative Stress Induced MAP kinase pathways. Poster presented in International symposium, 13th Human Genome Meeting at Hyderabad from September 27-30, 2008.

Manjari Kundu, Mayukh Banerjee, Pritha Ghosh, Sujata De Chaudhuri, Nilanjana Banerjee and Ashok K. Giri (2008) Epidemiological, Cytogenetic and Molecular Approaches to Decipher Arsenic Susceptibility: Poster presented in International symposium, 13th Human Genome Meeting at Hyderabad from September 27-30, 2008.

Polya, David A., Giri, Ashok K., Lloyd Jon R., Ballentine Chris J., Ganguli, Bhaswati, Chatterjee, Debasish, Rodriguez-Lado, Luis, Boyce, Adrian J., Banerjee, Mayukh, Lawson, Michael, Hery, Marina, Mondal, Debapriya, Kundu, Manjari, Bradford, William, Hennerman, Karl and Majumder, Santanu (2008) PRAMA: Probabilistic Risk Assessment Modeling to Inform Arsenic Mitigation. Invited talk presented in 14th Alexander Hollaender Course on Genetic Toxicology: Genomic and Proteomic Approaches & Special Workshop on Arsenic Exposure Assessment at Kolkata from December 10-12, 2008.

Mondal, Debapriya, Giri, Ashok K., Ganguli, Bhaswati, Kundu, Manjari, Bradford, William, Banerjee,

Mayukh, Halder, Babli, Hennerman, Karl and Polya, David A. (2008) Probabilistic Risk Assessment – Quantifying the Relative Magnitudes of Arsenic- and Water-Borne Pathogen Attributable Risks in Chakdha Block, West Bengal. Invited talk presented in 14th Alexander Hollaender Course on Genetic Toxicology: Genomic and Proteomic Approaches & Special Workshop on Arsenic Exposure Assessment at Kolkata from December 10-12, 2008.

Ghosh, Pritha, Pandey, Akhilesh and Ashok K. Giri (2008) Gene Targets in Arsenicosis. Invited talk presented in 14th Alexander Hollaender Course on Genetic Toxicology: Genomic and Proteomic Approaches & Special Workshop on Arsenic Exposure Assessment at Kolkata from December 10-12, 2008.

Banerjee, Nilanjana and Giri Ashok K. (2008) Impaired Macrophage Functions and Genetic Polymorphisms are Associated with Chronic Arsenic Exposure. Poster presented in 14th Alexander Hollaender Course on Genetic Toxicology: Genomic and Proteomic Approaches & Special Workshop on Arsenic Exposure Assessment at Kolkata from December 10-12, 2008.

Biswas, Debabrata, Banerjee, Mayukh, Sen, Gargi, Das, Jayanta K., Banerjee, Apurba, Sau, T. J., Pandit, Sudipta, Giri Ashok K. and Biswas Tuli (2008) Mechanism of Erythrocyte Death in Human Population Exposed to Arsenic through Drinking Water. Poster presented in 14th Alexander Hollaender Course on Genetic Toxicology: Genomic and Proteomic Approaches & Special Workshop on Arsenic Exposure Assessment at Kolkata from December 10-12, 2008.

De Chaudhuri, Sujata, Kundu, Manjari, Roychoudhury, Susanta and Giri, Ashok, K. (2008) Study of Arsenic-Induced Premature Senescence in Exposed Population in West Bengal, India. Poster presented in 14th Alexander Hollaender Course on Genetic Toxicology: Genomic and Proteomic Approaches & Special Workshop on Arsenic Exposure Assessment at Kolkata from December 10-12, 2008.

Banerjee, Saptarshi and Giri Ashok K. (2008) Ophthalamological Studies on a Population Chronically Exposed to Arsenic. Poster presented in 14th Alexander Hollaender Course on Genetic Toxicology: Genomic and Proteomic Approaches & Special Workshop on Arsenic Exposure Assessment at Kolkata from December 10-12, 2008.

Banerjee, Mayukh and Giri, Ashok K. (2008) Arsenic Susceptibility: Epidemiological and Cytogenetic Assessment. Poster presented in 14th Alexander Hollaender Course on Genetic Toxicology: Genomic and Proteomic Approaches & Special Workshop on Arsenic Exposure Assessment at Kolkata from December 10-12, 2008.

Ashima Bhattacharjee, Deblina Banerjee, Suddhasil Mookherjee, Moulinath Acharya, Abhijit Sen, and Kunal Ray; *CYP1B1* SNP as a Susceptible Factor for Predisposition to Primary Open Angle Glaucoma, 7th Annual Casey Devers Eye Research Day (May 15, 2008) at Casey Eye Institute, Oregon Health & Science University, Portland, Oregon [Poster presentation].

Maitreyee Mondal, Mainak Sengupta, Moumita Chaki, SwapanSamanta, K Ray; Heterozygous deletion of the 3' region of *TYR* is one of the potential mutations which remains uncharacterized in 15% of the oca1 patients worldwide, Annual Meeting of The Indian Eye Research Group (July 26-27, 2008) at LV Prasad Eye Institute [Oral presentation].

Deblina Banerjee, Suddhasil Mookherjee, Subhadip Chakraborty, Antara Banerjee, Abhijit Sen and Kunal Ray; A haplotype in interleukin-1 gene cluster is associated with elevated risk of normal tension glaucoma, Annual Meeting of The Indian Eye Research Group (July 26-27, 2008) at LV Prasad Eye Institute [Oral presentation].

Mainak Sengupta, Maitreyee Mondal, Moumita Chaki, Swapan Samanta, K Ray; Unidentified Genetic Defects Causing Oculocutaneous Albinism: Heterozygous Deletion in 3'-Region of Tyrosinase Gene as a Potential Case, Annual Meeting of Local Chapter of SBC (Aug 22-24, 2008) at Digha [Oral presentation].

Subhadip Chakraborty, Suddhasil Mookherjee, Deblina Banerjee, Antara Banerjee, Abhijit Sen and Kunal Ray; Analysis of IL-1 gene cluster for its potential association with glaucoma pathogenesis, Annual Meeting of Local Chapter of SBC (Aug 22-24, 2008) at Digha [Oral presentation].

Atreyee Saha, Saibal Mukherjee, Parbati Biswas, Chhabinath Mandal and Kunal Ray; Structural analysis of factor IX variants for genotype phenotype correlation in hemophilia B patients, Human Genome Meeting 2008 (Sept 27-30, 2008) at Hyderabad [Poster presentation].

Tufan Naiya, Shyamal K. Das, Kunal Ray and Jharna Ray; Molecular pathogenesis of dystonia: Role of *GCH1* gene in Indian patients, Human Genome Meeting 2008 (Sept 27-30, 2008) at Hyderabad [Poster presentation].

Mainak Sengupta, Moumita Chaki, Maitreyee Mondal, Swapan Samanta, and Kunal Ray; Molecular characterization of oculocutaneous albinism type 1 (OCA1) mutations found in Indian population, Human Genome Meeting 2008 (Sept 27-30, 2008) at Hyderabad [Poster presentation].

Jharna Ray, Arindam Biswas, Gautami Das, Shyamal K Das , Kunal Ray; Molecular pathogenesis of Parkin gene related Parkinson's disease in Indian population, Human Genome Meeting 2008 (Sept 27-30, 2008) at Hyderabad [Oral presentation by the collaborator J. Ray].

Arindam Biswas, Tamal Sadhukhan, Sayantani Majumder, Shyamal K. Das, Indian Genome Variation consortium, Kunal Ray, Jharna Ray; Evaluation of *PINK1* variants in Indian Parkinson's disease patients, Human Genome Meeting 2008 (Sept 27-30, 2008) at Hyderabad [Poster presentation].

Deblina Banerjee, Ashima Bhattacharjee, Suddhasil Mookherjee, Moulinath Acharya, Antara Banerjee, Ananya Ray, Abhijit Sen, Indian Genome Variation Consortium and Kunal Ray; A nonsynonymous SNP in *CYP1B1* is associated with Primary Open Angle Glaucoma, Human Genome Meeting 2008 (Sept 27-30, 2008) at Hyderabad [Poster presentation].

Subhadip Chakraborty, Suddhasil Mookherjee, Deblina Banerjee, Antara Banerjee, Abhijit Sen and Kunal Ray; Involvement of IL-1 gene cluster in glaucoma pathogenesis, Human Genome Meeting 2008 (Sept 27-30, 2008) at Hyderabad [Poster presentation].

Suddhasil Mookherjee, Moulinath Acharya, Ashima Bhattacharjee, Deblina Baneerjee and Kunal Ray; Functional Implication of *CYP1B1* in Primary Open Angle Glaucoma, Human Genome Meeting 2008 (Sept 27-30, 2008) at Hyderabad [Poster presentation].

Bhattacharyya S N. miRNA mediated translation repression and P-bodies. "Senior Research Fellows' Meeting of The Wellcome Trust", London. 8-9 October 2008 in the Wellocme Trust London, U.K.

Bhattacharyya, S.N. , Kundu, P., Dugelli, R., Artus-Revel, C., Closs, E.I., and Filipowicz W., Mechanism of the HuR-mediated reversal of miRNA repression in human cells. Keystone symposium on Regulation by RNA interference held on 25th-30th April 2009, Victoria, Canada.

Taraswi Banerjee, Somsubhra Nath and Susanta Roychoudhury, Repression of Spindle Assembly checkpoint gene *CDC20* by p53 upon DNA Damage, 99th AACR Annual Meeting, San Diego, USA, April 12-16, 2008.

Sumana Bhattacharjya, Dipanjana Datta De, Meenakshi Maitra, Subhobrata Purokayastha, Abhijit Choudhury, and Susanta Roychoudhury. Interleukin 1beta (IL1B) as potential host susceptibility factor in Helicobacter pylori mediated duodenal ulcer in eastern India population, HGM 2008: 13th Human Genome Meeting (HUGO), Hyderabad, September 27-30, 2008.

Pinaki Mondal, Debasish Boral, Jayanta Chakrabarti, Anup Roy, Chinmay K Panda and Susanta Roychoudhury. MLH1 -93G>A promoter polymorphism and risk of head and neck squamous cell cancer. HGM 2008: 13th Human Genome Meeting (HUGO), Hyderabad, September 27-30, 2008.

Chaitali Misra, Mousami Majumder, Swati Bajaj, Sourav Ghosh, Bidyut Roy, IGVC and Susanta Roychoudhury. Studies on interplay among TP53, TP73 & MDM2 loci at the risk of tobacco associated Leukplakia and oral cancer and analysis of apoptotic property of wild type & mutant TP53 gene under different polymorphic background. HGM 2008: 13th Human Genome Meeting (HUGO), Hyderabad, September 27-30, 2008.

Somsubhra Nath, Taraswi Banerjee and Susanta Roychoudhury. Expression profile of SAC genes in HNSCC samples and study of transcriptional regulation of a key SAC gene *CDC20* upon DNA damage. HGM 2008: 13th Human Genome Meeting (HUGO), Hyderabad, September 27-30, 2008.

Dipanjana Datta De, Meenakshi Chakravorty, Sumana Bhattacharjyya, G.K Dhali, Abhijit Choudhury, and Susanta Roychoudhury. Differential Down regulation of Gastrin by IL1B promoter polymorphism through signaling intermediates NFkB and Smad 7. 58th Annual ASHG Meeting, Philadelphia, USA November 11-15, 2008.

Dipanjana Datta De, Meenakshi Maitra, Sumana Bhattacharjya, Abhijit Choudhury, G.K. Dhali, Susanta Roychoudhury. Regulation of Acid Secreting Hormone Gastrin By Proinflammatory Cytokine IL1B: A Biochemical Insight In *Helicobacter pylori* mediated Gastroduodenal Disease Phenotype. 35th Indian Immunological Society Conference, Bhubaneswar, December 11-13, 2008.

Sumana Bhattacharjya, Dipanjana Datta De and Susanta Roychoudhury, Functional Characterization of the IL1B Promoter. 34th Annual Conference of the Indian Society of Human Genetics. New Delhi, March 17-20, 2009.

Taraswi Banerjee, Somsubhra Nath and Susanta Roychoudhury, "DNA damage induced p53 downregulates Cdc20 by direct binding to its promoter causing chromatin remodeling" at the XXXII All India Cell Biology Conference & Symposium on Stem Cells and Pattern Formation, Pune, December 4-6, 2008.

Conferences/Symposia/Workshops organized

Kunal Ray was a member of the National Organization Committee of Human Genome Meeting 2008 (Sept 27-30, 2008).

Kunal Ray was a Member, National Advisory Committee of ASIA-Association of Research in Vision & Ophthalmology 2009 (Jan 15-18, 2009).

Kunal Ray was a Member, Local Executive Committee of NEUROCON 2009 (Feb 8-10, 2008).

Deputations Abroad

Suvendra Nath Bhattacharyya was deputed on a Short Term Fellowship from International Human Frontier Science Program Organization (HFSPO) to Friedrich Miescher Institute, Basel, Switzerland, October-November 2008.

Ashok Giri visited Department of Toxicology and Pharmacology, University of Louisville, Kentucky, USA from Feb. 1, 2009 to March 31, 2009 to work on a collaborative project entitled "Identification of p53 mutations in the laser capture micro-dissected cells from the keratotic and Bowen's tissue" from arsenic exposed individuals.

DRUG DEVELOPMENT, DIAGNOSTICS & BIOTECHNOLOGY

Invited Lectures:

Dr. J. R. Vedasiromoni

Topic : Exploring plant materials for anti-inflammatory potential
Venue : UGC Refresher Course on Thrust Areas on Development of Natural Products, School of Natural Product Studies, Jadavpur University, Kolkata
Date : November 20-27, 2008

Dr. Snehasikta Swarnakar

Topic : Targeting matrix metalloproteinases for prevention of gastric inflammation
Venue : Institute of Life Science, Bhubaneswar
Date : October 18, 2008

Topic : Twist and turns in understanding gastric ulcers: MMPs a novel pathway
Venue : ICCS&MM at Bose Institute, Kolkata
Date : November 27-29, 2008

Topic : A novel regulator in Gastric ulcers and carcinomas
Venue : International Con. on Advanced Medicine, Kolkata
Date : December 9-11, 2008

Topic : Induction and activation of MMP-3 are attributed to chronic gastric ulcers: protection by melatonin
Venue : SFRR-India, Lucknow, UP
Date : March, 19-21, 2009

Dr. Pratap K. Das

Topic : Molecular motors
Venue : IIT, Kharagpur (Conference on Nanobioengineering)
Date : December, 1-2, 2008

Topic : Biological motors and pumps
Venue : CMERI, Durgapur (tutorial lecture series to engineers)
Date : January, 2009

Dr. Suman Khowala

Topic : Fungal Biotechnology in food and feed bioprocessing
Venue : 3rd International Congress on Bioprocesses in Food Industries (ICBF) 2008 & 5th Convention of Biotech Research Society of India (BRSI) 2008 at Osmania University, Hyderabad, India
Date : November, 6 -8, 2008

Topic : Biodepolymerization of lignocellulosics by carbohydrases for production of bioethanol.
Venue : National Conference on Frontiers in Biological Sciences at BRD School of Sciences, Sardar Patel University, Vallabh Vidyanagar, Gujarat
Date : February 27-28, 2009

Dr. Sharmila Chattopadhyay

Topic : Indian medicinal plants and its potential
Venue : Asian Symposium on Medicinal Plants, Spices and Other Natural Products (ASOMPS) XIII-2008, IICT, Hyderabad
Date : 3-5th November 2008

Chairing session

Dr. Aparna Gomes

Chaired a session on UGC sponsored National Science Current trend in human Physiology Research: its contemporary relevance organized by Department of Physiology, Presidency College on December 19, 2008.

Dr. Snehasikta Swarnakar

Chaired a session at CME 2009, " New Frontiers in Haematology and Oncology", Kolkata, India, April 2009.

Dr. Suman Khowala

Chaired session at Rashtriya Vigyan Sangoshthi at Institute of Genomics & Integrative Biology, N. Delhi, April 23-24, 2008.

Chaired session at 3rd International Congress on Bioprocesses in Food Industries (ICBF) & 5th Convention of Biotech Research Society of India (BRSI) at Osmania University, Hyderabad, November, 6-8, 2008.

Invited as Expert at Task Force Meeting of DST (Govt of India) on 'Sensors and Probes for bioprocesses' at National Institute for Interdisciplinary Science and Technology (NIIST), Trivandrum, August 22-23, 2008.

Invited to evaluate Poster sessions 3rd International Congress on Bioprocesses in Food Industries (ICBF) & 5th Convention of Biotech Research Society of India (BRSI) at Osmania University, Hyderabad, November 6-8, 2008.

Academic Performance/Teaching

Dr. Tarun Kumar Dhar

Reviewer of several papers to be published in Analytica Chimica Acta, Analytical Chemistry, J. Science Food and Agriculture.

Evaluated project proposals submitted for funding to CSIR, DST., Govt. of India.

Examined Ph.D. Thesis submitted to Poona University.

Dr. J. Rajan Vedasiromoni

Member, Editorial Board of Indian Journal of Pharmacology since 1992.

Reviewer for Life Sciences, Indian Journal of Experimental Biology, Indian Journal of Biochemistry & Biophysics, Indian Journal of Medical Research, Natural Product Radiance and Journal of Ethnopharmacology.

Member, PG Expert Committee in Physiology, Presidency College, Kolkata.

Nominated as DBT representative on the Institutional Bio-safety Committee (IBSC) of National Institute of Cholera and Enteric Diseases (NICED), Kolkata.

Member, Academic Committee of the School of Natural Product Studies, Jadavpur University.

Dr. Aparna Gomes

Reviewer of Indian Journal of Pharmacology, Indian Journal of Biotechnology,

Toxicology, Phytotherapy Research, Journal of Ethnopharmacology, Protein and peptide letter, Chinese Journal of Physiology.

Evaluated Research Proposals submitted to ICMR, DST.

Dr. Pratap K. Das

Visiting Faculty in the Department of Bioscience & Engineering, Jadavpur University—Teaching Biochemistry to Students of M. Tech. in Biomedical Engineering.

Guest Faculty in the Department of Biochemistry, Manipur University—Teaching Membrane Biology to M. Sc. (Biochemistry) Students.

Dr. Snehasikta Swarnakar

M.Sc examiner Biochemistry, Environmental Science and Microbiology, Calcutta University, and Biochemistry and Biophysics, Kalyani University.

Editorial Board member of International Journal of Biomedical Science, 2008.

Reviewer of external projects under CSIR and DST.

Board member of SFRR-ASIA, 2008.

Life member of The Biotech Research Society, 2009.

Dr. Suman Khowala

Ph.D./Thesis Examiner - Biochemistry Department, Acharya Nagarjuna University, Guntur; Dept of Biochemistry, Anna Malai University, Chidamabaram; Department of Genetics, Madurai Kamraj University; Bidhan Nagar College, Salt Lake, Kolkata.

Reviewer for Bioresource Technology, Food Research International, Applied Biochemistry and Biotechnology, Current Microbiology, Biotechnology progress, Electronic Journal of Biotechnology, Current Trends in Biotechnology and Pharmacy, International Journal of Association of Biotechnology and Pharmacy, International Journal of Biomedical Science.

Reviewing projects from DBT and CSIR, Govt. of India.

Dr. Sharmila Chattopadhyay

Examined Ph.D. Thesis submitted to JNU, Delhi; M.Sc. Thesis of BIRSA Agricultural University, Ranchi and conducted Viva-Voce.

Evaluated project proposals submitted for funding to Tea Board, Kolkata, ICNR, New Delhi, Reviewer NISCAIR Journals.

Deputation abroad

Dr. Aparna Gomes

Attended the 8th IST-Asia Pacific Meeting on Animal, Plant & Microbial Toxins held in Hanoi Capital & Halong Bay, Vietnam from 30th November to 8th December, 2008.

Dr. Snehasikta Swarnakar

Attended Gordon Research Conference on Pineal Cell Biology at Ilciocco, Italy, 2008

Training Received

Dr. Snehasikta Swarnakar

Intellectual property rights and related WTO issues, Nov 3-7, 2008 at Jaipur, India.

Sixth review meeting sponsored by DST at ASCI, Hyderabad , Nov 14-15, 2008.

Dr. Sharmila Chattopadhyay

"Introduction of Nanotechnology and its Emerging Role in Industries" organized by Foundation for Innovation and Technology Transfer, IIT, Delhi on 24th October, 2008.

Workshop for DBT Nominees and ISBC members for strengthening regulatory compliance, organized by Department of Biotechnology, Govt. of India, and BCIL, New Delhi at CAS-Department of Botany, University of Calcutta, Kolkata.

Papers/Abstracts presented in the Conference

Nandi, D., Besra, S. E., Pal, C., Giri, V. S., Vedasiromoni, J. R. and Jaisankar, P. 'Isolation and Characterization of Active Principle of Wattakaka Volubilis's Leaf Extract for Anti-inflammatory and Anti-Leukemic activity' presented at the Asian Symposium on Medicinal Plants and other Natural Products (ASOMPS) XIII, Indian Institute of Chemical Technology, Tarnaka, Hyderabad, November 3-6, 2008.

Besra, S. E., Roy, S., Vedasiromoni, J. R., Nayan, P. and Besra, S. 'Anti-leukemic activity of haemolymph of fresh water edible crab *Sartoriana spinigera'* presented at 1st International Conference on Transdisciplinary Biological Research (ICTBR), Indian Institute of Natural Resins & Gums, Namkum, Ranchi. Jharkhand, November 20-22, 2008.

Roy, S., Besra, S. E. and Vedasiromoni, J. R. 'Anticancer efficacy of Swietenia mahagoni leaf extract against 3-methylchlolathrene induced solid tumour in mice' presented at 2nd Eastern Regional & 19th Annual State Conference of Indian Pharmacological Society, West Bengal Branch, organised by Central Research Institute of Ayurveda, Kolkata, November 28-29, 2008.

Mallick, S., Ghosh, P., Pal, B. C. and Vedasiromoni, J. R. Antileukemic studies with the whole plant extract of *Corchorus acutangulus* Lam. presented at 2nd Eastern Regional and 19th Annual State Conference of Indian Pharmacological Society, West Bengal Branch, Kolkata, November 28-29, 2008.

Das, T., Vedasiromoni, J. R. and Gomes, A. 'Anticancer activity of Indian spectacled cobra venom fraction' presented at 2nd Eastern & 19th Annual State Conference of Indian pharmacological Society, West Bengal Branch, Central Research Institute of Ayurveda, Kolkata, November 28-29, 2008.

Gomes, A. 'Heat stable cytotoxic protein from Indian cobra (Naja kaouthia) venom' presented at 8th IST Asia Pacific Meeting on Animal , Plant and Microbial Toxins. Hanoi & Halong Bay, Vietnam, December 2-6, 2008.

Debnath, A. and Gomes, A. 'A low-molecular weight protein NK-31 identified from Indian monocellate cobra (Naja kaouthia) venom has apoptotic effect on C6 (glioma) cells' presented at 41st Annual Conference of Indian Pharmacological Society & International Conference on Translational Pharmacology, AIIMS, New Delhi, December 18-20, 2008.

Saha, A. Vedasiromoni, J. R. and Gomes, A. 'A non-protein toxin (NK-NPT1) from Indian *Naja kaouthia* venom arrested cancer cell growth by apoptosis involving caspase 9' presented at 41st Annual Conference of Indian Pharmacological Society, and International Conference on Translational Pharmacology, AIIMS, New Delhi, December 18-20, 2008.

Bhattacharya, S., Vedasiromoni, J. R. and Gomes, A. 'Study of crude *Bungarus caereleus* snake venom (BCV) on macrophage', 41st Annual Conference of Indian Pharmacological Society and International Conference on Translational Pharmacology, AIIMS, New Delhi, December 18- 20, 2008.

DasGupta, S., Vedasiromoni, J. R. and Gomes, A. 'A partially purified antineoplastic protein from Indian black scorpion (Heterometrus bengalensis Koch) venom active against human leukemic U937 and K562 cells' presented at 41st Annual Conference of Indian Pharmacological Society, & International Conference on Translational Pharmacology, AIIMS, New Delhi, December 18-20, 2008.

Swarnakar, S., Mishra, A. and Paul, S. 'Melatonin protects alcohol induced liver damage in mice by attenuation of matrix metalloproteinase-9 activity' presented at Gordon Research Conference on Pineal Cell Biology, Ilciocco, Italy, Europe, April 20-25, 2008.

Karmaker, P., Mondal, A. and Swarnakar, S. 'MMP-9 as potential biomarker for N-Ethyl-N- nitrosourea induced gastric tumor' presented at SBC Annual Meeting, Kolkata Chapter, Digha, West Bengal, April 2008.

Dey, S., Saha, D. and Swarnakar, S. 'Involvement of functional polymorphisms in the promoter regions of MMP-2, -3 and -9 in the susceptibility of gastric cancer' presented at International Human Genome Meeting, Hyderabad, September 27-30, 2008.

Mishra, A., Paul, S. and Swarnakar, S. 'Regulation of MMP-9 in alcohol induced liver damage and its protection by melatonin' presented at 77th SBC, IIT, Madras, Decenber 18-20, 2008.

Ganguly, K. and Swarnakar, S. 'Melatonin promotes angiogenesis via induction of matrix metalloproteinase-2 during gastric ulcer healing' presented at ICCS &M, Bose Institute, Kolkata, November 27-29, 2008.

Singh, P. K. Selected for '14th Alexander Holland course on genetic toxicology genomic and proteomic approaches and special workshop on arsenic exposure assessment' at CGCRI, Kolkata, December 10-12, 2008.

Paul, S., Dey, S., Mahapatra, P. D. and Swarnakar, S. 'Involvement of oxidative stress in regulation of MMP3 activity during endometriosis and reversal by melatonin' presented at SFRR-India, Lucknow, UP, March 19-21, 2009.

Basistha, B., Ghosh, A. K. and Ghosh, S. 'Regulation of Trehalose Metabolism by Adox and AdoMet in Mutant Strain MAT aKna of *Saccharomyces cerevisiae'*, presented at UGC Sponsored National Seminar on Stress, Drug Development & Nanotechnologly, Bethune College, Kolkata, March, 05 – 06, 2009.

Kumar, A., Chakraborty, A., Ghanta, S., Banerjee, A., Bhattacharya, D. and Chattopadhyay, S. 'Phytoremediation by transgenic pudina - A heavy metal tolerant plant' presented at Environmental Sciences Section, 96th Indian Science Congress, Shillong, January 3-7, 2009.

Banerjee, A., Chakraborty, A., Bhattacharya, D. and Chattopadhyay, S. '*Phyllanthus amarus*-a novel hepatoprotective plant' presented at "A Journey from Plant physiology to Plant Biology- An International Symposium to commemorate the 150th birth anniversary of Sir J. C. Bose and Birth centenary of Prof. S.M. Sircar" Bose Institute, Kolkata, Nov. 24-28, 2008.

Ghanta, S., Bhattacharya, D., Das, P. and Chattopadhyay, S. 'Tissue specific overexpression of γ-ECS and/or GS in *Nicotiana tabacum'* presented at "A Journey from Plant physiology to Plant Biology- An International Symposium to commemorate the 150th birth anniversary of Sir J. C. Bose and Birth centenary of Prof. S.M. Sircar", Bose Institute, Kolkata, Nov. 24-28, 2008.

Poddar, A., Banerjee, A., Bhattacharya, D. and Chattopadhyay, S. "Potential herbal antileishmanial agent to combat *kala-azar*" presented poster at 4th World Congress on Leishmaniasis 2009, CDRI, Lucknow, Feb. 3-7, 2009.

Chakraborty, A., Banerjee, A., Bhattacharya, D. and Chattopadhyay, S. 'Health promoting potential of leafy vegetables' presented at 16th West Bengal State Science & Technology Congress, Burdwan University, Burdwan, Feb. 28 - March 1, 2009.

Bhattacharya, D., Chakraborty, A., Banerjee, A. and Chattopadhyay, S. 'Oxidative DNA damage preventive activity and antioxidant potential of selected Indian spices' presented at 16th West Bengal State Science & Technology Congress Burdwan University, Burdwan, Feb. 28 - March 1, 2009.

Maity, A., Mukherjee, S., Guha, B., Verma, D. and Khowala S., 'Production of lignocellulolytic enzymes from filamentous fungus *Termitomyces clypeatus*', presented at International Society for Biotechnology at Gangtok, Dec. 28-30, 2008.

Mukherjee, S., Maity, A., Guha, B., Verma, D. and Khowala, S. 'Production of highly efficient β-glucosidase from fungus *Termitomyces clypeatus* in presence of glycosylation inhibitors', presented at International Society for Biotechnology at Gangtok, Dec. 28-30, 2008.

Majumder, R., Banik, S. P. and Khowala, S. 'Production of Proteolytic enzyme in edible fungus *Termitomyces clypeatus'*, presented at International Society for Biotechnology at Gangtok, Dec. 28-30, 2008.

Ghorai, S., Swagata Pal, Samudra Prosad Banik, Sudeshna Chowdhury and Suman Khowala, 'Underglycosylation produces highly active and stable cellobiase in Termitomyces clypeatus', Oral presentation at CARBO-XXIII Bhavnagar University Department of Chemistry, Gujarat, January 22-24, 2009.

Samudra Prosad Banik, Shakuntala Ghorai, Swagata Pal, Sudeshna Chowdhury and Suman Khowala, 'Interference of Sugars in the Coomassie Blue G Dye Binding Assay of Proteins' in Young Researchers Conferences at University Institute of Chemical Technology (UICT) Mumbai, January 27 –28, 2009.

Ghosh, A., Sarkar, S., Mandal, A. K. and Das, N. 'Nanocapsulated quercetin in combating age related ischemia-reperfusion induced oxidative damage in different brain regions of experimental rats' presented at International Conference on Advances in Free Radical Research: Natural products, Antioxidants and Radioprotectors and 8th Annual Meeting of the Society for Free Radical Research, Departments of Biochemistry, C.S.M. Medical University & Era's Lucknow Medical College, Lucknow March, 19-21 2009.

Ghosh, D., Mandal, A. K. and Das, N. 'Liposomal flavonoid in combating diethylnitrosamine induced hepatocarcinoma in rat model', delivered in Two Days Symposium on Recent Advances in Biological Sciences organized by Society of Biological Chemists, Kolkata Chapter, Digha, West Bengal, August 22-24, 2008.

CHEMISTRY

Invited Lecture

Dr. V. S. Giri

Topic : Scope for Analysing compounds
Venue : QIP Programme, Pharmacy Dept., Jadavpur Univ., AICTE sponsored
Date : August 18-September 13, 2008

Topic : Analytical Instruments and their role in Research
Venue : UGC Refresher Course, Jadavpur University
Date : February 4-5, 2009

Dr. Partha Chattopadhyay

Topic : Recent progress in the synthesis and biological perspectives of benzannulated medium ring heterocycles
Venue : CARBO– XXIII, Dept. of Chemistry, Bhavnagar University, Bhavnagar, Gujrat
Date : January 22-24, 2009

Dr. G. Suresh Kumar

Topic : Microcalorimetry of interaction of small molecules to nucleic acids: From basic concepts to application of isothermal titration calorimetry
Venue : Saha Institute of Nuclear Physics, Kolkata
Date : February 4-6, 2009

Dr. B. C. Pal

Topic : Bioactive Molecules from Indian Medicinal Plants
Venue : School of Natural Product Studies, Jadavpur University, Kolkata
Date : November 20, 2008

Dr. P. Jaisankar

Topic : LCMS interfaces/Analyzers
Venue : International Seminar on Recent Advances in LC/MS, KMCH College of Pharmacy and Hospital, Coimbatore, Tamil Nadu
Date : January28, 2009

Dr. Chinmay Chowdhury

Topic : Biochemical investigation of Plant's Constituents: Searching for Cure
Venue : Symposium on Sustainable Uses of Natural Resources from Medicinal & Aromatic Plants, held at Narendrapur R. K. Mission Ashram
Date : December 24-25, 2008

Dr. Asish K. Sen

Topic : Structural study, and Immunomodulatory and anti-leishmanial studies of an acidic polysaccharide isolated from Bael fruit (Aegle marmelos) pulp
Venue : CARBO-XXIII, Dept of Chemistry, Bhavnagar University, Bhavnagar, Gujarat
Venue : January 22-24, 2009

Topic : The sweet way to cures, DST Refresher Course for College and University Teachers
Venue : Dept. of Chemistry, Jadavpur University
Date : January 3, 2009

Topic : Carbohydrate as drugs with special reference to O-antigenic polysaccharides and carbohydrate-based vaccines, UGC sponsored National Symposium
Venue : Dept. of Chemistry, Burdwan University, West Bengal
Date : February 20-22, 2009

Academic Performance / Teaching

Dr. V. S. Giri

Guest faculty member, NIPER, Kolkata.

Taught IICB Ph.D. Course work and Master Program in Instrumentation, Jadavpur University of Kolkata.

Dr. Partha Chattopadhyay

Guest faculty member for Post Graduate Teaching, Department of Chemistry, Scottish Church College, Kolkata.

Guest faculty member of NIPER, Kolkata.

Acting as a Reviewer of Journal of Organic Chemistry, Tetrahedron and Tetrahedron Letter.

Member of the Editorial Board of Referees ARKIVOC, USA.

Dr. A. K. Banerjee

Acting as a Reviewer of Organic Letters and Journal of Organic Chemistry

Acting as Project Director of NIPER, Kolkata.

Member of the Steering Committee, Dept. of Pharmaceuticals, Ministry of Chemicals & Fertilizers, Govt. of India.

Member of the Joint Counseling Committee for the Master program in NIPER, Mohali, Punjab.
Guest faculty member, NIPER, Kolkata.

Dr. G. Suresh Kumar

Taught NIPER students and students of IICB course work.

Acted as an Editor, International Journal of Physical Sciences (Academic Journal).

Acted as a Member, Editorial Advisory Board, African Journal of Biochemistry Research (Academic Journal).

Acted as a Member, Editorial Advisory Board, The Open Natural Product Journal (Bentham Sciences)

Reviewed manuscripts of Journals: Chemical Research in Toxicology (ACS); Bioorganic Medicinal Chemistry; Biophysical Chemistry; Biochimica et Biophysica Acta (Elsevier), DNA and Cell Biology.

Served as Ph.D. Examiner of Jadavpur University.

Dr. B. C. Pal

Served as Ph.D. Examiner of Jadavpur University.

Guest faculty member of NIPER, Kolkata.

Chaired a Poster Session at International Herbal Conference – 2009 on Herbal Medicine – Evaluation of Quality, Efficacy and Safety, Bangalore, February 26- 28, 2009.

Dr. S. Mukhopadhyay

Honorary Lecturer in Postgraduate Teaching in Chemistry Deparment, Calcutta University

Guest faculty member of Niper, Kolkata

Dr. P. Jaisankar

Guest faculty member of NIPER, Kolkata and Ph.D. Course work, of IICB, Kolkata.

Acting as Reviewer of Organic Letters, American Chemical Society.

External examiner of Ph.D. thesis of Madras and Osmania universities.

Dr. Asish K. Sen

Ph.D. thesis examiner Burdwan University, Jadavpur University and CFTRI, Mysore.

Ten lectures given to M.Tech. students at Rajabazar Science College, Calcutta University, January-February, 2009.

Fifteen lectures at WBUT, Glycobiology Course & Associate course coordinator.

Seven Lectures at NIPER, Kolkata centre.

Chaired a Technical Session at the XXIII Carbohydrate Conference, Dept of Chemistry, Bhavnagar University, Bhavnagar, Gujarat, January 22-24, 2009.

Training Received

Dr. P. Jaisankar

CSIR-Leadership Programme 02-08 - consisting of four modules from 20. 04. 2008– 11. 07. 2008 in phase wise successfully completed all the four modules on development of leadership skills with Merit, HRDC (CSIR), Ghaziabad.

Programme on Reservation in Service and Maintenance of Roster (Comprehensive) from 02.03.2009 - 05.03.2009, HRDC (CSIR), Ghaziabad.

Honors and awards

Dr. G. Suresh Kumar

Elected Fellow, West Bengal Academy of Science and Technology.

Dr. Kakali Bhadra, RA

Received Full Travel Award for a participation and presentation of the work in Asian Biophysics Association Symposium at Hong Kong during January 11-15, 2009 (one among the 11 awards given).

Dr. Asish K. Sen

Elected as Hon. Vice President of the Association of Carbohydrate Chemists & Technologists (India) 2008-2010.

Conferences/Symposium/workshop

Dr. G. Suresh Kumar

Organized the Biocalorimetry Workshop, during Feb 4-6, 2009 at IICB, Kolkata in collaboration with SINP, Kolkata.

Dr. Asish K. Sen

Acted as a convener, CPYLS-2008 Programme of CSIR.

Dr. R. C. Yadav

Acted as a member in the organizing committee member of the "National Conference on Luminescence and its Applications (NCLA-2009)" held at IACS Kolkata during February 19-21, 2009.

Papers/ Abstracts presented during Seminar/Symposium

Dr. B. C. Pal

Kundu R., Dasgupta S., Biswas A., Pal B. C., Bhattacharya S. & Bhattacharya, S. Hepatocyte bilirubin accumulation could be attenuated by a chemical compound that induces signaling pathway for the conversion". International Conference on Perspectives of Cell Signaling and Molecular Medicine, November 27 – 29, 2008, Kolkata.

Samanta S. K., Bhattacharya K., Mandal C. & Pal B. C. Isolation and Purification of Plant Derived Carbazole Alkaloid with Potent Antileukemic Activity. International Conference on Perspectives of Cell Signaling and Molecular Medicine, November 27 – 29, 2008, Kolkata

Bhattacharya K., Samanta S. K., Chandra S., Pal B. C. & Mandal C. CD95/FAS mediated apoptosis by a purified carbazole alkaloid, IICB-4, in acute lymphoblastic leukemia (ALL). International

Conference on Perspectives of Cell Signaling and Molecular Medicine, November 27 – 29, 2008, Kolkata.

Saha P., Sarkar K., Bhattacharya D., Pal B. C., Kabir S. N. Puerarin, a herbal molecule from Pueraria tuberosa as prospective nonsteroidal contraceptive. International Herbal Conference, Bangalore, February 26 –28, 2009.

Dr. G. Suresh Kumar

Bhadra K., Maiti M. & Suresh Kumar G. DNA binding of phototoxic protoberberine alkaloids: Energetics of binding of berberine, palmatine and coralyne, National conference on recent advances in Photosciences, Jadavpur University, August 9, 2008, Kolkata.

Hossain M., Adhikari A., Maiti M. & Suresh Kumar G. Energetics of the DNA binding of phototoxic and cytotoxic plant alkaloid sanguinarine: Isothermal titration calorimetric studies, National conference on recent advances in Photosciences, Jadavpur University, August 9, 2008, Kolkata.

Islam Md. M., Roy Chowdhury S. & Suresh Kumar G. RNA targeting by small molecule alkaloids: A biophysical study, National conference on recent advances in Photosciences, Jadavpur University, August 9, 2008, Kolkata.

Sinha R. & Suresh Kumar G. Studies on protoberberine alkaloids-triplex RNA interaction", National conference on recent advances in photosciences, Jadavpur University, August 9, 2008, Kolkata.

Bhadra K., Maiti M. & Suresh Kumar G. Interaction of isoquinoline alkaloids berberine, palmatine and coralyne with polymorphic DNA structures: A comparative study, 6th Asian Biophysics Association Symposium, Honk Kong University of Science and Technology, Honk Kong, January 11-15, 2009. Full Travel Fellowship for Ms. Bhadra's participation in ABA Symposium at Hong Kong (one among the 11 awards).

Islam Md. M. & Suresh Kumar G. Interaction of isoquinoline alkaloids with double stranded ribonucleic acids, National Symposium on Cellular and Molecular Biophysics IBS, Hyderabad, January 22-24, 2009.

Hossain M. and Suresh Kumar G. Comparative binding and thermodynamic profiles of DNA intercalation of benzophenanthridine compounds sanguinarine and ethidium, National Symposium on Cellular and Molecular Biophysics IBS, Hyderabad, January 22-24, 2009.

Roy Chowdhury S., Islam Md. M. & Suresh Kumar G. Comparative studies on the interaction of sanguinarine with DNA, tRNA and poly(A), National Symposium on Cellular and Molecular Biophysics IBS, Hyderabad, January 22-24, 2009.

Bhadra K., Maiti M. & Suresh Kumar G. A comparative study of the interaction of isoquinoline alkaloids with polymorphic DNA structures, National Symposium on Cellular and Molecular Biophysics, IBS, Hyderabad, January 22-24, 2009.

Pandya P., Suresh Kumar G. & Kumar S. DNA binding of indoles: experimental and theoretical evidence, National Symposium on Cellular and Molecular Biophysics, IBS, Hyderabad, January 22-24, 2009.

Giri P. & Suresh Kumar G. Small molecules inducing self structure formation in poly(A) tail of mRNA; an approach towards RNA based drug design, 16th State Science and Technology Congress, Burdwan, Feb 28-March 1, 2009.

Dr. Chinmay Chowdhury

Chowdhury, C. & Das, B. 'Chemical Investigations of Plant's Constituents' presented at the Asian Symposium on Medicinal Plants, Spices and other Natural Products, IICT Hyderabad, November 3-6, 2008.

Dr. R. C. Yadav

Paul Puja & Yadav R. C. Comparative studies of interaction of berberine and ethidium with AMP, ATP and Poly(A), National Symposium on Cellular and Molecular Biophysics, January 22-24, 2009, Hyderabad.

Dr. P. Jaisankar

Nandi D., Besra S. E., Pal C., Giri V. S., Vedasiromoni J. R., Jaisankar P. Isolation and characterization of active principle of Wattakaka volubilis's leaf extract for anti-inflammatory and anti-leukemic activities: Asian Symposium on Medicinal Plants, Spices and other Natural Products (ASOMPS) XIII, organized by IICT, Hyderabad. November 3-6, 2008.

Pal C., Roy S., Giri V. S. & Jaisankar P. Molecular aspects on the enhancement of aqueous solubility of 2, 2'-dipheny l-3, 3'-diindolylmethane using cyclodextrin inclusion complexes. International Symposium on Frontiers of Functional Materials, organized by Department of Chemistry, University of Calcutta, Kolkata, January 3-7, 2009.

Mukherjee T., Giri V. S. & Jaisankar P. Bioactive Flavonoids from the stem bark of Oroxylum indicum. International Symposium Frontiers of Functional Materials, organized by Department of Chemistry, University of Calcutta, Kolkata. January 3-7, 2009.

Mahato S. K., Dey S., Giri V. S. & Jaisankar P. Indium trichloride catalyzed facile one-pot synthesis of substituted oxazines and quinoxalines. International Symposium Frontiers of Functional Materials, organized by Department of Chemistry, University of Calcutta, Kolkata, January 03-07, 2009.

Vinayagam J., Dey S., Giri V. S. & Jaisankar P. Indium trichloride catalyzed one-pot synthesis of substituted 2-pyrones. International Symposium Frontiers of Functional Materials, organized by Department of Chemistry, University of Calcutta, Kolkata, January 03-07, 2009.

Ajay Kumar T., Lata Pillai S., Pal C., Giri V. S. & Jaisankar P. Development of 3,3'-diindolylmethane (DIM) based Cisplatin analogues as potent anti-cancer agents. International Symposiumn Frontiers of Functional Materials, organized by Department of Chemistry, University of Calcutta, Kolkata. January 03-07, 2009.

Dr. Asish K. Sen

Das G., Bhaumick S., De T. & Sen A. K. Structural study, and Immunomodulatory and anti-leishmanial studies of an acidic polysaccharide isolated from Bael fruit (Aegle marmelos) pulp, CARBO-XXIII, Dept of Chemistry, Bhavnagar University, Bhavnagar, Gujarat, January 22-24, 2009.

Sen A. K. Carbohydrate as drugs with special reference to O-antigenic polysaccharides and carbohydrate-based vaccines. UGC sponsored National Symposium, February 20-22, 2009, Dept. of Chemistry, Burdwan University, West Bengal.

STRUCTURAL BIOLOGY & BIOINFORMATICS

Invited Lectures

Prof. Siddhartha Roy

Topic : Methods in Protein Structure Analysis
Venue : Hokkaido University, Sapporo, Japan
Date : 26-29 August, 2008

Dr. M. C. Bagchi

Topic : Modelling in Environmental, Earth, Mathematical and Chemical Sciences.
Venue : Presidency College, Kolkata
Date : 13 January, 2009.

Dr. Debasish Bhattacharyya

Topic : Toxins from Russells viper venom of Eastern India origin
Venue : Tezpur University, Assam (International conference)
Date : 19th December, 2009

Topic : Role of bromelain in the disintegration of amyloid aggregates
Venue : Women's Christian College, Madras (National conference on lasers and spectroscopy)
Date : 24th September, 2009

Dr. Nanda Ghoshal

Topic : Evolving Integrated In-Silico Approaches in Search of Potential Drug Candidates: Some Encouraging Case Studies
Venue : International Conference on "Open Source for Computer Aided Drug Discovery", at Institute of Microbial Technology, Chandigarh
Date : 22-26 March, 2009

Dr. Subrata Adak

Topic : Function of mitochondrial ascorbate peroxidase from Leishmania major
Venue : Indo-Brazil mini symposium on Leishmaniasis at IICB, Kolkata
Date : 9th February 2009

Dr. Krishnananda Chattopadhyay

Topic : National workshop in fluorescence correlation spectroscopy
Venue : Tata Institute of Fundamental Research, Mumbai
Date : March, 2009

Topic : Fluorescence in biology
Venue : Tata Institute of Fundamental Research, Mumbai
Date : 16-19 March, 2009

Dr. Jayati Sengupta

Topic : International Conference on Perspective of Cell Signaling and Molecular Medicine
Venue : Bose Institute, Kolkata
Date : 27-29 Nov 2008

Session Chairman

Dr. Debasish Bhattacharyya

Topic : National conference on Lasers and Spectroscopy
Venue : Women's Christian College, Madras
Date : 25th September, 2009

Academic Performance/Teaching

Dr. M. C. Bagchi

Acted as a Guest Faculty Member, Paper setter and Examiner in Biostatistics for the M.S.(Pharm) course of National Institute of Pharmaceutical Education and Research (NIPER), Kolkata.

Served as a reviewer for QSAR and combinatorial sciences, Journal of Enzyme Inhibition and Medicinal Chemistry, Chemical Biology and Drug Design.

Evaluated proposal for funding by Indo-US Science & Technology Forum, New Delhi.

Acted as a coordinator of Statistics course for Ph.D. students of IICB.

Acted as a member of project staff recruitment committee, Dept. of Pharmaceutical Technology, Jadavpur University.

Dr. Chitra Dutta

Guest Lecturer and Examiner: M.Sc. (Genetics), M.Sc. (Microbiology), M.Sc. (Neuroscience), M. Sc, (Biotechnology) in Calcutta University; NIPER, Kolkata

Examiner: BIT – Kolkata, DOEACC – Kolkata

Dr. Debasish Bhattacharyya

Guest lecturer at the Department of Bio-Technology, Jadavpur University, Calcutta (M.Sc. Bio-Tech, Semester I.).

Guest lecturer at the Department of Zoology, Bethune College, University of Calcutta (M.Sc. Part I,

Proteins and Enzymology, Semester I).

Guest lecturer at the Department of Life Sciences, University of Tripura, Agartala.

Dr. Nanda Ghoshal

Acted as Examiner for M.Pharm. final (thesis and corresponding oral) examination, J.U., held in June, 2008 at Pharmaceutical Technology Div., J.U.

Teaching at NIPER, Kolkata, as a Guest Faculty Member (for the Academic Year 2008- 09).

Evaluated manuscripts to be published in J. Med. Chem., Eur. J. Med. Chem., J. Mol Graph Model. etc.

Taken classes as a faculty in the training programme "Computer Course for Biologists" for Research Scholars, organized by IICB on the following topics during July-September, 2008: Introduction to Molecular Modelling. Molecular Modelling in relation to Drug Designing.

Acted as External Examiner to conduct viva on QSAR and Drug Design at School of Biotechnology, West Bengal University of Technology, held on Dec. 04, 2008.

Evaluated a Research Project Proposal entitled, "Structure–function studies of diaminothiazoles, a new class of potential anticancer agents", submitted to CSIR for funding.

Dr. Subrata Adak

Examiner in M.Sc. (Microbiology) and M. Sc. (Biochemistry) of Calcutta University.

Deputation Abroad:

Dr. Debasish Bhattacharyya

Participation at the International Conference of 'Separation Science' held at Singapore between 26-28 August, 2009.

Papers/Abstract Presented in the Conference

Ghosh P. & Bagchi M. C. "Usefulness and applications of structural descriptors in QSAR of quinoxaline derivatives" at the Fourth Indo-US lecture series/workshop on discrete mathematical chemistry, Hyderabad, January 6-10, 2009.

Nandi S. & Bagchi M. C. "Usefulness of calculated descriptors in QSAR of aminopyrido[2,3-d] pyrimidin-7-yl-derivatives" at the Discussion Meeting on Theoretical Chemistry, IISc Bangalore, January 18-22, 2009.

Mascarenhas N. M. & Ghoshal N. "Understanding Selective CDK4 Inhibition Through Molecular Dynamics", P26, 8th International Conference on Chemical Structures, held in Noordwijkerhout, Netherlands, June 1-5, 2008.

Bhutoria S. & Ghoshal N. “Understanding the Mechanism of Adenosine Kinase Inhibition: New Insights for Drug Designing”, at National Conference on Drug Discovery, New Delhi, January 21-23, 2009.

Palit P., Ali N., Paira P., Hazra A., Banerjee S., Mondal N. B., Vijayan R. S. K. & Ghoshal N., “Orally effective novel 4-amino-quinaldine analogues induce apoptosis via targeting dihydrofolate-reductase in Leishmania”, at WorldLeish4 (4th World Congress on Leishmaniasis, held in CDRI, Lucknow, February 3-7, 2009.

Yadav R. K. Dolai S, Pal S. & Adak S. Mutational analysis of active site residues of unusual plant like ascorbate peroxidase from Leishmania major presented at 4th Worldleish Congress on Leishmaniasis in Feb. 2009 at CDRI, Lucknow.

Dolai S., Pal S., Yadav R. K. & Adak S. ‘Leishmania major ascorbate peroxidase over-expression protects cells against apoptosis during mitochondrial oxidative stress’ presented at 4th Worldleish Congress on Leishmaniasis in Feb. 2009 at CDRI, Lucknow.

Pal S., Dolai S., Yadav R. K. & Adak S. ‘Deletion of ascorbate peroxidase renders Leishmania major more susceptible to oxidative stress’ presented at 4th Worldleish Congress on Leishmaniasis in Feb. 2009 at CDRI, Lucknow.

Ghosh P. & Bagchi M. C. “Prediction of glass transition of polymers using theoretical structural properties”, Proceedings of Young Scientists Colloquim (2008), Materials Research Society of India, pp 23-27.

Science Exhibition of IICB organised by "Central Calcutta Science Culture Organisation for Youth" on 5 - 10 Sept, 2008

External Funding

INFECTIOUS DISEASES AND IMMUNOLOGY

i)	Principal Investigator	:	Dr. H. K. Majumder
	Project Title	:	*Leishmania donovani* unusual bi-subunit topoisomerase I: Solving the new twist in topoisomerase research related to evolution, functional conservation and preferential sensitivity to the specific inhibitors of type IB family
	Funding Agency	:	DBT, Govt. of India
	Total Fund	:	Rs. 21.98 lakhs only
	Duration	:	June 9, 2006 to June 8, 2009
ii)	Principal Investigator	:	Dr. Pijush K. Das
	Project title	:	Cyclic nucleotide signaling in the infectivity of an eukaryotic intracellular pathogen like *Leishmania*
	Funding Agency	:	DST, Govt. of India
	Total Fund	:	Rs. 22.00 lakhs
	Duration	:	November 2006 to November 2009
iii)	Principal investigator	:	Dr. Chitra Mandal
	Project Title	:	The influence of 9-O-Acetylated cell surface expressed sialoglycan on angiogenesis of bone marrow-associated Leukaemias
	Funding Agency	:	ICMR-German
	Funds (1st year)	:	Rs. 13,28,623
	Duration	:	May 2009- April 2012
iv)	Principal investigator	:	Dr. Susanta Roychoudhury
	Co-Investigator	:	Dr. Chitra Mandal
	Project Title	:	Identification of new molecular targets for the development of anti-cancer agents
	Funding Agency	:	DBT, Govt. of India
	Total Funds	:	Rs. 162.65 lakhs
	Duration	:	2007-2012
v)	Principal Investigator	:	Dr. Nahid Ali
	Project Title	:	A comparative evaluation of the potency and durability of *Leishmania donovani* gp63 DNA and Protein-based vaccines against experimental visceral leishmaniasis
	Funding Agency	:	DST, Govt. Of India
	Total Fund	:	Rs. 23.23 lakhs
	Duration	:	2008-2011

vi) Principal Investigator : Dr. Tripti De
Project Title : Protective efficacy of purified constituents of Centella asiatica leaf extract in an experimental model of Visceral Leishmaniasis
Funding Agency : DBT
Total Fund : Rs. 19.74 lakhs
Duration : March 2008-February 2011

vii) Principal Investigator : Dr. Tripti De
Project Title : Lipid immunity to vaccine generation: Identification, Protective efficacy and Mechanism of action of leishmanial glycolipid in the murine model of visceral leishmaniasis
Funding Agency : DST
Total Fund : Rs. 19. 75 lakhs
Duration : April 2009 to March 2012

viii) Principal Investigator : Dr. Malini Sen
Project Title : Role of Wnt5a Signaling in Inflammation in Rheumatoid Arthritis.
Funding Agency : DBT
Total Fund : Rs. 34.50 lakhs
Duration : April 2008-March 2011

ix) Principal Investigator : Dr. Malini Sen
Project Title : Role of WISP3 in Maintenance of Cartilage Integrity
Funding Agency : DST
Total Funds : Rs. 52 lakhs
Duration : March 2008 to Feb.2011

x) Principal Investigator : Dr. (Mrs.) Mridula Misra
Project Title : Development of New Radiopharmaceuticals for Nuclear Brain Imaging : Pharmacokinetics and Mechanism of action.
Funding Agency : ICMR, Govt. of India
Total Fund : Rs. 28 lakhs
Duration : January 2005 – December 2008

xi) Principal Investigator : Dr. (Mrs.) Mridula Misra
Project Title : Tyr3-Octreotide derivatives : Synthesis, Radiolabeling and Application as Tumor Targeted Radiopharmaceuticals
Funding Agency : DAE, BRNS, Govt. of India
Total Fund : Rs. 19 lakhs
Duration : 2009-2012

CELL BIOLOGY & PHYSIOLOGY

Principal Investigator	:	Dr. Sandhya Rekha Dungdung
Project Title	:	Purification and characterization of sperm motility inhibiting protein factor from goat epididymal plasma and fertility management
Funding agency	:	ICMR, Govt. of India
Total Fund	:	Rs. 8.41 lakhs
Duration	:	2007 – 2010
Investigator	:	Dr. Sumantra Das (CoPI)
Project Title	:	Limbal stem cell culture and transplantation of cultivated Corneal epithelial stem cells in ocular surface disorders
Funding Agency	:	Department of Biotechnology
Total Fund	:	Rs. 24.45 lakhs
Duration	:	November 2005 – October, 2008
Principal Investigator	:	Dr. Sandhya Rekha Dungdung
Co-Investigator	:	Dr. Asoke Dasgupta
Project Title	:	Further studies on upgrading the recently developed computerized spectrophotometer sperm motility analyzer and its application for assessing sperm fertility potential
Funding agency	:	DST, Govt. of India
Total fund	:	Rs. 20.94 lakhs
Duration	:	2008 –2010
Principal Investigator	:	Dr. Mrinal K. Ghosh
Project title	:	Regulation of Stat: Understanding Mechanisms to counteract Prostate Cancer
Funding agency	:	DST, Govt. of India
Total fund	:	Rs. 5.43 lakhs
Duration	:	2009 –2010
Principal Investigator	:	Dr. Sib Sankar Roy
Project title	:	The role of Pitx2 homeodomain transcription factor to regulate ovarian function
Funding agency	:	DST
Total fund	:	Rs. 23.53 lakhs
Duration	:	28.09.2007 to 27.09.2010
Principal investigator	:	Dr. Sib Sankar Roy (Co-PI)
Project title	:	Isolation, molecular characterization and biological evaluation of anti-diabetic principles from a few Indian medicinal plants
Funding agency	:	DST-Industry-Institute
Total fund	:	Rs. 20.26 lakhs
Duration	:	25.06.2007 to 24.06.2010

MOLECULAR & HUMAN GENETICS

EXTERNAL FUNDING

Principal Investigator	:	Dr. Suvendra Nath Bhattacharyya
Project Title	:	Effects of cellular microenvironment on post-transcriptional regulation of gene expression in mammalian cells
Funding Agency	:	Career Development Award of International Human Frontier Science Program Organization (HFSPO)
Total Fund	:	300,000 USD only
Duration	:	March 2008-February 2011

Principal Investigator	:	Dr. Suvendra Nath Bhattacharyya
Co-Investigator	:	Prof. Siddhartha Roy
Project Title	:	Role of the ELAV Protein HuR in microRNA-mediated Gene Regulation in Normal and Transformed Human Cells
Funding Agency	:	Indo-Swiss Joint Research Projects, DST
Total Fund	:	Rs. 27.50 lakhs
Duration	:	February 2009-January 2012

Principal Investigator	:	Dr. Susanta Roychoudhury
Project Title	:	IIdentification of new molecular targets for the development of anti-cancer agents
Funding Agency	:	DBT, Govt. of India
Total Fund	:	Rs. 162.65 lakhs
Duration	:	2006-2010

Principal Investigator	:	Dr. Susanta Roychoudhury
Project Title	:	Identification of susceptibility alleles for the development of head and neck cancer in Indian population
Funding Agency	:	DBT, Govt. of India
Total Fund	:	Rs. 44.51 lakhs
Duration	:	2006-2010

Principal Investigator	:	Dr. Ashok Giri
Project Title	:	Molecular Epidemiology and Environmental Health
Funding Agency	:	Fogarty International Training Fund from the University of California, Berkeley, USA
Total Fund	:	$16,500.00
Duration	:	2008-2009

Principal Investigator	:	Dr. Ashok Giri
Project Title	:	PRAMA Project under UKIERI
Funding Agency	:	University of Manchester, U.K
Total Fund	:	14,627.00 GBP
Duration	:	2008-2009

DRUG DEVELOPMENT, DIAGNOSTICS & BIOTECHNOLOGY

Principal Investigator	:	Dr. (Mrs.) Aparna Gomes
Co-investigator	:	Dr. J. R. Vedasiromoni
Project Title	:	Pharmacological and molecular actions of Snake venom anticancer protein fraction (s) on experimental animals and on leukemic cell lines
Funding Agency	:	ICMR, Govt. of India
Total Fund	:	Rs. 23.80 lakhs
Duration	:	2007–2009

Principal Investigator	:	Dr. Snehasikta Swarnakar
Project Title	:	Targeting metalloproteinase(s) for new therapeutic in gastric cancer
Funding Agency	:	DBT, Govt. of India
Total Fund	:	Rs. 9.00 lakhs
Duration	:	2008–2011

Principal Investigator	:	Dr. Snehasikta Swarnakar
Co-investigator	:	Dr. (Mrs.) Aparna Gomes
Project Title	:	Prevention of gastric ulceration by black tea: An insight intoextracellular matrix remodeling of gastric tissues
Funding Agency	:	NTRF
Total Fund	:	Rs. 8 lakhs
Duration	:	2009–2012

Cooordinator	:	Dr. Pratap K. Das
Project Title	:	Chemical standardization and biological evaluation with a view to increase efficacy of herbal medicines
Funding Agency	:	DST, Govt. of India & Dey's Medical Mfg. Co. Ltd.
Total Fund	:	Rs. 45.81 lakhs (IICB Component)
Duration	:	2005-2008

Principal Investigator	:	Dr. Suman Khowala
Project Title	:	Conversion of cellulose and hemi-cellulose into sugars and ethanol
Funding agency	:	CSIR, (NMITLI) Govt. of India
Total Cost	:	Rs. 59.80 lakhs
Duration	:	2007-2010

Principal Investigator	:	Dr. Sharmila Chattopadhyay
Project Title	:	Role of Glutathione as a signaling molecule
Funding agency	:	DST., Govt. of India
Total Cost	:	Rs. 23 lakhs
Duration	:	2007-2010

Principal Investigator	:	Dr. Sharmila Chattopadhyay
Project Title	:	Indian Medicinal Plants to combat kala-azar
Funding agency	:	ICMR, Govt. of India.
Total Cost	:	Rs. 28.50 lakhs
Duration	:	2007-2010

CHEMISTRY

Project Co-ordinator	:	Dr. Nirup Bikash Mondal
Title of Project	:	Active targeting of nanoparticles grafted with ligands to the cells of the reticulo-endothelial system by receptor mediated endocytosis and their application against macrophage-associated diseases
Funding Agency	:	DBT
Total Fund	:	Rs. 51.72 lakhs
Duration	:	2008-2011

Principal investigator	:	Dr. B. C. Pal and Prof. S. Bhattacharya (Visva Bharati)
Title of Project	:	Isolation, molecular characterization and biological evaluation of anti-diabetic principle(s) from Indian medicinal plants
Funding agency	:	DST
Total Fund	:	Rs. 20.26 lakhs (IICB component)
Duration	:	2007-2010

Principal investigator	:	Dr. Partha Chattopadhyay
Title of project	:	Synthesis of Benzannulated Medium Ring Heterocycles by using Intramolecular Buchwald – Hartwig reaction and their Binding Studies to Nucleic acids and Proteins
Funding Agency	:	DST
Total Funds	:	Rs. 18 lakhs
Duration	:	2008-2011

Principal Investigator	:	Dr. Asish K. Sen
Title of project	:	Chemical Characterization and modification of coir fiber for enhanced longevity, and their physico-chemical studies
Funding Agency	:	COIR BOARD, Govt. of India
Total Fund	:	Rs. 29.48 lakhs
Duration	:	October 2006- September 2009

STRUCTURAL BIOLOGY & BIOINFORMATICS

Co-Investigator	:	Prof. Siddhartha Roy
Project title	:	Structure function analysis of Tumor suppressor, P53 interacting protein: Structural basis of p53 activation
Funding agent	:	Department of Biotechnology, New Delhi
Total fund	:	Rs.7.02 lakhs
Duration	:	2006- Sept.2009
Co-Investigator	:	Prof. Siddhartha Roy
Project title	:	Development of Anti-Viral Agent against Chandipura Virus
Funding agent	:	Department of Biotechnology, New Delhi
Total Fund	:	Rs.10.70 lakhs
Duration	:	2005 –Feb.2009
Principal Investigator	:	Dr. M. C. Bagchi
Project title	:	Anti-tuberculosis Drug Design by Calculated Molecular descriptors: A QSAR Approach
Funding Agency	:	Department of Biotechnology, (Govt. of India) New Delhi
Total Funds	:	Rs. 12.07 lakhs
Duration	:	2006-2010
Principal Investigator	:	Dr. Chitra Dutta
Project title	:	Establishment of Sub-DIC at IICB
Funding Agency	:	Department of Biotechnology, (Govt. of India) New Delhi
Total Funds	:	Rs. 53 lakhs
Duration	:	2002-2007 (extended up to 2012)
Principal investigator	:	Dr. Debasish Bhattacharyya
Project title	:	Regulation of activity and assembly of multineric proteins
Funding agency	:	DST
Total funds	:	Rs. 20.00 lakhs
Duration	:	2006 (December) – 2009 (November)
Principal investigator	:	Dr. Saumen Datta
Project title	:	Structural Insights into the Type III Secretion System (TTSS) of Pathogenic Bacteria
Funding agency	:	DST
Total funds	:	Rs. 22.51 lakhs
Duration	:	2007-2010
Principal Investigator	:	Dr. Subrata Adak
Co-Investigator	:	Dr. Alok K. Datta
Project title	:	Molecular and functional characterization of ascorbate peroxidase from Leishmania major
Funding Agency	:	DST, Govt. of India
Total Funds	:	Rs. 21.77 lakhs
Duration	:	2006-2009

66th CSIR Foundation Day celebration : Lightening of lamp by Prof. S. Raha

Science Exhibition of IICB organised by 'Institute of Social Studies' on 12-20 April, 2008

Publications

INFECTIOUS DISEASES AND IMMUNOLOGY

Ganguly A., Sengupta S., BoseDasgupta S., Roy A. & Majumder H. K. 2009. Mutational studies reveal lysine 352 on the large subunit is indispensable for catalytic activity of bi-subunit topoisomerase I from *Leishmania donovani*. *Mol. Biochem. Parasitol.* **165:**57-66.

Roy A., BoseDasgupta S., Ganguly A., Jaisankar P. & Majumder H. K. 2009. Topoisomerase I gene mutations at F270 in the large subunit and at N184 in the small subunit contribute to the resistance mechanism of unicellular parasite *Leishmania donovani* towards 3,3'-Diindolylmethane (DIM). *Antimicrob. Agents Chemother.* **53:**2589-2598.

Castelli S., Campagna A., Vassallo O., Tesauro C., Fiorani P., Tagliatesta P., Oteri F., Falconi M., Majumder H. K. & Desideri. 2009. A Conjugated eicosapentaenoic acid inhibits human topoisomerase IB with a mechanism different from camptothecin. *Arch. Biochem. Biophys*. **486:**103-110.

Kar S., Ukil A. & Das P. K. 2009. Signaling events leading to the curative effect of cystatin on experimental visceral leishmaniasis: Involvement of ERK1/2, NF-κB and JAK/STAT pathways. *Eur. J. Immunol.* **39:**741-751.

Mandal C., Srinivasan G. V., Chowdhury S., Chandra S., Mandal C., Schauer R. & Mandal C. 2009. High Level of Sialate-O-acetyltransferase Activity in Lymphoblasts of Childhood Acute Lymphoblastic Leukaemia (ALL): Enzyme Characterization and Correlation with Disease Status. *Glycoconjugate J.* **26:**57-73.

Ansar W., Habib S. H., Roy S., Mandal C. & Mandal C. 2009. Unraveling the C-reactive protein complement-cascade in destruction of red blood cells: Potential pathological implications in *Plasmodium falciparum* malaria. *Cell. Physiol. Biochem.* **23:**175-190.

Mukherjee K., Chava A. K., Bandyopadhyay S., Mallick A., Chandra S., Mandal C. 2009. Co-expression of 9-O-acetylated sialoglycoproteins and their binding proteins on lymphoblasts of childhood acute lymphoblastic leukaemia: An anti-apoptotic role. *Biol. Chem.* **390:**325-335.

Ghoshal A., Mukhopadhyay S., Saha B. & Mandal C. 2009. 9-O-acetylated sialoglycoproteins: Important immunomodulators in Indian visceral leishmaniasis. *Clin. Vac. Immunol.* **18:**889-898.

Ghoshal A., Mukhopadhyay S., Gerwig G. J., Kamerling J. P., Chatterjee M. & Mandal C. 2009. 9-*O*-acetylated sialic acids enhance entry of virulent *Leishmania donovani* promastigotes into macrophages. *Parasitology* **15:**1-15.

Chowdhury R., Chowdhury S., Roychoudhury P., Mandal C. & Chaudhuri K. 2009. Arsenic induced apoptosis in malignant melanoma cells is enhanced by menadione through ROS generation, p38 signaling and p53 activation. *Apoptosis* **14:**108-123.

Pal A., Bhattacharya I., Bhattacharyya K., Mandal C. & Ray M. 2009. Methylglyoxal induced activation of murine peritoneal macrophages and surface markers of T lymphocytes in Sarcoma-180 bearing mice: Involvement of MAP kinase, NF-κB signal transduction pathway. *Mol. Immunol.* **46:**2039-2044.

Rakshit S., Bagchi J., Mandal L., Paul K., Ganguly D., Bhattacharjee S., Ghosh M., Biswas N., Chaudhuri U. & Bandyopadhyay S. 2009. N-acetyl cysteine enhances imatinib-induced apoptosis of Bcr-Abl+ cells by endothelial nitric oxide synthase-mediated production of nitric oxide. *Apoptosis* **14:**298-308.

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CELL BIOLOGY & PHYSIOLOGY

Das S. & Mohanakumar K. P. (Eds.) A handbook of neurobiological techniques. You Can Do It Series-II, Indian Institute of Chemical Biology, pp. 1-144, 2009.

MOLECULAR & HUMAN GENETICS

Roy M. K., Ray K. & Das S. K. Wilson's Disease. *In*: Movement disorders: A clinical and therapeutic approach (Ed. S. K. Das), Jaypee Brothers Medical Publishers Pvt Ltd., pp. 261-278, 2008.

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DRUG DEVELOPMENT, DIAGNOSTICS & BIOTECHNOLOGY

Swarnakar S. Gastric ulceration in animals: A technique for studying biomarkers. *In*: Biotechnology applications (Eds. S K Mishra & P Champagne), International Publishing House Pvt. Ltd., New Delhi, 2009.

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Pal S., Guha B., Maity A., Ghorai S. and Khowala S. Microbial production of food enzyme. *In*: Food biotechnology (Eds. A Pandey, C Larroche & CR Soccol), Asiatech Publishers Inc., New Delhi, 2009.

Das N., Mandal A. K., Sarkar S. and Ghosh A. Liposomal flavonoid in combating age related cerebral oxidative damage. *In*: Biotechnology applications (Eds. SK Mishra & P Champagne), International Publishing House Pvt. Ltd., New Delhi, 2009.

CHEMISTRY

Sahu N. P., Banerjee S., Mondal N. B. and Mondal D. Steroidal saponin. *In*: Fortschritt der chemie organischer naturstoffe (Progress in the chemistry of organic natural products), Springer Wien, New York, USA, Vol. 89, pp. 45-141, 2008.

STRUCTURAL BIOLOGY & BIOINFORMATICS

Chakraborty P. D., De D., Bandyopadhyay S. & Bhattacharyya D., 2009. Human aqueous placental extract as a wound healer. *J. Wound Care* **18:**462-467.

OTHER DIVISIONS

Dana S. K., Roy P. K. and Kurths (Eds.) Complex Dynamics in Physiological systems: From Heart to Brain, Understanding Complexity Series. Springer, 2009.

Doctorates from the Institute

INFECTIOUS DISEASES AND IMMUNOLOGY

No.	*Name of the candidate*	*Title of Thesis*	*Name of Supervisor*
1.	Dr. Agneyo Ganguly	Structural and Functional studies of eukaryotic topoisomerase I with special reference to *Leishmania donovani* type I DNA topoisomerase	Dr. H.K. Majumder
2.	Dr. Rakhee Das	*Leishmania donovani* DNA topoisomerases I & II : Molecular Biological studies in relation to their mode of action	Dr. H.K. Majumder
3.	Dr. Somdeb Dasgupta	Mechanistic studies of the unusual properties inherent to topoisomerase I of *Leishmania donovani*	Dr. H.K. Majumder
4.	Dr. Arijit Bhattacharya	Role of Cyclic Nucleotide Mediated Responses in Leishmania Infectivity	Dr. Pijush K. Das
5.	Dr. Kankana Mukherjee	Role of O-acetylation of sialic acid in survival of cancer cells of childhood acute lymphoblastic leukemia	Dr. Chitra Mandal
6.	Dr. Bhabatosh Das	Molecular Studies on Stringent Response Modulator Gene *spoT* of *Vibrio cholerae*	Dr. Rupak Bhadra
7.	Dr. Jayashree Bagchi Chakraborty	Studies on herbal compounds with broad-spectrum anti-cancer activity through generation of reactive oxygen species	Dr. Santu Bandyopadhyay
8.	Dr. Arun Kumar Haldar	Studies on the Cellular and Molecular Basis of Immunoregulations by Selective Compounds in Experimental Visceral Leishmaniasis	Dr. Syamal Roy
9.	Dr. Bidisha Saha	Studies on signaling pathways involved in human placental sphingolipid(s)-induced melanogenesis in skin cell melanocyte/melenoma	Dr. Syamal Roy
10.	Dr. Kaushik Roychoudhury	Studies on the interaction of leishmania parasites with human chemokines	Dr. Syamal Roy
11.	Dr. Arpita Chatterjee	Survival, gene expression and virulence of *Vibrio cholerae* in response to bile salts	Dr. Rukhsana Chowdhury
12.	Dr. Sohini Chaudhuri	Survival and virulence of *Vibrio cholerae* biotypes: Effect of physico-chemical parameters	Dr. Rukhsana Chowdhury
13.	Dr. Jayeeta Ghose	Therapeutic efficacy of cationic liposome complexed antileishmanial drugs against experimental visceral leishmaniasis	Dr. Nahid Ali
14.	Dr. Sudipta Bhowmick	Vaccine efficacy of *Leishmania donovani* membrane antigens against experimental visceral leishmaniasis	Dr. Nahid Ali

CELL BIOLOGY & PHYSIOLOGY

No.	*Name of the candidate*	*Title of Thesis*	*Name of Supervisor*
15.	Dr. Goutam Chandra	Role of Calcium in Experimental Neurodegeneration	Dr. K. P. Mohanakumar
16.	Dr. Merina Varghese	Mitochondrial dysfunction in Parkinson's disease	Dr. K. P. Mohanakumar
17.	Dr. Mritunjay Pandey	Studies on striatal neurodegeneration in 3-nitropropionic acid-induced rat model of Huntington's disease	Dr. K. P. Mohanakumar
18.	Dr. Mausam Ghosh	Molecular mechanisms associated with thyroid hormone induced differentiation and maturation of astrocytes using primary cultures from rat brain	Dr. Sumantra Das
19.	Dr. Sreerupa Ghose Roy	Molecular Mechanism of Extracellular Matrix Remodelling in Hypertrophied Heart	Dr. Arun Bandyopadhyay
20.	Dr. Herambananda Ray	Studies on contraceptive potential and safety margins of a novel herbal spermicide	Dr. S. N. Kabir
21.	Dr. Arunima Maiti	Purification and characterisation of a protein substrate of sperm ecto-cyclic AMP-independent protein kinase and its role in flagellar motility	Drs. G. C. Majumder & S. R. Dungdung
22.	Dr. Sudipta Saha	A novel method of sperm motility analysis and characterisation of a sperm motility promoting protein from goat blood serum	Drs. G. C. Majumder & S. R. Dungdung
23.	Dr. Pomy Barma	Amelioration of diabetes type II: Studies on different possibilities and strategies	Dr. Sib Sankar Roy

MOLECULAR & HUMAN GENETICS

No.	*Name of the candidate*	*Title of Thesis*	*Name of Supervisor*
24.	Dr. Sudarshana Basu	Structure and function of a Lesihmania mitochondrial tRNA import factor	Dr. Samit Adhya
25.	Dr. Arunava Bandyopadhaya	Host-*Vibrio cholerae* interaction: Modulation of cytokine responses in human intestinal epithelial cells following *V. cholerae* infection	Dr. Keya Chaudhuri
26.	Dr. Raghunath Chatterjee	Computational analysis of nucleotide sequences and their implications	Dr. Keya Chaudhuri
27.	Dr. Rajdeep Chowdhury	A mechanistic analysis of the anti-carcinogenic and carcinogenic potential of arsenic and a possible remedy to its toxic response	Dr. Keya Chaudhuri
28.	Dr. Chaitali Misra	Analysis of polymorphic variants of wild type and mutant p53 gene in head and neck cancer	Dr. Susanta Roychoudhury
29.	Dr. Pritha Ghosh	Evaluation of the genetic changes and the incidence of different diseases in the symptomatic and asymptomatic individuals exposed to arsenic	Dr. A.K. Giri
30.	Dr. Babli Halder	Evaluation of the antimutagenic and anticlastogenic effects of black tea polyphenols theaflavins and thearubigins in multiple systems	Dr. A.K. Giri

DRUG DEVELOPMENT, DIAGNOSTICS & BIOTECHNOLOGY

No.	Name of the candidate	Title of Thesis	Name of Supervisor
31.	Dr. Debjani Saha	Rapid non-instrumental immunoassay for mycotoxins	Dr. Tarun K. Dhar
32.	Dr. Debopam Acharya	Improved immunoassay strategies for the mycotoxins and steroid hormones	Dr. Tarun K. Dhar
33.	Dr. Tanima Saha	Studies on cellobiose dehydrogenase of *Termitomyces clypeatus*	Dr. Mina Mukherjee
34.	Dr. Suchandra Goswami	Screening of Indian biodiversity in search of anti-peptic ulcer principle(s) : Evaluation of plant and microbial products, single molecules as well as multi-ingredient herbal preparations in preclinical experimental models	Dr. Pratap K. Das
35.	Dr. Rajdeep Chakravarty	A study on the membrane components of acidophilic heterotrophic bacteria of mine origin	Dr. Anil K. Ghosh
36.	Dr. Paramita Chaudhuri	Purification and characterization of trehalose synthase from yeast	Dr. Anil K. Ghosh
37.	Dr. Parag Kundu	Role of matrix metalo-proteases on extracellular matrix remodeling during *H. pylori* mediated gastric injury	Dr. Snehashikta Swarnakar
38.	Dr. Akhiles Kumar	Evaluation of antioxidant potential of mentha spp. with special reference to the genetic improvement of *Mentha arvensis*	Dr. Sharmila Chatterjee

CHEMISTRY

No.	Name of the candidate	Title of Thesis	Name of Supervisor
39.	Dr. Joy Krishna Maity	Synthetic Studies on Nucleosides and Other Heterocycles Using Carbohydrates as Chiral Pool	Dr. S. B. Mandal
40.	Dr. Biswajit Gopal Roy	Synthesis of Enantiomerically Pure Nucleosides and Analogues Involving Carbohydrates as Chiral Pool	Dr. S. B. Mandal
41.	Dr. Gora Das	Structural & Biochemical studies of the polysaccharides isolated from bael fruit *(Aegle marmelos)* pulp	Dr. Asish Sen (Jr.)
42.	Dr. Koushik Mazumder	Studies on Bacterial Polysaccharide: Structure and Synthesis	Dr. Asish Sen (Jr.)
43.	Dr. Kakali Bhadra	Polymorphic DNA structures and their interaction with isoquinoline alkaloids	Drs. G. Suresh Kumar & M. Maiti
44.	Dr. Prabal Giri	Biophysical studies on the interaction of plant alkaloids with polyadenylic acid structures	Dr. G. Suresh Kumar
45.	Dr. Sumit Dey	Synthetic Studies on Organic Compounds Using Catalysts	Dr. Parasuraman Jaisankar

No.	Name of the candidate	Title of Thesis	Name of Supervisor
46.	Dr. Tirtha Pada Majhi	Synthesis of medium ring heterocyclic compounds using carbohydrates as precursors	Dr. Partha Chattopadhyay
47.	Dr. Arpita Neogi	Synthetic studies towards medium ring oxacycles and analogues: An approach to the synthesis of chiral tricyclic nucleosides and benzannulated medium ring systems	Dr. Partha Chattopadhyay

STRUCTURAL BIOLOGY & BIOINFORMATICS

No.	Name of the candidate	Title of Thesis	Name of Supervisor
48.	Dr. Suranjana Chattopadhyay	Structural and functional studies of nucleic acid binding proteins	Prof. Siddhartha Roy
49.	Dr. Aparna Laskar	Structure-function studies on the specificity of interaction of proteases with their inhibitors	Dr. Chhabinath Mandal
50.	Dr. Somnath Mondal	Russell's viper venom of Eastern India origin: Toxicological characters and their inhibition	Dr. Debasish Bhattacharyya
51.	Dr. Ipsita Chanda	Bioinformatic study of genomes and proteomes of parasiric organisms	Dr. Chitra Dutta

Honours and Awards

INFECTIOUS DISEASES AND IMMUNOLOGY

Dr. H. K. Majumder

- Member of the Institutional Ethical Committee, Institute of Post Graduate Medical Education & Research (IPGMER), Kolkata. 2007-till date.
- Member of the Research Advisory Committee of the Central Sericulture Research & Training Institute, Berhampur, Murshidabad, West Bengal.
- Member of the Selection Committee for SRF/RA of CSIR.
- Member of the Section Committee (VII) of Indian National Science Academy (FNA)
- Member of the Fellowship Scrutiny Committee of National Academy of Sciences, India (FNASc)
- Prof. Jnan Chandra Ghosh Memorial Award by Science Association of Bengal for excellent contribution in the field of science & technology, research promotion and development in India and abroad in 2007.
- Chairman of the NASI, Allahabad Kolkata Local Chapter (NASI), w.e.f. 31.12.2007.
- Chairman, Expert Committee for State Innovation Award, Govt. of West Bengal.
- Chairman, State Level Climatic Change Committee, Govt. of West Bengal.
- Working Chairman of the West Bengal State Council of Science & Technology-2004 onwards.

Dr. Pijush K. Das

- Senior Scientist Oration Award from Indian Immunology Society (IIS) for outstanding work in Immunology at 34th Annual Meeting of IIS held in December 16-18, 2007 at National Aids Research Institute (NARI), Pune.
- Member of the American Association of Immunologists.
- Departmental Core Committee Member of the Recruitment and Assessment Board (RAB) of CSIR.
- Member of Board of Studies of Calcutta University
- Reviewer of National & International journals.

Dr. Chitra Mandal

- Selected for the Senior Scientist Oration Award for the year 2008 by the Indian Immunology Society
- Reviewer of National and International journals
- Reviewer of National and International projects for national and International fundings

Dr. Nahid Ali

- Elected Fellow of the West Bengal Academy of Science and Technology.
- Reviewer of papers to be published in European Journal of Pharmaceutics and Biopharmaceutics, Experimental Parasitology, Journal of Biosciences, Nanomedicine: Nanotechnology, Biology and Medicine, European Journal of Pharmaceutical sciences, Future Medicine and Scholarly Research Exchange.

Dr. Uday Bandopadhay

- Fellow of the National Academy of Sciences (FNASc), India 2008
- Professor R. C. Shah Memorial Award, 96th Indian Science Congress, January 3-7, 2009, Shillong, Meghalaya

Dr. Mridula Misra

- Convener of the Lab Safety Committee and Bio-Safety Committee of IICB.

CELL BIOLOGY & PHYSIOLOGY

Dr. K. P. Mohanakumar

- Dr. Lalitha Kameswaran Memorial Oration, 2009. Southern Region Indian Pharmacological Society.
- Symposium Co-Organizer, “Neurocon” February 7-10, 2009
- Organizer IBRO Workshop for the Asia-Pacific Regional Countries, Dec 29, 2008 to Jan 8, 2009
- Symposium Co-Organizer, “NeuroUpdate, Kolkata – 2008” Sept 20-21, 2008
- Elected Fellow of the National Academy of Sciences, India, 2008

Dr. S. N. Kabir

- Appointed by Indian Council of Agricultural Research as the Chairman of a Consortium Advisory Committee for successful implementation of the World Bank-funded project "Genetic basis of inferior sperm quality and fertility of cross-bred bulls", awarded to the Project Directorate on Cattle, Meerut, UP, India.
- Prof. N. M. Basu Memorial Oration at the National Seminar on Current Trends in Research in Health & Diseases, organized by Department of Physiology, Vidyasagar University, Medinipur, 30 March 2009. Topic: “Microbicidal spermicides: women’s weapon against HIV infection & unintended pregnancies”.

Dr. Sib Sankar Roy

- Appointed as a UGC visiting teacher by Tripura University, Agartala.
- CSIR Raman Research Fellowship Award in 2008.

MOLECULAR & HUMAN GENETICS

Dr. Keya Chaudhuri

- Prof. J. C. Bose 150th Birth Centenary Award by Science Association of Bengal for excellent contribution in the field of science & technology, research promotion and development in India

Dr. Ashok Giri

- Elected as member of the Editorial Board of Mutation Research journal (Genetic Toxicology and Environmental Mutagenesis)

Dr. Suvendra Nath Bhattacharyya

- Selected as International Senior Research Fellow of the Wellcome Trust London, UK

Dr. Suvendra Nath Bhattacharyya

- Awarded short-term postdoctoral fellowship from HFSPO (Human Frontier Science Program Organization).

DRUG DEVELOPMENT, DIAGNOSTICS & BIOTECHNOLOGY

Dr. Snehasikta Swarnakar

- Adjunct Faculty in Calcutta University, Dept of Environmental Science, Kolkata
- Advisory Board member of Africa Bound Corporation, Senegal, Africa and BIRDS, WB, India.

Dr. Sharmila Chattopadhyay

- Selected as a member of Plant Tissue Culture Association (India).

CHEMISTRY

Dr. G. Suresh Kumar

- Elected Fellow, West Bengal Academy of Science and Technology.

Dr. Asish K. Sen

- Elected as Hon. Vice President of the Association of Carbohydrate Chemists & Technologists (India) 2008-2010.

STRUCTURAL BIOLOGY & BIOINFORMATICS

Prof. Siddhartha Roy

- Nominated as a President of West Bengal Academy of Science & Technology

Dr. Chitra Dutta

- Member, Editorial Board, International Journal of Soft Computing & Bioinformatics
- Member, Advisory Board, NIPER-Kolkata
- Reviewer, Nucleic Acids Research, DNA Research, Bioinformatics, BMC Genomics, BMC Evolutionary Biology, Microbiology etc.

Dr. Debasish Bhattacharyya

- Selected as a member of the editorial board of the 'Journal of Chromatography B' for 3 years term (2008-2011).

Dr. Krishnananda Chattopadhyay

- Awarded the Indo US Science and Technology Fellowship (2009).

Staff List of IICB as on March 31, 2009

Staff Strength at a Glance

Director	…	…	1
Scientist – Gr. IV	…	…	74
Engineer	…	…	4
Technical – Gr. III	…	…	53
Technician – Gr. II	…	…	37
Helper – Gr. I	…	…	19
Ministerial Officer	…	…	13
Ministerial Staff	…	…	53
Gr. D (Non-Technical)	…	…	16
Canteen Staff	…	…	10
TOTAL			**279**

Detailed Staff List

Scientific and Technical

Sl. No.	Employee's Name	Emp. ID	Designation
1.	Prof. Siddhartha Ray	489	Director
2.	Dr. H.K. Majumdar	23	Scientist Gr. IV (6)
3.	Dr. Samit Adhya	37	Do
4.	Dr. Pijush K. Das	40	Do
5.	Dr. V.S. Giri	39	Do
6.	Dr. S.B. Mondal	76	Do
7.	Dr. K.P. Mohanakumar	77	Do
8.	Dr. Tarun K. Dhar	63	Do
9.	Dr. A.K. Sen (Jr)	65	Do

Sl. No.	Employee's Name	Emp. ID	Designation
10.	Dr. (Mrs.) Chitra Mandal	60	Scientist Gr. IV (6)
11.	Dr. J.R. Vedasiromoni	53	Do
12.	Dr. B.C. Pal	64	Do
13.	Dr. Anil K. Ghosh	68	Do
14.	Dr. Syamal Roy	93	Scientist Gr. IV (5)
15.	Dr. (Mrs.) Keya Chaudhuri	83	Do
16.	Dr. Sumantra Das	87	Do
17.	Sri Ajoy Kr. Banerjee	85	Do
18.	Dr. S.B. Mukhopadhyay	80	Do
19.	Dr. Santu Bandyopadhyay	97	Do
20.	Dr. Partha Chattopadhyay	81	Do
21.	Dr. Manish Ch. Bagchi	78	Do
22.	Dr. S.N. Kabir	90	Do
23.	Dr. (Mrs.) Chitra Dutta	95	Do
24.	Dr. Ashok Kumar Giri	402	Do
25.	Dr. Debashish Bhattacharya	96	Do
26.	Dr. Shyamal Kumar Dana	86	Do
27.	Dr. (Mrs.) Aparna Gomes	91	Do
28.	Dr. Nirmalendu Das	100	Do
29.	Dr. (Mrs.) Nahid Ali	103	Do
30.	Dr. Susanta Roychowdhury	98	Do
31.	Dr. Ashish Kr. Sen (Sr.)	55	Scientist Gr. IV (4)
32.	Dr. Aparesh Bhattacharya	59	Do
33.	Dr. U.S. Chowdhury	84	Do
34.	Dr. G. Suresh Kumar	105	Do
35.	Dr. (Miss) Moonmoon Bhowmik	110	Do
36.	Dr. Kunal Ray	415	Do
37.	Dr. Samir Kr. Dutta	111	Do
38.	Dr. Sukdeb Bandopadhyay	102	Do
39.	Dr. Nirup Bikash Mondal	107	Do

Sl. No.	Employee's Name	Emp. ID	Designation
40.	Dr. (Mrs.) Tuli Biswas	109	Scientist Gr. IV (4)
41.	Dr. Arun Bandyopadhyay	445	Do
42.	Dr. P. Jaisankar	112	Do
43.	Dr. S.N. Chakraborty	94	Do
44.	Dr. Rupak Kr. Bhadra	124	Do
45.	Dr. (Mrs.) Rukhshana Chowdhury	115	Do
46.	Dr. (Mrs.) Nanda Ghoshal	119	Do
47.	Dr. Ram Chandra Yadav	154	Do
48.	Dr. Ranjan Mukhopadhyay	114	Do
49.	Dr. Asish Kr. Banerjee	116	Do
50.	Dr. (Mrs.) Suman Khowala	118	Do
51.	Dr. Tushar Kanti Chakraborty	99	Do
52.	Dr. (Mrs.) S.R. Dungdung	120	Do
53.	Dr. Tanmoy Mukherjee	125	Do
54.	Dr. Pratap Kr. Das	62	Scientist Gr. IV (3)
55.	Sri U.K. Barua	464	Do
56.	Dr. (Mrs.) Padma Das	117	Do
57.	Dr. (Mrs.) Debjani Mondal	123	Do
58.	Dr. Sibsankar Ray	443	Do
59.	Dr. Aditya Konar	441	Do
60.	Mrs. N.V.M. Khalko	122	Do
61.	Dr. (Mrs.) Tripti De	433	Do
62.	Dr. Soumen Datta	503	Do
63.	Dr. Chinmay Chowdhury	520	Do
64.	Dr. Uday Bandopadhyay	521	Do
65.	Dr. K.N. Chattopadhyay	523	Do
66.	Dr. Mrinal Kanti Ghosh	524	Do
67.	Dr. (Mrs.) Malini Sen	527	Do
68.	Dr. Anindya Dasgupta	531	Do
69.	Dr. (Mrs.) Jayati Sengupta	532	Do

Sl. No.	Employee's Name	Emp. ID	Designation
70.	Dr. S.N. Bhattacharya	530	Scientist Gr. IV (3)
71.	Dr. (Mrs) Sarmila Chattopadhyay	447	Do
72.	Dr. Subrata Adak	472	Do
73.	Dr. (Miss) Snehasikta Swarnakar	473	Do
74.	Dr. Bijon Kumar Ghosh	404	Scientist Gr. IV (2)
75.	Dr. Saraswati Garai	528	Scientist Gr. IV (1)
76.	Dr. (Mrs.) Mridula Misra	142	Technical Officer Gr. III (7)
77.	Dr. (Mrs.) Krishna Das Saha	143	Technical Officer Gr. III (7)
78.	Sri H.N. Roy	152	Do
79.	Dr. (Mrs.) S.E. Besra	145	Do
80.	Sri Tapan Kumar Mukherjee	140	Do
81.	Sri Sailendra Nath Dey	148	Do
82.	Sri Kalyanmay Dutta	153	Do
83.	Sri Tapan Kr. Chakraborty	159	Technical Officer Gr. III (6)
84.	Sri A.K. Das	151	Do
85.	Dr. (Mrs.) Mita Chatterjee Debnath	432	Do
86.	Sri S.K. Sahoo	163	Do
87.	Dr. S. Majumdar	164	Do
88.	Sri Chirantan Debdas	535	Do
89.	Sri Sandip Saha	494	Exec. Engineer Gr. III (5)
90.	Sri Susanta Ray	514	Asst. Exec. Engineer Gr. III (4)
91.	Sri B. Jayakumar	517	Do
92.	Mrs. Nirali Bage	466	Junior Engineer, Gr. I
93.	Sri Mohan Lal Jana	167	Technical Officer Gr. III (5)
94.	Dr. Prashanta Kr. Chakraborty	169	Do
95.	Dr. Kalidas Paul	168	Do
96.	Sri Shekhar Ghosh	467	Do
97.	Sri A.K. Bairagi	165	Do
98.	Sri Samir Kr. Roy	171	Do
99.	Dr. Ashok Kumar Dasgupta	172	Do

Sl. No.	Employee's Name	Emp. ID	Designation
100.	Sri Narayan Ch. Ghosh	499	Technical Officer Gr. III (5)
101.	Sri Surajit Mohan Roy	166	Do
102.	Sri Gautam Gupta	170	Do
103.	Sri Binayak Pal	448	Do
104.	Mrs. Aparna Laskar	449	Do
105.	Dr. Sankar Kumar Maitra	174	Do
106.	Dr. (Mrs.) Gayatri Tripathi	462	Do
107.	Dr. Ardhendu Kr. Mandal	175	Do
108.	Dr. Tapas Sarkar	177	Do
109.	Dr. (Miss) Subhagata Ghosh	179	Do
110.	Sri Arupesh Majumdar	180	Do
111.	Sri Kshudiram Naskar	162	Technical Officer Gr. III (4)
112.	Sri R.N. Mandi	185	Do
113.	Sri Rajat Bandopadhyay	181	Do
114.	Dr. Ramdhan Majhi	184	Do
115.	Sri P. Gangopadhyay	186	Do
116.	Sri Asish Mullick	187	Do
117.	Mrs. Dipika Roy	188	Do
118.	Mrs. Purnima Chatterjee	173	Do
119.	Mrs. Banasri Das	176	Do
120.	Sri Diptendu Bhattacharya	178	Do
121.	Sri E. Padmanaban	496	Do
122.	Sri Sekhar Mukherjee	477	Do
123.	Sri Pratap Ch. Kayal	182	Do
124.	Sri Utpal Halder	157	Technical Officer Gr. III (3)
125.	Sri Sandip Chowdhury	411	Technical Assistant Gr. III (2)
126.	Dr. (Mrs.) Shampa Sarkar	461	Do
127.	Mrs. Arti Khetrapaul	463	Do
128.	Sri Swapan Kr. Mondal	465	Do
129.	Sri Jishu Mandal	495	Technical Assistant Gr. III (1)

Sl. No.	Employee's Name	Emp. ID	Designation
130.	Sri Debashis Banik	513	Technical Assistant Gr. III (1)
131.	Sri Sandip Chakraborty	516	Do
132.	Sri T. Muruganandan	539	Do
133.	Sri Ajoy Kr. Pramanik	195	Technician Gr. II (4)
134.	Sri M.B. Malakar	219	Do
135.	Sri S.K. Basak	220	Do
136.	Sri Phelaram Dhank	309	Do
137.	Sri Goutam Malik	224	Do
138.	Sri Gopal Ch. Sarkar	234	Do
139.	Sri P.K. Chanda	236	Do
140.	Sri S.N. Mondal	237	Do
141.	Sri S.K. Prodhan	239	Do
142.	Sri S.C. Das	241	Technician Gr. II (3)
143.	Sri S.R. Tudu	251	Do
144.	Sri Swapan Kumar Naskar	244	Do
145.	Md. Ayub Shah	344	Do
146.	Sri Sheo Shankar Verma	242	Do
147.	Sri Tapas Chowdhury	246	Do
148.	Sri Pradip Mondal	383	Do
149.	Sri A.K. Sen	478	Do
150.	Sri Tarak Prasad Nandi	247	Do
151.	Mrs. Sutapa Ganguly	248	Do
152.	Sri Sanjib Biswas	249	Do
153.	Sri R.P. Gorh	250	Do
154.	Sri Sarit K. Sarkhel	245	Do
155.	Sri Nishikanta Naskar	252	Do
156.	Sri Pallab Mukherjee	253	Do
157.	Sri Ranjit Das	345	Do
158.	Sri Abhijit Paul	450	Technician Gr. II (2)
159.	Sri Anirban Manna	410	Do

Sl. No.	Employee's Name	Emp. ID	Designation
160.	Sri Samir Majumder	426	Technician Gr. II (2)
161.	Md. M. Ahmed	360	Do
162.	Sri Paresh Sarkar	409	Do
163.	Sri Sujit Kr. Majumdar	416	Do
164.	Mrs. Mahua Bhattacharjee	419	Do
165.	Sri Prabir Kr. Das	418	Do
166.	Sri Atanu Maitra	417	Do
167.	Sri Tapan Das	460	Do
168.	Sri Ujjal Roy	529	Technician Gr. II (1)
169.	Sri Arup Karmakar	534	Do
170.	Sri R. Mahato	258	Helper Gr. I (4)
171.	Sri Sunil Nath	272	Do
172.	Sri R.N. Jana	274	Do
173.	Sri Prahlad Das	275	Do
174.	Sri Bhaskar Basu	440	Do
175.	Sri Brihaspati Das	347	Do
176.	Sri Shyamal Das	279	Helper Gr. I (3)
177.	Sri Sasthi C. Sil	356	Do
178.	Sri Madan Halder	479	Do
179.	Sri Amerika Das	280	Do
180.	Sri Nimai Charan Prodhan	282	Do
181.	Sri Sambhu Raul	351	Do
182.	Sri Suresh Balmiki	353	Do
183.	Sri U.N. Mandi	358	Do
184.	Sri Nandalal Routh	352	Helper Gr. I (2)
185.	Sri S.K. Banik	361	Do
186.	Sri Ashoke Sardar	501	Helper Gr. I (1)
187.	Sri Ram Kumar Sarkar	502	Do
188.	Sri Shyamal Nath	519	Do

Administration

Sl. No.	Employee's Name	Emp. ID	Designation
1.	Sri S.K. Chaudhuri	497	Administrative Officer
2.	Sri S.K. Das	498	F&A Officer
3.	Sri U.S. Das	515	Stores & Purchase Officer
4.	Sri Subhas Ch. Dutta	290	Sr. Security Officer
5.	Sri Kausik Bhattacharjee	492	Section Officer (General)
6.	Sri Siddhartha Dey	485	Do
7.	Mrs. Shampoo Sengupta	525	Do
8.	Sri P.K. Saha	468	Do
9.	Sri Asim Kr. Jha	518	Section Officer (F&A)
10.	Sri Abhimanyu Kr. Tiwary	533	Do
11.	Sri Basudev Bhattacharya	459	Private Secretary
12.	Sri S.K. Chhatui	312	Do
13.	Sri Nilratan Biswas	538	Do
14.	Sri Kanu Mondal	392	Assistant (General) Gr. I (ACP)
15.	Sri Ratan Bage	397	Do
16.	Sri K.C. Das	302	Assistant (General) Gr. I
17.	Mrs. Ratnabali Adhikari	304	Do
18.	Sri D.R. Chakraborty	306	Do
19.	Mrs. Anjana Mandi	308	Do
20.	Mrs. Sanhita Ganguly	427	Do
21.	Mrs. Monalisa Mukhopadhyay	428	Do
22.	Mrs. Rita Sikdar	326	Do
23.	Miss Lily Das	330	Do
24.	Mrs. Indira Kundu	331	Do
25.	Sri R.N. Hansda	334	Do
26.	Sri Prem Singh	335	Assistant (General) Gr. II
27.	Sri D.K. Kisku	340	Do
28.	Sri Alok Ray	396	Do
29.	Sri Jayanta Pal	510	Assistant (General) Gr. III
30.	Sri Tarun Kr. Sinha Roy	508	Do

Sl. No.	Employee's Name	Emp. ID	Designation
31.	Sri Raju Pal	507	Assistant (General) Gr. III
32.	Sri Ranjit Debnath	509	Do
33.	Sri Saugata Das	511	Do
34.	Sri Sukhendu Biswas	512	Do
35.	Sri Mrinal K. Ghosh	299	Assistant (F&A) Gr. I
36.	Sri A.K. Chanda	327	Do
37.	Mrs. Banani Dutta	476	Do
38.	Sri Sanjoy Mukhopadhyay	343	Do
39.	Mrs. P.L. Saha	332	Assistant (F&A) Gr. II (ACP)
40.	Sri Asit K. Roy	336	Assistant (F&A) Gr. II
41.	Sri M.K. Dutta	338	Do
42.	Sri Vishal Agarwal	506	Assistant (F&A) Gr. III
43.	Sri Tapan Kr. Mitra	320	Assistant (S&P) Gr. I
44.	Sri Panchanan Naskar	322	Do
45.	Sri A.B.S. Roy	328	Do
46.	Sri R.L. Bhattacharya	329	Do
47.	Sri Rajib Ray	536	Do
48.	Sri Bisweswar Das	342	Assistant (S&P) Gr. II
49.	Mrs. Bula Pal	363	Do
50.	Sri Pradipta Sarkar	505	Assistant (S&P) Gr. III
51.	Sri Arnab Sen	504	Do
52.	Mrs. Ambalika Nag	321	Sr. Hindi Translator
53.	Sri Mangala Prasad Banerjee	469	Sr. Stenographer (ACP)
54.	Sri Debdas Guhathakurta	313	Do
55.	Sri Nikhil Kumar Das	315	Do
56.	Sri Sankar Prasad Dutta	316	Do
57.	Sri Dipak Kr. Guin	318	Do
58.	Sri Asim Roy	323	Do
59.	Mrs. Pratima Banerjee	324	Sr. Stenographer
60.	Sri Shankar Bhakta	325	Do
61.	Sri Rabindranath Das	393	Do

Sl. No.	Employee's Name	Emp. ID	Designation
62.	Sri Saibal Giri	405	Sr. Stenographer
63.	Sri Gautam Saha	453	Jr. Stenographer
64.	Sri Sudip Ghosh	454	Do
65.	Sri Sankar Santra	490	Do
66.	Smt. Moumita Majumdar	491	Do
67.	Sri N.N. Pradhan	354	Gr-D (NT) (Upgraded / ACP)
68.	Sri Ashok Ram	348	Do
69.	Sri Bideshi Nayak	349	Do
70.	Mrs. Chaina Devi Nayak	366	Gr-D (NT) (Upgraded)
71.	Sri Kailash Chandra Nayak	365	Do
72.	Mrs. Gita Ghosh	364	Do
73.	Mrs. Soma Devi Sharma	401	Do
74.	Sri Gopal Ch. Mandal	412	Do
75.	Sri Asit Mitra	413	Do
76.	Sri Janmanjoy Midya	431	Do
77.	Sri Pasupati Midya	430	Do
78.	Sri Shyamal Kr. Ghosal	423	Do
79.	Sri P.C. Dehury	414	Do
80.	Sri Manoranjan Adhikary	425	Do
81.	Sri Tapan Sarkar	424	Do
82.	Sri Dinesh Mehali	451	Group-D (NT)
83.	Sri Tarun Dutta	367	Asstt. Manager-cum-Store Keeper
84.	Sri Amal Dutta	369	Coupon Clerk
85.	Sri Balaram Panda	368	Halwai-cum-Cook
86.	Sri Sudhangshu Halder	373	Tea Maker
87.	Sri Bimal Das	372	Bearer
88.	Sri Ashok Sadhukhan	371	Bearer
89.	Sri Badal Haldar	370	Bearer
90.	Sri Jagabandhu Biswas	374	Wash Boy
91.	Sri Mantu Das	376	Sweeper
92.	Sri Nirapada Halder	375	Sweeper

Retirement List from April 01, 2008 to March 31, 2009

Sl. No.	Name of the Staff Member	Designation	Date of Retirement
1.	Sri Subodh Kr. Roy	TO, Gr. III(6)	30-04-2008
2.	Sri K.K. Sarkar	TO, Gr. III(7)	31-05-2008
3.	Mrs. Uma Biswas	Helper, Gr. I(3)	31-05-2008
4.	Sri D. Pal	Scientist Gr. IV(5)	31-07-2008
5.	Sri P. Purkait	Asstt. (G), Gr. I	31-08-2008
6.	Dr. Binayak Das	Scientist Gr. IV(3)	30-09-2008
7.	Dr. Chhanda Mitra	Scientist, Gr. IV(3)	30-09-2008
8.	Dr. Minarani Mukherjee	Scientist, Gr. IV(5)	31-10-2008
9.	Sri A.T. Mukherjee	Tech., Gr. II(4)	31-01-2009
10.	Dr. J.R. Vedasiromoni	Scientist, Gr. IV(6)	31-03-2009
11.	Sri A.K. Banerjee	Scientist, Gr. IV(5)	31-03-2009
12.	Sri N.N. Prodhan	Gr. D (Non-Tech.)	31-03-2009

New Appointment from April 01, 2008 to March 31, 2009

Sl. No.	Name of the Staff Member	Designation	Date of Appointment
1.	Dr. Jayati Sengupta	Scientist Gr. IV(3)	17-06-2008
2.	Dr. S.N. Bhattacharjee	- DO -	18-07-2008
3.	Sri Anup Karmakar	Tech., Gr. II(1)	25-08-2008
4.	Sri T. Muruganandan	TA, Gr. III(1)	11-12-2008

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Vice-Chancellor
University of Hyderabad
Hyderabad - 500 046

Dr. A. N. Bhisey
Former Director
Cancer Research Institute
7, Yug Prabhat Society
Naryan Pathara Marg, Mahim
Mumbai - 400 016

Dr. K. N. Ganesh
Director
Indian Institute of Science Education and Research (ISER)
900, NCL Innovation Park
Dr. Homi Bhabha Road
Pune - 411 008

Prof. R. V. Hosur
National Facility for High Field NMR
Tata Institute of Fundamental Research
Homi Bhabha Road, Navy Nagar
Mumbai - 400 005

Prof. K. Muniyappa
Head, Department of Biochemistry
Indian Institute of Science
Bangalore - 560 012

Dr. P. Bhatnagar
Senior Vice-President
New Drug Discovery Research
Ranbaxy Laboratories Limited
Plot No. 20, Sector - 18, Udyog Vihar, Industrial Area
Gurgaon - 122 015

Dr. Sukhdev Sinha
Advisor
Department of Biotechnology
Block-2, 7th Floor, CGO Complex
Lodi Road
New Delhi - 110 003

Dr. Gopal Pandey
Scientist F
Centre for Cellular & Molecular Biology
Uppal Road
Hyderabad - 500 007

Dr. Girish Sahni
Director, Institute of Microbial Technology
Sector 39-A
Chandigarh - 160 036

Dr. Naresh Kumar
Head, RDPD
Council of Scientific & Industrial Research
Anusandhan Bhawan, Rafi Marg
New Delhi - 110 001

Prof. Siddhartha Roy, Member
Director, Indian Institute of Chemical Biology
4, Raja S. C. Mullick Road, Jadavpur, Kolkata - 700 032
Fax : 033 2473 5197
Tel : 033 2413 1157 / 2473 5638 (O); 033 2429 8795 / 2412 1261 (Res.)
E-mail : siddhartharoy@iicb.res.in

Dr. Kunal Roy, Secretary
Scientist, Indian Institute of Chemical Biology
4, Raja S. C. Mullick Road, Jadavpur, Kolkata - 700 032
Fax : 033 2473 5197
Tel : 033 2473 0492 /3491/3493 (O); 033 2432 8022 (Res.)
E-mail : kray@iicb.res.in

Special Permanent Invitee

Prof. B. Bhattacharyya
Department of Biochemistry, Bose Institute
Centenary Building, P-1/12 C.I.T. Scheme VII M,
Kolkata - 700 054

Prof. D. J. Chattopadhyay
Pro-Vice-Chancellor (Academic Affairs)
Department of Biotechnology
B. C. Guha Centre for Biotechnology and Genetic Engineering
University of Calcutta
35, Ballygunge Circular Road
Kolkata - 700 019

Prof. Chanchal Das Gupta
Department of Biophysics, Molecular Biology and Genetics,
University College of Science, 92 A.P.C. Road
Kolkata - 700 009

प्रबंध परिषद्

(1 जुलाई, 2007 से 31 दिसम्बर, 2009 तक)

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(For the period from 01.07.2007 to 31.12.2009)

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Tel : (033) 2473 3491 / 0492 / 3493 / 6793
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43A Abdul Halim Lane, Kolkata - 700 016
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