28-09-2020

To
Prof. Syed Arshad Hussain
Department of Physics
Tripura University
Suryamaninagar - 799 022
Tripura, India

YAMAGUCHI UNIVERSITY
山口大学

To whom it may concern

I am very happy to mention that we have active collaboration with your research group at Department of Physics, Tripura University and my research group at Department of Chemistry, Yamaguchi University, Japan since 2013. As a result of collaborative rsearch we have several peer reviewed joint publications in our credit. Also researchers from your group and my group have made two successful exchange visit. I hope in near future our collaborative research will results some more fruitful outcome.

Thank you very much.

Sincerely

Jun Kawamata

Prof. Jun Kawamata
Department of Chemistry
Yamaguchi University
Yamaguchi 753-8512, Japan
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Adsorption behavior of DNA onto a cationic surfactant monolayer at the air–water interface

Chaitali Hansda [a], Syed Arshad Hussain [b], Debajyoti Bhattacharjee [b], Pabitra Kr. Paul [a,*]

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ABSTRACT

This communication reports the adsorption of DNA to the preformed Langmuir monolayer of cationic surfactant Octadecylamine (ODA) at the air–water interface and thereby formation of ODA/DNA complex monolayer at the interface. Effect of concentration of DNA in the subphase as well as subphase pH on the adsorption of DNA onto ODA monolayer assemblies have been studied by monitoring the change in surface pressure of ODA/DNA complex monolayer as a function of time. The complex monolayer was also transferred onto solid substrate to prepare ODA/DNA Langmuir–Blodgett films which were analyzed by UV–vis absorption, ATR–FTIR spectroscopic techniques. The most significant observations is that the extent of interactions between ODA and DNA at the air–water interface increases with increasing concentration of DNA in the subphase and also subphase pH. At higher pH, hydrophobic interaction dominates over electrostatic interaction between DNA and ODA in the aqueous subphase. DNA immobilized in the backbone of ODA lies almost flat or extended onto solid substrate at neutral pH whereas, they lie aggregated and compacted coil rather than flat when adsorbed from high pH namely, 11.5 of the subphase. This was confirmed by atomic force microscopy of these complex LB films onto solid substrate.

1. Introduction

Deoxyribonucleic acid (DNA) is well-known as a source of biological information depending on its base sequences. DNA is also interesting as a material that exists as double helical rodlike molecules consisting of base-pair (bp) stacking. Rod-like polymers such as polyglutamate [1–3] polysiloxane [4], alkylated cellulose, [5] and discotic crystals [6] have been reported to form Langmuir–Blodgett (LB) films in which rod-like molecules aligned in one direction during the compression process on the subphase [7,8] or the deposition process of monolayers [9]. DNA is a good candidate to form an oriented Langmuir monolayer when adsorbed from an aqueous subphase to the oppositely charged surfactant monolayer at the air–water interface.

Monolayers of charged surfactant molecules at the air–water interface (Langmuir monolayers) have long been acknowledged to be the excellent media for the organization of large inorganic ions [10,11], colloidal nanoparticles [12], phospholipids [13]and biomacromolecules such as proteins/enzymes [14,15] and in the growth of oriented crystals [16]. The interaction of DNA with Langmuir monolayers has received considerable attention with a view to understand templated supramolecular organization as well as the transfer of DNA across biological bilayer membranes in gene therapy in cancer, VIH, Ebola or heart infarction [17–19]. Moreover, anchoring of DNA in a Langmuir–Blodgett film has made possible in its immobilization [20–22] and construction of DNA chip [23]. Studies on DNA immobilization at the air–water interface have hitherto concentrated on electrostatic complexation between DNA molecules with cationic surfactant Langmuir monolayers and hydrogen bonding between alkylated monolayer-forming nucleobases and complementary water-soluble bases and oligonucleotides. This electrostatic complexation between DNA and cationic surfactant sometimes very much sensitive to the different microenvironment from which it is adsorbed. There are some previous reports on the immobilization of DNA onto Langmuir monolayers onto hydrophilic solid substrate [24,25]. However the effect of subphase pH on the complexation of DNA and cationic surfactant is still not extensively studied. It is already believed that DNA-surfactant complexation is a non-viral method of gene delivery into the cell [26]. DNA immobilized onto solid substrates may have profound implication with respects to its biological functionalities and protein or enzymatic recognition [27,28]. In this present paper, the interaction mechanism of DNA on to the preformed Langmuir monolayer of cationic Octadecylamine (ODA) at the air–water interface as a function of various parameters like concentrations, pH of the subphase etc. and the successful transfer of the resultant complex Langmuir monolayer onto solid support have been demonstrated. pH of the medium can play important role for different headgroup interactions of surfactant in an aqueous subphase and can cause compaction or condensation of nucleotides while complexation with surfactant [29]. Adsorption of DNA onto ODA monolayer has been studied by monitoring the surface pressure (in mN/m) of the

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No. BT/Env/BC/01/2010
GOVERNMENT OF INDIA
MINISTRY OF SCIENCE & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY

Block 2, (6-8th Floors)
CGO Complex, Lodhi Road,
New Delhi- 110 003
Date: 01.10.2015

RELEASE ORDER

In continuation of this Department's sanction order of even number dated 23.03.2012 sanction of the President is hereby accorded, under Rule18 of the Delegation of Financial Powers Rule, 1978, for the release of **Rs. 10.657 lakhs** (Rupees Ten lakhs sixty five thousand seven hundred Only) being the fourth year release for the project entitled **"Preventing extinction and improving conservation status of threatened plants through application of biotechnological tools "**being implemented by:-

1. Prof. H. Lalramnghinglova, Professor, Departmental Environmental Sciences, Mizoram University, Tanhril post Box No.190, Aizawl, Mizoram - 796001.
2. Dr. Aparajita De, Assistant Professor, Department of Ecology & Environmental Sciences, Assam University, Silchar - 788 011, Assam, India.
3. Prof. B.K. Datta, Professor, Department of Botny, Tripura University, Suryamaninagar - 799022 Tripura

The detailed break-up is as given below:

Name of Institution	Manpower	Consumables	Travel	Contingencies	Overhead	Total Rs. In Lakhs
Mizoram University, Aizawl	1.78	1.00	1.00	0.40	0.00	**4.18**
Assam University, Silchar	1.59	0.32	0.40	0.255	0.00	**2.565**
Tripura University, Agartala	2.376	0.336	0.40	0.30	0.50	**3.912**
Total						**10.657**
Rs. 0.164 lakhs Interest earned by Tripura University is re-appropriated to consumables head. Accordingly, total amount in Consumables head is Rs. 0.50 lakhs (Rs. 0.164+0.336).						

2. The amount of **Rs. 10.657 lakhs** (Rupees Ten lakhs sixty five thousand seven hundred Only) will be drawn by the Drawing & Disbursing Officer, DBT, from the Pay & Accounts Officer, DBT, and disbursed through RTGS as per following details:

Rs. 4.18 Lakhs to Registrar, Mizoram University, Aizwal
Bank Name : United Bank of India
Branch Name: Mizoram University Branch, Tanhril, Aizawal
A/c No. : 1548010004312
IFSC Code : UTBIOMZUH61
MICR Code : 796027003

Rs. 2.565 Lakhs to Registrar, Assam University, Silchar
Bank Name : Canara Bank
Branch Name: Silchar Branch, Rangirkhari, Silchar-5
A/c No. : 3050101000285
IFSC Code : CNRB0003050
MICR Code : 788015002

Rs. 3.912 Lakhs to Registrar, Tripura University, Tripura
Bank Name : State Bank of India (SBI)
Branch Name: Tripura University Branch
A/c No. : 30371209938
IFSC Code : SBIN0010495
MICR Code : 799002524

No. BT/Env/BC/01/2010
GOVERNMENT OF INDIA
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Administrative
(Application No: HC-153)

File No.BT/247/NE/TBP/2011
GOVERNMENT OF INDIA
MINISTRY OF SCIENCE & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY
(NER DIVISION)
****

Block-2, 7th Floor,
CGO Complex, Lodhi Road
New Delhi-110003
Dated: 01 / 05 / 2012

ORDER

Sanction of the President is here by accorded under Rule 18 of the Delegation of Financial Powers Rules, 1978 for the implementation of the project under **'DBT's Twinning programme for the NE'** titled **"Molecular epidemiology of HPV and cervical cancer in Tripura: genetic variations influencing HPV persistence and disease development"** Dr. Samir Sil, Tripura University, Agartala, Tripura and Dr. Sharmila Sengupta, National Institute of Biomedical Genomics, Kalyani West Bengal at a total cost of **₹ 107.75 lakhs (Rupees One Crore Seven lakhs and Seventy five thousand only)** for a period of three years, on the terms and conditions detailed as under:

2.0 The Project:

2.1 Project Title: Molecular epidemiology of HPV and cervical cancer in Tripura: genetic variations influencing HPV persistence and disease development.

2.2 Project Investigators

2.2.1 Principal Investigator: (Parent Institute)

Dr. Samir Sil
Associate Professor
Molecular Genetics Laboratory,
Dept. of Human Physiology,
Tripura University,
Dimsagar,
Agartala, Tripura- 799001

2.2.2 Principal Investigator: (Collaborating Institute)

Dr. Sharmila Sengupta
Professor
National Institute of Biomedical Genomics,
Netaji SubhasSanatorium, (T.B. Hospital),
2nd Floor, N.S.S., Kalyani,
West Bengal- 741251.

28-09-2020

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Prof. Syed Arshad Hussain
Department of Physics
Tripura University
Suryamaninagar - 799 022
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YAMAGUCHI UNIVERSITY
山口大学

To whom it may concern

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Thank you very much.

Sincerely

Jun Kawamata

Prof. Jun Kawamata
Department of Chemistry
Yamaguchi University
Yamaguchi 753-8512, Japan
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j_kawa@yamaguchi-u.ac.jp

●●● Porter School of
the Environment and
Earth Sciences

●●● בית הספר לסביבה
ולמדעי כדור הארץ
על שם פורטר

The Raymond and Beverly Sackler
Faculty of Exact Sciences
Tel Aviv University

הפקולטה למדעים מדויקים
ע"ש ריימונד ובברלי סאקלר
אוניברסיטת תל אביב

4 October 2020

International Collaboration with Dr. Anirban Guha

I am writing this letter to describe the international collaboration between Dr. Anirban Guha and my team at Tel Aviv University in Israel. I have known Dr. Guha for about 7 years after meeting him at an international conference on Atmospheric Electricity. We were both presenting papers at the conference, and since we both work in similar fields, we had a lot to talk about. We have remained in close contact since, and today we are working closely together on topics related to lightning, thunderstorms, atmospheric electricity and climate change.

In recent years Dr. Guha and myself applied for a joint research grant to study the link between thunderstorms and upper tropospheric water vapor. This joint research has involved mutual visits in Israel and India, and our students have also started collaborating together. The main field of our interest is related to the Schumann resonances, and Dr. Guha has become one of the world experts in this field, with additional international collaborations with scientists in the US, Europe and Japan on this topic. He has visited many countries for work and research, and has attended many research workshops and international conference around the globe, including one in Israel that I organized a few years ago.

Due to Dr. Guha's pleasant manner, and readiness to always help and collaborate, he has earned himself additional international recognition, as shown by the co-authors on some of his recent papers. Dr. Guha is also promoting a South Asian Lightning Network of research dealing with lightning safety issues to help protect the public from lightning risks. I attended a workshop in Tripura on this topics, and was impressed with the international turnout from neighboring regions (Nepal, Bangladesh, Sri Lanka, Zambia, South Africa, Malaysia, Indonesia, etc.). Hence, Dr. Guha has significant international cooperation, which appears to be expanding all the time.

I you would like any additional information, please feel free to contact me.

Sincerely,

Prof. Colin Price
Head of the Environmental Studies Department
Porter School of the Environment and Earth Sciences
Tel Aviv University

Massachusetts Institute of Technology

October 5, 2020

Dr. Anirban Guha
Department of Physics
Tripura University
India

Dear Anirban

This letter summarizes the collaborative research in atmospheric electricity and global climate between Tripura University and MIT, initiated by your receipt of a Fulbright Fellowship (2012- 2013), with interest in the relationship between global lightning activity and temperature. Your important initiative here, with a followup visit in 2014, led to the organization of the long-term recording of the Earth's Schumann resonances at the MIT field station in West Greenwich, Rhode Island. We then drew together the records of ~30 ELF stations worldwide on the MIT SuperCloud site as inputs to geophysical inversion schemes for global lightning activity in absolute units. You remain the leading expert on one of these schemes called FULLGEAR, and much progress was made in this area as a result of your Raman Post-Doctoral Fellowship (2016-2017) that enabled you to return to MIT for an extended period. This work has also led to productive international collaboration with another group in Hungary engaged in inversion work. Your visiting scientist opportunity at MIT in 2019 was particularly helpful in moving toward validation of the Schumann resonance inversion results on individual days.

Your group investigated earlier the behavior of LIS/OTD-observed lightning activity in the transition between phases of ENSO events (Guha et al., 2017). More recently a larger international group of Schumann resonance experts has been involved with a study on the impact of two Super El Nino events on global lightning activity that has raised important questions about the physical nature of ENSO transitions.

The new access to global ELF records has stimulated additional work by your group on the global time-of-arrival location of Q-burst lightning transients, and in the interest in documenting so-called lightning megaflashes that predominate in parts of Africa, and North and South America. The impact of large transients on the background Schumann resonances has been the interesting subject of one of your recent publications (Guha et al., JASTP, 2017). You and your students have investigated the so-called End of Storm Oscillation (EOSO) in thunderstorms in India and have recently generously shared with us your extensive findings toward identifying a possible polarity asymmetry between Type I (normal) and Type II (inverted) EOSO events.

On the incentive of a recent action of the World Meteorological Organization to make lightning a climate variable, you and your students took productive action in organizing a global dataset on thunder day observations that will serve as a valuable metric for regional and global climate change.

Regarding recent trends in global warming, you and I together have been investigating the remarkable increases in lightning activity at high latitudes, and especially in Alaska (Williams and Guha, 2019). I was pleased to participate (remotely) in the Lightning Symposium you successfully organized at Tripura University a year ago on this topic. In collaborative work with MIT post-doc Yakun Liu from China, the effects of aerosol on lightning behavior in global shipping lanes (Liu et al., GRL, 2020) and in the recent wildfire outbreak in Australia's "black summer" have been explored.

Your interest and enthusiasm have played an important role in the direction of international research activity, and we are indebted to you for your continued collaboration.

Sincerely

Earle R Williams

Earle R. Williams

Parsons Laboratory
Building 48-211

77 Massachusetts Avenue
Cambridge, Massachusetts
02139–4307

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28-09-2020

To
Prof. Syed Arshad Hussain
Department of Physics
Tripura University
Suryamaninagar - 799 022
Tripura, India

YAMAGUCHI UNIVERSITY
山口大学

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Thank you very much.

Sincerely

Jun Kawamata

Prof. Jun Kawamata
Department of Chemistry
Yamaguchi University
Yamaguchi 753-8512, Japan
Tel & Fax +81-83-933-5729
j_kawa@yamaguchi-u.ac.jp

File No. BT/468/NE/TBP/2013
GOVERNMENT OF INDIA
MINISTRY OF SCIENCE & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY
(NER DIVISION)
****

Block-2, 7th Floor,
CGO Complex, Lodhi Road
New Delhi-110003
Dated: 13/3/2014

ORDER

Sanction of the President is hereby accorded under Rule 18 of the Delegation of Financial Powers Rules, 1978 for the implementation of the project under **'DBT's Twinning programme for the NE'** titled **"Molecular and cellular studies on normal and diabetic wound healing activities of Parkia javanica, a medicinal plants of Tripura, northeast India"** by Dr. Samir K. Sil, Tripura University, Agartala, Tripura and Prof. Parimal Karmakar, Jadavpur University, Kolkata, West Bengal at a total cost of **₹ 63.36 lakhs (Rupees Sixty Three lakhs and Thirty Six thousand only)** for a period of three years, on the terms and conditions detailed as under:

2.0 The Project:

2.1 Project Title: Molecular and cellular studies on normal and diabetic wound healing activities of Parkia javanica, a medicinal plants of Tripura, northeast India.

2.2 Project Investigators

2.2.1 Principal Investigator: (Parent Institute)	Dr. Samir K. Sil Associate Professor Dept. of Molecular Genetics Laboratory, Human Physiology Tripura University, Dimsagar Agartala- 799001, Tripura
2.2.2 Co- Investigator I: (Parent Institute)	Dr. Surajit Bhattacharya Assistant Professor Dept. of Molecular Biology & Bio Informetics Tripura University, Suryamaninagar- 799022, Tripura
2.2.3 Co- Investigator II: (Parent Institute)	Dr. Swapan Majumder Reader Dept. of Chemistry Tripura University, Suryamaninagar- 799022, Tripura
2.2.4 Co- Investigator III: (Parent Institute)	Dr. Biplab Ghosh Assistant Professor Dept. of Chemistry Netaji Subhash Mahavidhyalaya, Udaypur- 799022, Tripura

BIOTECH CONSORTIUM INDIA LIMITED

BCIL

5th Floor, Anuvrat Bhawan, 210, Deen Dayal Upadhyaya Marg, New Delhi-110002
Tel : 2321 9064 - 67 **Fax :** 011- 2321 9063
Email : info.bcil@nic.in, bcildelhi@vsnl.com **Website :** http://www.bcil.nic.in

BCIL/NER-BPMC/2014 March 18, 2014

The Registrar
Tripura University
Suryamaninagar,
Agartala-799022
Tripura

Dear Sir/Madam,

Sub.: Release of grant to the implementing agency of the project entitled "Studies on anticancer activities of extracts (Bromelain and Peroxidase) of different pineapple (Ananas cosmosus) cultivars of Tripura" under DBT's Twinning Programme for the NE

As you may be kindly aware, the Department of Biotechnology (DBT), Government of India, has setup a North Eastern Region-Biotechnology Programme Management Cell (NER-BPMC) for promotion of Biotechnology in the North Eastern Region of India through Biotech Consortium India Limited (BCIL), a company promoted by the Department of Biotechnology.

We are happy to inform you that the above proposal submitted by your organization has been sanctioned by DBT. Please find enclosed herewith a copy of the Sanction Order No. BT/472/NE/TBP/2013 dated March 13, 2014 of the DBT along with terms and conditions of the grant, format of UC/SE, format of asset acquired, format of memorandum of agreement, etc.

Please also find enclosed herewith a cheque no. 846134 dated 18.03.2014 for an amount of Rs. 9.93 lakhs as first year release towards implementation of the above project at your organization.

We request you to please send the signed Memorandum of Agreement (MOA) which has to be executed on Rs 100/- non-judicial stamp paper as per the format enclosed. You are also requested to send a signed copy of the terms and conditions of the grant. These signed documents may please be sent to **Dr. T. Madhan Mohan, Adviser, Department of Biotechnology (DBT), Block No. 2, 7th Floor, CGO Complex, Lodhi Road, New Delhi-110003** with in a month's time from the date of release of funds to your organization, latest by April 18, 2014.

Kindly acknowledge the receipt.

Thanking you,

Yours faithfully

(Vinod Kumar)
Deputy Manager

CC for kind information to :

1. The Vice Chancellor, Tripura University, Suryamaninagar, Agartala-799022, Tripura
2. Dr. Debassish Maitit, Associate Professor, Dept. of Human Physiology, Tripura University, Suryamaninagar, Agartala-799022, Tripura

Encl.: a/a

Administrative
(Application No: MAP/2013/241)

File No. BT/472/NE/TBP/2013
GOVERNMENT OF INDIA
MINISTRY OF SCIENCE & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY
(NER DIVISION)
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Block-2, 7th Floor,
CGO Complex, Lodhi Road
New Delhi-110003
Dated: 13 / 3 / 2014

ORDER

Sanction of the President is hereby accorded under Rule 18 of the Delegation of Financial Powers Rules, 1978 for the implementation of the project under **'DBT's Twinning programme for the NE'** titled **"Studies on anticancer activities of extracts (Bromelain and Peroxidase) of different pineapple (Ananas comosus) cultivars of Tripura"** by Dr. Debasish Maiti, Tripura University, Suryamaninagar, Tripura and Dr. Krishna Das Saha, Indian Institute of Chemical Biology, Kolkata at a total cost of **₹ 42.25 lakhs (Rupees Forty Two lakhs and Twenty Five thousand only)** for a period of three years, on the terms and conditions detailed as under:

2.0 The Project:

2.1 Project Title: Studies on anticancer activities of extracts (Bromelain and Peroxidase) of different pineapple (Ananas comosus) cultivars of Tripura.

2.2 Project Investigators

2.2.1 Principal Investigator: (Parent Institute)	**Dr. Debasish Maiti** Associate Professor Dept. of Human Physiology Tripura University, Suryamaninagar, Tripura-799022
2.2.2 Co- Investigator I: (Parent Institute)	Dr. Durgadas Ghosh Professor Dept. of Zoology Tripura University, Suryamaninagar, Tripura-799022
2.2.3 Principal Investigator: (Collaboration Institute)	**Dr. Krishna Das Saha** Principal Technical Officer Dept. of Cancer Biology & Inflammatory Disorder, Indian Institute of Chemical Biology, 4, Raja S.C. Mullick Road, Kolkata- 700032

2.3 Objectives:

1. To characterize the different enzymatic fractions of pine apple fruit.
2. To find out the cytotoxic effect of Bromelain alone and Bromelain, peroxidase in combination (extract of two cultivars of pineapple of Tripura) on different cancer cell lines mentioned above.
3. To find out the apoptotic effect of Bromelain alone and Bromelain, peroxidase in combination (extract of two cultivars of pineapple of Tripura) in the cancer cell line(s) where bromelain or the pineapple extracts are more potent.

2.4 Time Schedule:

The duration of the project is **three years** from the date of issue of sanction order.

2.5 Equipment Details:

2.5.1 Tripura University, Suryamaninagar, Tripura

(₹ in lakhs)

Sl. No.	Description of equipment	Grant Recommended (Rupees in lakhs)
1.	Water bath with shaker (digital)	**0.39**
2.	Protein gel electrophoresis and blotter with power pack	**1.68**
3.	Centrifuge	**0.72**
4.	Stirrer hot plate	**0.18**
	Total	**2.97**

2.5.2 Indian Institute of Chemical Biology, Kolkata

Nil

2.6 Manpower:

Fellowship Conditions:
JRF emoluments shall be ₹ 16,000/- + HRA for the 1st two years and ₹ 18,000/- + HRA for the 3rd year for SRF and applicable, only if JRF/SRF is NET/GATE/BET/BINC SLET/Professional course qualified, otherwise it shall be ₹ 12,000/- + HRA for the 1st two years for JRF and ₹ 14,000/- + HRA for the 3rd year for SRF.

2.6.1 Tripura University, Suryamaninagar, Tripura

(₹ in lakhs)

S. No.	Position (No.)	Emolument	1st Year	2nd Year	3rd Year	Total
1.	JRF (1)	JRF @ ₹ 16,000/- + 10 % HRA for the 1st & 2nd yr SRF @ ₹ 18,000/- + 10 % HRA for 3rd yr	2.11	2.11	2.38	**6.60**
		Total	**2.11**	**2.11**	**2.38**	**6.60**

2.6.2 Indian Institute of Chemical Biology, Kolkata

(₹ in lakhs)

S. No.	Position (No.)	Emolument	1st Year	2nd Year	3rd Year	Total
1.	JRF (1)	JRF @ ₹ 16,000/- + 30 % HRA for the 1st & 2nd yr SRF @ ₹ 18,000/- + 30 % HRA for 3rd yr	2.50	2.50	2.80	**7.80**
		Total	**2.50**	**2.50**	**2.80**	**7.80**

2.7 Budget Estimate:

The total cost of the project is **₹ 42.25 lakhs (Rupees Forty Two lakhs and Twenty Five thousand only)** as per budget summary given below:

2.7.1 Tripura University, Suryamaninagar, Tripura

(₹ in lakhs)

Heads	1st Year	2nd Year	3rd Year	Total
I. Non-Recurring (Equipment's and accessories)	2.97	0.00	0.00	**2.97**
Sub Total- I	**2.97**	**0.00**	**0.00**	**2.97**
II. Recurring				
1. Manpower	2.11	2.11	2.38	**6.60**
2. Consumables	3.60	3.60	3.30	**10.50**
3.Travel	0.50	0.50	0.50	**1.50**
4. Contingency	0.25	0.25	0.25	**0.75**
5.Overhead charges	0.50	0.50	0.50	**1.50**
Sub Total- II (1-5)	**6.96**	**6.96**	**6.93**	**20.85**
GRAND TOTAL (I+II)	**9.93**	**6.96**	**6.93**	**23.82**

2.7.2 Indian Institute of Chemical Biology, Kolkata

(₹ in lakhs)

Heads	1st Year	2nd Year	3rd Year	Total
I. Non-Recurring (Equipment's and accessories)	0.00	0.00	0.00	**0.00**
Sub Total- I	**0.00**	**0.00**	**0.00**	**0.00**
II. Recurring				
1. Manpower	2.50	2.50	2.80	**7.80**
2. Consumables	2.50	4.50	2.58	**9.58**
3.Travel	0.00	0.00	0.00	**0.00**
4. Contingency	0.00	0.00	0.00	**0.00**
5.Overhead charges	0.35	0.35	0.35	**1.05**
Sub Total- II (1-5)	**5.35**	**7.35**	**5.73**	**18.43**
GRAND TOTAL (I+II)	**5.35**	**7.35**	**5.73**	**18.43**

(i) Grand total for 3 years (23.82+ 18.43) = ₹ 42.25 lakhs
(ii) Total for 1st year release (9.93+ 5.35) = ₹ 15.28 lakhs

2.8 Other Terms & Conditions:

2.8.1 The other terms and conditions governing this sanction are attached at **Annexure-I.**

2.8.2 A Memorandum of Agreement (MoA) will be signed between the Department of Biotechnology and the grantee institute on a ₹ 100/- stamp paper in the format given at **Annexure II** and the subsequent releases will be made only after signing of MoA by the grantee institute and its acceptance by DBT. All pages need to be signed by the PI and the forwarding authority and the MoA returned to DBT within 30 days of issue of this letter.

2.8.3 The Non-recurring items must be procured and installed within 6 month period from the date of sanction.

2.8.4 In case the amount of grant-in-aid is refunded, the whole or a part amount of the grant, with an interest at 10% per annum there on shall be recovered.

2.8.5 No international travel will be undertaken from the sanctioned project grant unless specified otherwise.

2.8.6 The Institute/Agency will keep the whole of the grant in a Bank Account earning interest, and the interest so earned should be reported to DBT in the Utilization Certificate and statement of Expenditure. The interest so earned will be treated as created to the institute / Agency and shall be adjusted towards further installment of the grant and or at the time of Final Settlement of Account.

2.9 Additional Terms & Conditions, specific for Twinning R&D program for NER:

2.9.1 Both NER & Rest of India (RoI), Institutions scientists should work together for the objectives stated in the sanction of the project and any deviation from this would attract closure of the project at any point of time.

2.9.2 In the project review meetings, both the PI's from NER & RoI Institutions should participate & make presentation.

2.9.3 The outcomes of the project such as research papers, patents, copy rights etc. should be made jointly.

2.9.4 The NER Scientists are to be trained at the collaborating institute appropriately to empower the NER Scientists.

2.9.5 The project personal such as Research Associate, JRF/SRF, Research Assistant are also to be trained at least once in the collaborating national institute.

2.9.6 The collaborating institute scientist should visit NER institutions more frequently to guide NER scientists in design and conduct of experiments.

2.10 This issues under the powers delegated to this Department and with the concurrence of IFD, DBT vide their **Dy No. 102/I.F.D/SAN/2628-2643/ 2013-14 Dated 02/09/2013.**

388-389

2.10.1 This sanction order has been noted at **Serial No.....** in the Register of Grants.

2.10.2 The accounts of grantee institution shall be open to inspection by sanctioning auditory / audit.

3.0 M/S Biotech Consortium India Ltd (BCIL), Anuvrat Bhawan, 210, Deen Dayal Upadhayay Marg, New Delhi- 110002, is administrating the North Eastern Region Biotechnology Programme Management Cell (NER-BPMC) of the DBT.

Vaishali Panjabi

(Dr. Vaishali Panjabi)
Scientist 'C'

To,

The Pay & Accounts Officer,
Department of Biotechnology,
New Delhi - 110003

Copy to:

1. The Principal Director of Audit (Scientific Department), AGCR Building, New Delhi - 110 002.
2. Cash Section, DBT (For information only).
3. Sanction Folder.
4. IFD, DBT.
5. The Registrar, Tripura University, Suryamaninagar, Tripura-799022.
6. The Vice-Chancellor, Tripura University, Suryamaninagar, Tripura-799022.
7. The Director, Indian Institute of Chemical Biology, 4, Raja S.C. Mullick Road, Kolkata-700032.
8. Dr. Debasish Maiti, Associate Professor, Dept. of Human Physiology, Tripura University, Suryamaninagar, Tripura-799022.
9. Dr. Krishna Das Saha, Principal Technical Professor, Dept. of Cancer Biology & Inflammatory Disorder, Indian Institute of Chemical Biology, 4, Raja S.C. Mullick Road, Kolkata- 700032.
10. Concern file.
11. The Managing Director, Biotech Consortium India Limited, (NER-BPMC), 5th Floor, Anuvart Bhawan, 210, Deen Dayal Upadhyay Marg, New Delhi- 110002.

Vaishali Panjabi

(Dr. Vaishali Panjabi)
Scientist 'C'

File No. BT/472/NE/TBP/2013
GOVERNMENT OF INDIA
MINISTRY OF SCIENCE & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY
(NER DIVISION)
****

Block-2, 7th Floor,
CGO Complex, Lodhi Road
New Delhi-110003
Dated: 13 / 3 / 2014

ORDER

In continuation of this department's sanction order of even number dated 13 / 3 / 2014, sanction of the President of India is hereby accorded under Rule 18 of the Delegation of Financial Powers Rules, 1978 for the release of first year grant of ₹ **9.93 lakhs (Rupees Nine lakhs and Ninety Three thousand only)** to **The Registrar, Tripura University, Suryamaninagar, Tripura** implementation of the project under **'DBT's Twinning Program for the NE'** titled **"Studies on anticancer activities of extracts (Bromelain and Peroxidase) of different pineapple (*Ananas comosus*) cultivars of Tripura"** Dr. Debasish Maiti, Tripura University, Suryamaninagar, Tripura and Dr. Krishna Das Saha, Indian Institute of Chemical Biology, Kolkata, as per the details given below:

(₹ in lakhs)

Heads	1st Year
I. Non-Recurring (Equipment's and accessories)	2.97
Sub Total- I	**2.97**
II. Recurring	
1. Manpower	2.11
2. Consumables	3.60
3.Travel	0.50
4. Contingency	0.25
5.Overhead charges	0.50
Sub Total- II (1-5)	**6.96**
GRAND TOTAL (I+II)	**9.93**

(Rupees Nine lakhs and Ninety Three thousand only)

2. The other terms and conditions governing the financial sanction will remain unaltered.

3. The Non-recurring items must be procured and installed within 6 month period from the date of sanction.

4. The account of the guarantee institution shall be open to inspection by the sanctioning authority/audit.

5. M/s Biotech Consortium India Ltd., Anuvrat Bhawan, 210, Deen Dayal Upadhyay Marg, New Delhi-110 002, who is administrating the North Eastern Region Biotechnology Program Management Cell (NER-BPMC) of the department, is hereby authorized to disburse the amount of **₹ 9.93 lakhs (Rupees Nine lakhs and Ninety Three thousand only),** as referred in Para 1 above, in favor of **"The Registrar, Tripura University, Suryamaninagar, Tripura-799022"** by an account payee cheque/demand draft under scheme North Eastern Region Biotechnology Program.

6. This issues under the powers delegated to this Department and with the concurrence of IFD, DBT vide their **Dy No. 102/I.F.D/SAN/2628-2643/ 2013-14 Dated 02/09/2013.**

7. This sanction order has been noted at **Serial No.....** 388 in the Register of Grants.

8. Being the first release of the project, Utilization Certificate is not applicable.

9. In case the amount of grant-in-aid is refunded, the whole or a part amount of the grant, with an interest at 10% per annum there on shall be recovered.

10. No international travel will be undertaken from the sanctioned project grant unless specified otherwise.

11. **Additional Terms & Conditions for Twining R&D program for NER:**

    a. Both NER & Rest of India (RoI), Institutions scientists should work together for the objectives stated in the sanction of the project and any deviation from this would attract closure of the project at any point of time.

    b. In the project review meetings, both the PI's from NER & RoI Institutions should participate & make presentation.

    c. The outcomes of the project such as research papers, patents, copy rights etc. should be made jointly.

    d. The NER Scientists are to be trained at the collaborating institute appropriately to empower the NER Scientists.

    e. The project personal such as Research Associate, JRF/SRF, Research Assistant are also to be trained at least once in the collaborating national institute.

    f. The collaborating institute scientist should visit NER institutions more frequently to guide NER scientists in design and conduct of experiments.

Vaishali Panjabi

(Dr. Vaishali Panjabi)
Scientist 'C'

To,

The Pay & Accounts Officer,
Department of Biotechnology,
New Delhi- 110 003.

Copy to:

1. The Principal Director of Audit (Scientific Department), AGCR Building, New Delhi - 110 002.
2. Cash Section, DBT (For information only).
3. Sanction Folder.
4. IFD, DBT.
5. The Registrar, Tripura University, Suryamaninagar, Tripura-799022.
6. The Vice-Chancellor, Tripura University, Suryamaninagar, Tripura-799022.
7. Dr. Debasish Maiti, Associate Professor, Dept. of Human Physiology, Tripura University, Suryamaninagar, Tripura-799022.
8. Concern File.
9. The Managing Director, Biotech Consortium India Limited, (NER-BPMC), 5th Floor, Anuvart Bhawan, 210, Deen Dayal Upadhyay Marg, New Delhi- 110002.

Vaishali Panjabi

(Dr. Vaishali Panjabi)
Scientist 'C'

Sanctioned for 2014-15

BIOTECH CONSORTIUM INDIA LIMITED

BCIL

5th Floor, Anuvrat Bhawan, 210, Deen Dayal Upadhyaya Marg, New Delhi-110002
CIN: U73100DL1990PLC041486 **Tel :** 2321 9064 - 67 **Fax :** 011- 2321 9063
Email : info.bcil@nic.in, bcildelhi@vsnl.com **Website :** http://www.bcil.nic.in

BCIL/NER-BPMC/2015/

October 15, 2015

The Registrar,
Tripura University,
Suryamaninagar, Agartala-799022,
Tripura

Dear Sir/Madam,

Sub.: DBT's Sanction Order No. BT/526/NE/TBP/2013 dated October 14, 2015 for implementation of the project "Overcoming EGFR resistant Oral Squamous Cell Carcinomas with traditional healers of Tripura – A preclinical study" at your organization: Release of 2nd year grant

As you may be kindly aware, the Department of Biotechnology (DBT), Government of India, has setup a North Eastern Region-Biotechnology Programme Management Cell (NER-BPMC) for promotion of Biotechnology in the North Eastern Region of India through Biotech Consortium India Limited (BCIL), a company promoted by the Department of Biotechnology.

We are pleased to inform you that DBT has sanctioned 2nd year grant towards implementation of the above project at your organization. Please find enclosed herewith a copy of the Release Order No. BT/526/NE/TBP/2013 dated October 14, 2015.

Our Accounts Division has transferred an amount of Rs. 6.04 Lakhs as Second year release towards implementation of the above project at your organization as per the following bank details:

Fund Receiving Authority: Registrar, Tripura University
Account Holder Name: TU-EARMARKED FUND
Name of the Bank: State Bank of India, Tripura University Campus
Bank Account Number: 30371209938
IFSC Code: SBIN0010495

Kindly acknowledge the receipt.

Thanking you,

Yours faithfully

(Vinod Kumar)
Deputy Manager

CC for kind information to:

Dr. Utpal Chandra De
Assistant Professor,
Dept. of Chemistry,
Tripura University,
Suryamaninagar, Agartala-799022,
Tripura

DST/IS-STAC/CO_2-SR-230/14(G)-AICP-AFOLU-VII
Government of India/Bharat Sarkar
Ministry of Science and Technology
Department of Science and Technology

Technology Bhavan
New Mehrauli Road
New Delhi-110016
Date: 11.09.2015

Sub: Financial assistance for the project entitled "***Assessment of Carbon Stock and Carbon Sequestration Potential in Major Land Use Sectors of Tripura***" **to be implemented by** Department of Forestry & Biodiversity, Tripura University **(PI- Dr. Sourabh Deb)** – Approval of the proposal and release of grants for the first year

Sanction of the President is hereby accorded to the above mentioned project at a **total cost of ₹45,10,258/- (Rupees forty five lakhs ten thousand two hundred fifty eight)** only with a break-up of **₹6,13,838/-under capital head and ₹38,96,420/- under General head for a duration of three years.** The items of expenditure for total allocation of **₹45,10,258/-** has been approved for a period of three years, are given below:

Head	I Yr	II Yr	III Yr	Total
A. Recurring	₹	₹	₹	₹
Manpower 2 JRF @₹25000/month, 28000/month (3rd year) + HRA @10%, 1 FA @ 8000/month	7,56,000	7,56,000	8,35,200	23,47,200
Travel	1,25,000	1,50,000	1,20,000	3,95,000
Contingencies	1,00,000	1,00,000	1,00,000	3,00,000
Consumables	2,00,000	2,00,000	1,00,000	5,00,000
Subtotal:	**11,81,000**	**12,06,000**	**11,55,200**	**35,42,200**
B. **Non- Recurring**		--		
Computer(at 29/c)	50,000			50,000
Muffle Furnace (at 31/c)	86,000			86,000
Hot Air Oven (at 32/c)	79,000			79,000
Nitrogen Estimation System (at 33-38/c)	3,98,838			3,98,838
Subtotal:	**6,13,838**	---	----	**6,13,838**
OH charges @ 10 %	**1,18,100**	**1,20,600**	**1,15,520**	**3,54,220**
Grand Total:	**19,12,938**	**13,26,600**	**12,70,720**	**45,10,258**

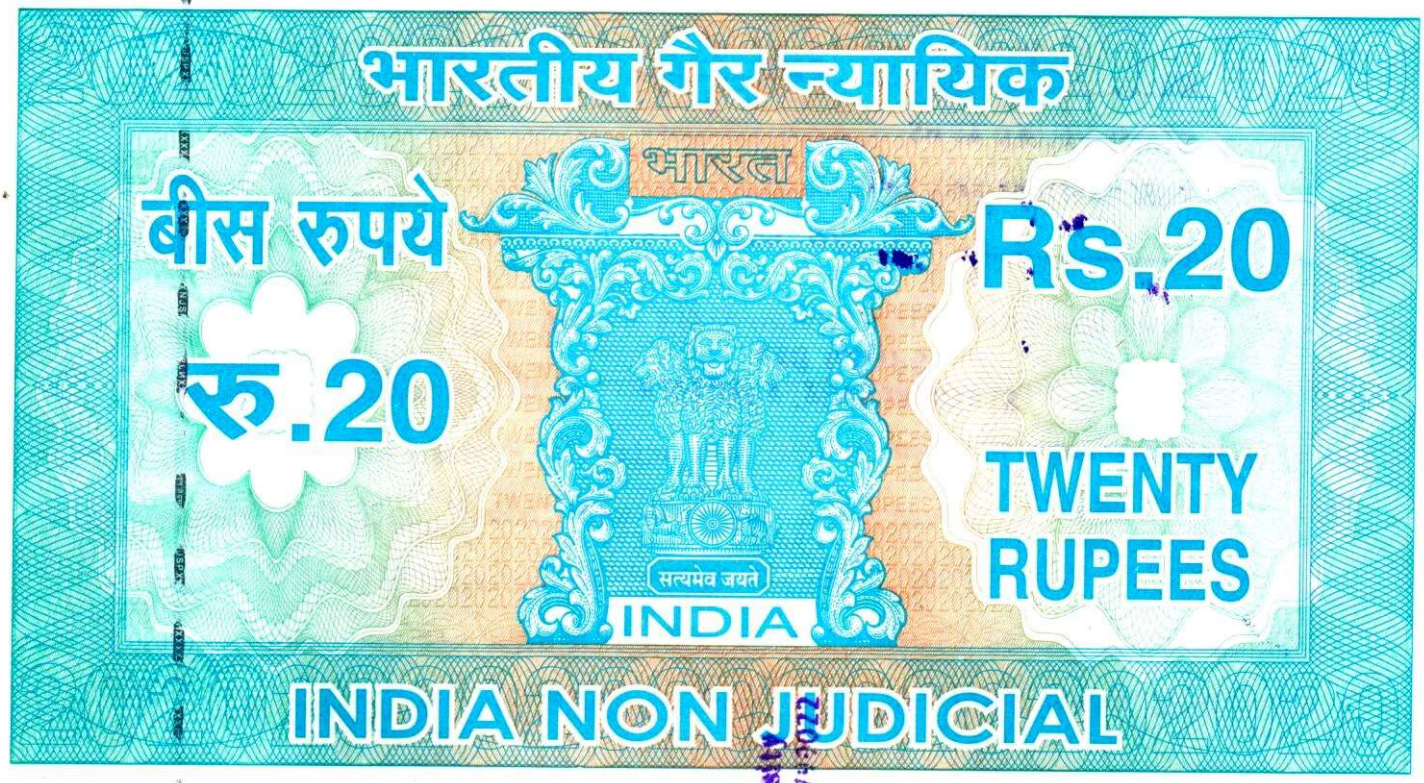
Total Project Cost: **₹ 45,10,258/-**

2. Overhead expense is meant for the host institute towards the cost for providing infrastructural facilities and benefits to the staff employed in the project.

3. Sanction of the President is also accorded for the payment of **₹6,13,838/- under 'Grants for creation of capital assets' and ₹12,99,100/- only under 'Grants-in-aid General to Registrar, Tripura University, Suryamaninagar – 799022, Agartala, Tripura** being the first installment of the grant for the year 2015-16 for implementation of the said research project.

4. This grant is subjected to the terms and conditions as detailed in Annexure-I (enclosed) and also can be downloaded from the website www.serc-dst.org.

5. The amount of ₹12,99,100/- (Rupees twelve lakhs ninety nine thousand one hundred) only under 'Grants-in-aid General' will be drawn by the Drawing & Disbursing Officer (DDO), DST and will be disbursed to the Registrar, Tripura Universityby means of RTGS as per bank details given below:



त्रिपुरा त्रिपुरा TRIPURA

00AA 529122

3/11/14

Registrar,
Tripura University
Suryamaninagar-799022

MEMORANDUM OF UNDERSTANDING

This MEMORANDUM OF UNDERSTANDING is made on the **Third day of November, 2014** at Agartala

between

TRIPURA UNIVERSITY (a Central University) having office address at- P.O. Suryamaninagar, PIN-799022, P.S.- Amtali, District- West Tripura, State- Tripura; established under the Tripura University Act, 2006 being authorised and represented presently by it's Joint Registrar (Registrar In-Charge) **Dr. Kalyan Bijoy Jamatia**, an Indian Citizen.

....hereinafter referred to as 'Tripura University' or 'the University', which expression, unless repugnant to the context or meaning thereof includes its successors in business and permitted assignees) as party of the FIRST PART.

Society for Applied Microwave Electronics Engineering and Research, an autonomous society under the Ministry of Communication and Information Technology, Government of India, and having its office adddress at: I.I.T. Campus, Hill Side, Powai, Post Box No: 8448 Mumbai, Maharashtra, India Pincode – 400076; represented through it's Head, Industrial & Meteorological Systems Division, **Mr. Anil A. Kulkarni,** (Scientist-F), as authorised signatory for and on behalf of **"Society for Applied Microwave Electronics Engineering and Research"**;

.....(herein referred to as the SAMEER) which expression shall unless repugnant to the context or meaning thereof, be deemed to mean and include its representatives, administrators, successors, permitted assignees, and executors of the SECOND PART.

Whereas the Department of Physics of Tripura University and SAMEER propose to work together on ***"Installation of indigenously developed Lightning Detection Network in North-East India & development of Lightning Location Algorithm"***, hereinafter referred to as **collaborative work, funded by Department of Electronics and Information Technology Government of India, under the North East Initiative.**

AND WHEREAS Tripura University is interested in developing and using ***Lightning Detection Network system*** for research purpose and SAMEER having the expertise in the development of Atmospheric Instrumentation would primarily develop the ***Lightning Detection Nodes***.

AND WHEREAS, the Memorandum of Understanding (MOU) defines the role and responsibilities of the participating institutes, monitoring and other matters related to the collaborative work.

The parties herein agree to the following:-

1.0 ROLE OF SAMEER

SAMEER, Mumbai Shall:

1. Design and develop Lightning Detection Network for research purpose.
2. To carry out the developmental work in close collaboration with Tripura University.

National Institute of Technology Agartala
राष्ट्रीय प्रौद्योगिकी संस्थान अगरतला
Jirania, West Tripura, 799046, India
Website: www.nita.ac.in
Government of India

Dr. Biswajit Saha
Assistant Professor
Department of Physics
Email: biswajit.physics@gmail.com
Mobile: +919436569904

Dated: 25th January 2021

Collaborative Research works

On the basis of joint agreement, with Professor R. K. Nath, Department of Chemistry, Tripura University, collaborative research works are being conducted science 2015.

The research fields of common interest like conductive polymer, their synthesis, functionalization and application as electronic material and in water treatment have been considered for collaborative work.

Joint Ph.D. guidance has also been a part of this collaboration and one Ph.D. candidate has been awarded his doctorate degree on 2020.

A number of research articles in International SCI journals have been published under this collaborative work as on date.

Based on the success and meaningful research outcome under this collaboration, I would like to continue this collaboration in future.

25/01/2021

(Dr. Biswajit Saha)
Assistant Professor
Department of Physics

Dr. Biswajit Saha
Asst. Professor in Physics
National Institute of Technology
Agartala Govt. of India

Society For Biomaterials

Comparative analysis of photocaged RGDS peptides for cell patterning

Catherine A. Goubko,[1] Ajoy Basak,[2] Swapan Majumdar,[2] Harold Jarrell,[3] Nam Huan Khieu,[3] Xudong Cao[1,4]

[1]Department of Chemical and Biological Engineering, University of Ottawa, Ottawa, Ontario K1N 6N5, Canada
[2]Ottawa Hospital Research Institute, Chronic Disease Program, The Ottawa Hospital, University of Ottawa, Ottawa, Ontario K1Y 4Y9, Canada
[3]Institute for Biological Sciences, National Research Council Canada, Ottawa, Ontario K1A 0R6, Canada
[4]Ottawa-Carleton Institute for Biomedical Engineering, University of Ottawa, Ottawa, Ontario K1N 6N5, Canada

Received 3 May 2012; accepted 18 June 2012
Published online 8 September 2012 in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/jbm.a.34381

Abstract: Photocaged RGDS is a cell nonadhesive tetrapeptide that can be activated with light to become cell-adhesive. Such molecules can find useful applications in controlling cell adhesion for biological study, drug development, and in forming dynamic, adhesion-controlled biomaterials. Herein, we prepared RGDS peptide photocaged either on the Arg-Gly backbone amide nitrogen atom (R[−]GDS) or Asp side chain carboxyl (RG[D]S). A critical comparison of the peptides' chemical and physiological properties relevant for biological applications was carried out. It was observed that RG[D]S was synthesized more readily via automated solid-phase synthesis, underwent uncaging with a rate constant 3-fold higher than R[−]GDS, and was more stable in aqueous solution. Automated docking studies were performed to examine the interactions of various caged RGDS peptides with cell surface integrin receptor to identify suitable locations for the photosensitive 2-nitrobenzyl (NB) group for biological applications. A competitive binding ELISA method compared the ability of various peptides to bind to $\alpha_V\beta_3$ cell integrin receptors and the data were found to be consistent with the modeling predictions. Finally, the application of our caged RGDS peptides in controlling cell adhesion to form cell patterns on a hydrogel material was presented. © 2012 Wiley Periodicals, Inc. J Biomed Mater Res Part A: 101A: 787–796, 2013.

Key Words: RGDS peptide, 2-nitrobenzyl photocage, photochemistry, docking, cell patterning

How to cite this article: Goubko CA, Basak A, Majumdar S, Jarrell H, Khieu NH, Cao X. 2013. Comparative analysis of photocaged RGDS peptides for cell patterning. J Biomed Mater Res Part A 2013:101A:787–796.

INTRODUCTION

Photocaged peptides incorporated into biocompatible materials create an exciting design opportunity toward the formation of photoresponsive biomaterials. Caging allows for the regulation of peptide bioactivity and associated cell signaling pathways with light.[1] It involves attaching a photoactive protecting group onto a key amino acid residue essential for bioactivity to essentially deactivate the peptide. Reactivation occurs upon irradiation with light which breaks the bond between the photosensitive group and the original peptide.[2] By merely shining light onto the peptide of interest, one can potentially switch it from an inactive to an active state. In this way, light can be used to control the activity of biomolecules temporally and spatially within a material to create a dynamic microenvironment for biological applications.

Despite showing great promise, this technique faces several challenges. One of which is finding an effective location for the photocaging group which must be predicted prior to synthesis.[3] Finding a location which effectively disrupts the interaction between biomolecule and target can prove challenging.[4] In fact, it is often necessary to prepare a variety of peptides caged on different locations within the peptide chain and compare the efficacy of each which can be time consuming and costly.[5,6] In the present work, synthesis was combined with automated molecular docking studies which were found to be useful to identify effective caging locations.

We are particularly interested in caging the RGD peptide sequence which binds with the cell surface integrin receptor. Since the identification of RGD in 1980s and its role in enhancing cell adhesion, this small peptide sequence has played an enormous role in the development of new biomaterials.[7] The ability to cage RGD peptides to render them physiologically inactive until exposure with near-UV light leads to a number of exciting applications. Others have

Additional Supporting Information may be found in the online version of this article.
No benefit of any kind will be received either directly or indirectly by the author(s)
Correspondence to: X. Cao; e-mail: xcao@eng.uottawa.ca
Contract grant sponsors: NSERC Discovery Grant, Heart & Stroke Foundation, and CIHR-HOPE fellowship grant

Research and Reports in Medicinal Chemistry

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Open Access Full Text Article

ORIGINAL RESEARCH

Identification of potent histone deacetylase 8 inhibitors using pharmacophore-based virtual screening, three-dimensional quantitative structure–activity relationship, and docking study

Tanusree Debnath[1]
Swapan Majumdar[2]
Kalle M Arunasree[3]
Vema Aparna[4]
Sudhan Debnath[1]

[1]Department of Chemistry, MBB College, Agartala, Tripura, [2]Department of Chemistry, Tripura University, Suryamanninagar, Agartala, Tripura, [3]University of Hyderabad Gachibowli, Hyderabad, [4]Sree Chaitanya Institute of Pharmaceutical Sciences, Karimnagar, India

Correspondence: Sudhan Debnath
Department of Chemistry, MBB College, Agartala, Tripura (W), India 799004
Tel +91 94 3651 8210
Email bcsdebnath@gmail.com

Abstract: In recent years, histone deacetylases (HDACs) have been considered one of the promising targets for cancer chemotherapy. In the present study, a six-featured pharmacophore model with two hydrogen bond acceptors (AA), two hydrogen bond donors (DD), and two aromatic rings (RR) was developed. A predictive three-dimensional quantitative structure–activity relationship model was generated using the pharmacophore models obtained. The model has an excellent correlation coefficient and good predictive ability, as shown by the significant statistical parameters for both the training set (R^2=0.9565, standard deviation =0.1171, F=99, and number of ligands in training set =21) and test set (Q^2=0.8468, Pearson's R=0.9363, number of ligands in test set =9) molecules. The pharmacophore model was employed for the virtual screening of molecules with HDAC8 activity. The screening resulted in 366 hits with predicted activity as HDAC8 inhibitors. The hits obtained from the virtual screening were subjected to a molecular docking study to identify the potent inhibitors that binds to the active site with high affinity. The molecular docking study of known inhibitors and their analysis showed that the crucial interacting amino acid residues of HDAC8 are TYR-306, HIS-142, PHE-152, TYR-100, HIE-180, PHE-207, and Zn-388. On the basis of fitness score, predicted activities, XP Glide score, ADME results, and interacting amino acid residues, ten structurally diverse hits were reported in this paper as HDAC8 inhibitors.

Keywords: pharmacophore, atom-based 3D QSAR, virtual screening, docking, ADME, HDAC8 inhibitors

Introduction

Histone deacetylases (HDACs) play an important role in the regulation of histone and nonhistone proteins; hence, they are considered to be crucial in many biological processes, such as the regulation of gene expression, the regulation of transcription,[1] cell cycle progression, and cell survival.[2,3] Deacetylation of histones is connected with transcriptional repression, together with a reduction in the expression of tumor suppressor genes.[4] Due to their role in various biological functions, HDAC inhibition has become a promising epigenetic target for the treatment of cancer.[5] HDAC inhibitors (HDACis) are structurally diverse and are classified into various groups as hydroximates,[6–8] cyclic tetrapeptides,[9] benzamides,[10,11] electrophilic ketones,[12] and carboxylic acids.[13] Two HDACis (vorinostat and romidepsin) have been approved by the United States Food and Drug Administration for the treatment of cutaneous T-cell lymphoma.[14] However, treatment with HDACis has demonstrated narrow clinical benefit for patients with

RSC Advances

COMMUNICATION

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DOI: 10.1039/c4ra13419b

www.rsc.org/advances

A protic ionic liquid catalyzed strategy for selective hydrolytic cleavage of *tert*-butyloxycarbonyl amine (*N*-Boc)†

Swapan Majumdar,*[a] Jhinuk De,[a] Ankita Chakraborty,[a] Dipanwita Roy[b] and Dilip K. Maiti[b]

A simple, mild and efficient strategy for selective hydrolytic cleavage of the *N*-*tert*-butyloxycarbonyl (Boc) group is devised using a protic ionic liquid as an efficient catalyst. The deprotection reaction proceeded well for *N*-Boc protected aromatic, heteroaromatic, aliphatic compounds, and chiral amino acid esters and peptides. A wide range of labile protecting groups such as *tert*-butyl ester, *tert*-butyl ether, benzyloxycarbonyl (Cbz), TBDMS, *O*-Boc and *S*-Boc remained unaffected under the reaction conditions.

Due to environmental and economic issues as well as legislation, chemistry is driven to reduce waste, and reuse and recycle materials in order to meet the principles of green chemistry.[1] Thus the development of an environmentally benign, efficient and simple methodology for a fundamental organic transformation is in great demand. The protection and deprotection of functional groups is a common feature to synthesize multifunctionalized molecules in target oriented syntheses.[2] The choice of a suitable protecting group is often crucial in the context of simplifying the procedure, achieving the highest yield of the desired product, easy workup and separation. The protection of amines plays pivotal role in the synthetic organic chemistry. For instance, the *N*-Boc group is extensively used as a protecting group of amines in organic synthesis and amino acids in peptide and nucleoside chemistry. Consequently, a number of methods were developed for cleavage of the *N*-Boc group using strong acids,[3] Lewis acids[4] and microwave assisted neutral conditions[5] to liberate the parent amine. In some cases, basic conditions[6] such as aq. Na_2CO_3, Cs_2CO_3–imidazole and NaO^{t}Bu have been employed. The heterogeneous catalysis promoted *N*-Boc deprotection using sulfonic acid resin,[7a] montmorillonite K10,[7b] silica,[7c] heteropolyacids,[7d] HY-zeolite[7e] are also reported. However, most of the reported strategies suffer from serious drawbacks such as (i) longer reaction time, (ii) high temperature, (iii) low yield of products and (iv) exploiting expensive catalysts. Moreover, preparations of some of the catalysts are very tedious. Thus, organic synthesis professionals of industries and academia seek simple, efficient and milder methods for deprotection of this most frequently used protecting group, which should be selective enough for preserving the other functionalities in the molecule. G. Wang *et al.* (2009) reported[8] a special and efficient "green", catalyst-free, *N*-Boc deprotection in supercritical water under pressure. In their methodology, both aromatic and aliphatic *N*-Boc amines can be converted into the corresponding amines in high yields within 2–16 h, using distilled and deionized water (20 mL mmol^{-1}) at 150 °C. J. Wang and his colleagues (2009) described[9] a selective *N*-Boc deprotection method using boiling water as a reaction medium. In spite of the potentiality of these green methods, their major limitation is the use of sophisticated and costly technology, incompatibility of the deprotection reaction with ester functionality and longer reaction time. As an inexpensive and readily available reagent, imidazolium based protic ionic liquid has attracted considerable interest due to its less hazardous nature and efficiency in various organic transformations.[10] We have reported earlier an efficient method[11a] for the *tert*-butyloxycarbonylation of amines, amino acids/esters, alcohols and a green strategy for the selective hydrolytic cleavage of acetals and ketals[11b] using protic ionic liquid as an effective catalyst. In this communication, we disclose the efficacy of a protic ionic liquid as a catalyst for the selective deprotection of *N*-Boc group of a wide range of achiral and chiral compounds.

In our initial experiments we choose readily available *N*-Boc aniline as a model substrate and, the results for development and optimization of the deprotection studies is displayed in Table 1. On treatment of the *N*-Boc aniline (1 mmol) with 1 mmol of Bronsted acid ionic liquid (**I** or **II**) in water–dioxane (1 : 1) at 30 °C, the deprotection did not take place (Table 1, entry 1). However on rising the temperature to 70–72 °C

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Key Points:
- The electricity parameters have discrepancy with the expected global diurnal pattern
- There are three dominant diurnal patterns during the fair-weather days
- The katabatic winds influence the of fair-weather electrical parameters

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Anomalous diurnal variation of atmospheric potential gradient and air-Earth current density observed at Maitri, Antarctica

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Abstract The scope of this paper is to explore the mechanisms operating over Maitri (70.76°S, 11.74°E, 117 m above mean sea level), a coastal Antarctic station, that produce an anomalous fair-weather diurnal pattern of the atmospheric electric potential gradient (PG) and air-Earth current density (AEC). The anomaly in the diurnal variations of AEC and the PG is displaying an ostensible minimum at ~10 UT and a diminished response to the thunderstorm over the African continent in the 14–16 UT time frame. The data sets (2005–2014, except 2012) of the PG, and to some extent, AEC, from Maitri, are used to explore this anomaly. It follows that the fair-weather electrical phenomena over Maitri can be ascribed to global electrified convection on the one hand and to regional phenomena like convection due to the replacement of warm air by katabatic winds on the other hand. The katabatic winds originate on the polar plateau and blow from ~130° at Maitri which are likely to transport various elements from the mountain slopes, and space charge from the polar plateau is expected to produce various disturbances in the PG and AEC monitored over the coastal Antarctica. This mechanism may be responsible for peaks in the early UT hours and also for the anomalous behavior of atmospheric electrical parameters observed at Maitri. Maitri data are compared with that of Carnegie cruise and Vostok to explain the source of anomaly.

1. Introduction

Monitoring of the global atmospheric electric circuit parameters is emerging as a useful tool in the study of climate changes because of its direct connection with lightning activity. They are directly related to the global electrified convection and therefore act as proxy variables for the mean global surface temperature [*Markson*, 1986; *Markson and Price*, 1999; *Williams*, 1992, 2005; *Price*, 1993]. It is also considered to be an important study to understand the relationship changes in the global circuit and space weather [*Rycroft et al.*, 2000, 2012]. The atmospheric electricity data, for such a study, should not be contaminated by any local anthropogenic and meteorological disturbances. Monitoring the atmospheric electricity parameters over the ocean, the data obtained during the 1915–1928 Carnegie Expedition [*Whipple and Scrase*, 1936] were found to be stable and systematic probably because there was no contamination from meteorological disturbances and radioactivity sources that were typical over the continental stations. Furthermore, aerosol concentrations over the oceans are markedly more dilute in comparison to the situation over land. In addition, it was believed that the fair-weather global signatures of the electrical parameters could be monitored from the remote continent, Antarctica, for the following reasons [*Cobb*, 1977]: (1) anthropogenic influences are nearly absent; (2) the surface of Antarctica is expected to be smoother than the typical continental surface, and as a result the air turbulence is negligible; and (3) the absence of radioactive soil. *Deshpande and Kamra*, [2001] cited three additional points. They are the following: (1) the weather remains clear for 70% of the time; (2) high surface winds which generally prevail over the continent generate mechanical turbulence by friction with the rough bare ground that is almost nonexistent or very much less intense; and (3) deep temperature inversions suppress the local atmospheric convection. Being an area of large-scale subsidence, the convective turbulence is very small.

Given these prevalent conditions over Antarctica, measurements from Amundsen and Scott (South Pole station) and Vostok (the interior continental stations over the Antarctic Plateau) proved to be suitable