NATIONAL ACADEMY OF BIOLOGICAL SCIENCES
NABS
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NABS News Letter

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Contents

From the Desk of the President.....

Dear NABSians,

Greetings

At the outset, I wish all the members a "Happy and Prosperous New Year 2013". With active participation of every member, I strongly believe, we can take NABS to greater heights and serve the cause of humanity through the contributions of young biologists which was the dream of our founder President, Prof. S. Kannaiyan.

I am happy to share with you that young biologists of the country are keen to patronize NABS and are enrolling themselves as life members; the membership during 2012 has crossed 60, putting the total membership to 505. Further, recent meeting of 12th Executive Council of NABS decided to organize the 7th Annual Meeting coupled with a National Seminar on "Microbes and Human Welfare" in collaboration with Department of Microbiology, Bharathidasan University, Tiruchirappalli, Tamil Nadu during July, 2013. The interest and enthusiasm shown by students and young biologists to participate and interact in earlier Interactive Workshops organized by NABS motivated us to organize a national level seminar, which I strongly believe will attract more participation. I also take this opportunity to thank Bharathidasan University for its willingness to collaborate in organizing the seminar.

I am also delighted that the EC has decided to confer Prof. S. Kannaiyan Memorial Award for the year 2013 on Dr. Kirti Singh, Chairperson, World Noni Research Foundation, a renowned horticulturist who contributed to research, development and horticultural education in the country.

I reiterate my request to all the members of NABS to actively participate in all the activities of NABS and to contribute towards the Corpus Fund of Prof. S. Kannaiyan Memorial Award in the years to come as only 50 out of 505 members have so far contributed to this cause.

(V. A. Parthasarathy)

2. From the Editor's Desk….

Firstly, let me take this opportunity to wish all the NABSians a HAPPY NEW YEAR. Like 2012, the New Year appears to be a busy year for the Academy. However, when we enter the New Year, it is imperative that we look back and assess whether the targets we set in the last year were met. I am glad to say that the Academy under the tutelage of the new President Dr V A Parthasarathy and the effervescent Secretary, Professor T. Marimuthu performed better than we actually thought possible. Though we are a fledgling Academy, we are growing fast and our roots are becoming stronger. In fact, the growing membership suggests that the Academy is poised for a big leap in the years to come. What is unique is that we draw members from all sciences adding a multi-disciplinary aura to the Academy. This means that we can collaborate and integrate across disciplines, across traditional boundaries and bring together and sharpen our skills to sustain the research agenda we wish to work on. This was the dream of our founder President, Prof. S. Kannaiyan and we intend to carry on the good work. At this moment, on behalf of all NABSians I would like to pay our tribute to his farsightedness.

The feel good factor is that NABS is slowly but steadily evolving into a major platform that would serve as a take-off point for constructive deliberations, to put thoughts-in-progress that might be useful to other scientists, and to find thoughts-in-progress of others that might be useful to us. What is imperative is that we prepare a road map that is unshakable and creates awareness on technologies that are state of the art and at the same time are simpler, sustainable and user friendly. I sincerely look forward to seeing what new understandings and thoughts we will generate together to enhance our position as the leading Academy that systematically addresses the myriad problems and complex issues in biological sciences using evidence-based approaches. Apparently the challenges are many. However, the coming together of large number of institutes and scientists under NABS means that the challenges can be confronted with collective resolve.

We do sincerely hope that the newsletter brings with it enough food for thought and the section on research highlights kindles the young minds and stimulates the intellectual mind. Our thanks are due to the Secretary, NABS for coming out with this novel idea.

Let us look forward to the New Year with lot of anticipation.

3. About National Seminar

NABS is organizing Interactive Workshop series since 2008 every year combining with the Annual Meeting of NABS. The 6th such series will be organized as a National Seminar for two days on "Microbes and Human Welfare" in collaboration with the Department of Microbiology, Bharathidasan University, Tiruchirappalli, Tamil Nadu on 20-21 July, 2013 at the main campus of the University. Dr. N. Thajuddin, EC member and Head i/c of Department of Microbiology will coordinate in organizing the event.

Prof. S. Kannaiyan Memorial Award for 2013 will be conferred on Dr. Kirti Singh during the inaugural function of the seminar. The conferment of Fellowship / Associate Fellowship, NABS-Best Woman Scientist Award, NABS- Best Research Paper Award will be conferred on the second day of the seminar during the Annual Meeting of NABS.

4. Awards and Recognition received by members of NABS

Congratulations to all the members who received awards and recognition from various institutions and organizations.

Name of Member	Name of Award /Recognition received
Anandaraj, M.	▪ Chairman, R& D Committee of International Pepper Community, Jakarta ▪ President (Elect), Indian Phytopathological Society -2013 ▪ President, Indian Society for Plantation Crops, Kasaragod (2013-14) ▪ Councillor, International Society for Plant Pathology, St Paul, Minnesota, USA
Balikai, R.A.	▪ Fellow of Royal Entomological Society of London- 2012
Ghousia Begum	▪ Scientist of the Year Award -2012 by National Environmental Science Academy
Guruvayoorappan, C	▪ UGC Research Award - 2012 by University Grant's commission
Janardhana, G. R.	▪ MIF Research Award by Matsumae International Foundation (MIF), Tokyo, Japan (2011-12)
Krish Jayachandran	▪ Excellence in Teaching (2012) ▪ President's Access and Equity (2012) ▪ Agroecology Program Excellence-2011- All the three by Florida International University , Miami, Florida
Lohithaswa, H.C	▪ Natasarvabhouma Dr. Rajkumar Sanmana Samithi Award 2011 -12 (2012) by University of Agricultural Sciences, Bangalore
Mahadevappa, M.	▪ Innovative BOOK AWARD - Sri M. G. Ranganathan Memorial Award

Muralitharan, G.	▪ BOYSCAST Fellowship by DST, India (2011-2012)
Nagaraja Reddy, N.	▪ Jawaharlal Nehru Award for Outstanding Doctoral Thesis Research in Agricultural and Allied Sciences by Indian Council of agricultural research (ICAR), New Delhi
Pandiyan, M.	▪ Recognition award for TNAU blackgram VBN6 variety -2011 by Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.
Paroda, R. S.	▪ First Dr. A.B. Joshi Memorial Award by Indian Agricultural Research Institute, Pusa Campus, New Delhi (2012) ▪ Prof. Kanniyan Memorial Award by National Academy of Biological Sciences, Chennai (2012) ▪ Medal for the Cause of Agriculture and Rural Development of Vietnam by Government of Vietnam (2012) ▪ D. Sc (Honoris Causa) by Punjab Agricultural University, Ludhiana (2012)
Prakashkumar, R.	▪ Fellow of the Linnean Society of London (FLS) by Linnean Society of London (2011)
Pramod W Ramteke	▪ Fellow of Maharashtra Academy of Sciences
Raaman, N.	▪ Mother Teresa Excellence Award by Integrated Council for Socio-Economic Progress, Thrissur, Kerala (2012) ▪ Academic Achievement Award by University of Madras (2012)
Rangan, Latha	▪ Prof Hira Lal Chakravarty Award by Indian Science Congress Association (ISCA), Kolkata, India (2012) ▪ Young Scientist Award by Indian Society for Chemists and Biologists (ISCB) Lucknow (2012)
Renu Agrawal,	▪ Fellow of Association of Microbiologists of India by Association of Microbiologists of India (2012)
Sajeena, A.	▪ Best Oral Presentation Award for the paper "Development of a commercial antifungal and antiviral formulation from the medicinal mushroom, *Ganoderma* sp." Presented at "National Symposium on Recent Advances in Bioinoculants Technology" March 1-2, 2012, Agricultural College & Research Institute, Madurai (TNAU)
Sardar, K.K.	▪ Member, National Academy of Sciences, India by National Academy of Sciences, India.

Selvam, P.	▪ International Travel Award by CSIR, New Delhi (2011-12) ▪ Best oral presentation Award for the paper "Studies on HIV IN/LEDGF inhibitory activity on Morinda citrifolia L Noni" presented during National Symposium on Noni- A Tool for Wellness, October, 2012, at Chennai, Tamil Nadu by World Noni Research Foundation, Chennai
Sivakumar, G	▪ Fellow of Society of Applied Biotechnology (SAB)-2012
Sudisha Jogaiah	▪ International Award for Young Agricultural Researcher – 2012 by Govt. of Japan

Note: Full address of members is available in website of NABS [www.nabsindia.org]

5. Research notes and short communications

i. Soil fertility analogues as a Decision Support Tool for fertilizer recommendation in Citrus

The cursory analysis on growth of citrus industry in India reveals that the average citrus productivity has been centring around 9 – 10 tons ha^{-1}. Many attempts were made in the past to overtake this stagnation in productivity. Despite so many efforts, we have failed to break this yield barrier through age old conventional practices of nutrient management. Citrus is an highly nutrient responsive crop and productivity has been suffering on account of multiple nutrient deficiencies, which take up a still alarming dimension when fertilizer application is practiced without taking into consideration the spatial variability in soil fertility. Any attempt to rationalise the fertilizer use and improve fertilizer efficacy in citrus orchard will surely be associated with consequent enhancement in production provided all other factors are optimum. Limited attempts in the past have been made in perennial crop like citrus, which needs to be managed through precision based technologies. The development of decision support tool based on soil fertility variation is one such viable option to address the nutrient mining and fluctuating yield levels. The utility of precision tool like GIS technology in mapping the fertility status of soil has undoubtedly provided the desired accuracy and effectiveness in fertilizer recommendations.

The rhizosphere (0-20 cm) oriented soil samples through four grid sizes (10 x 10 m, 20 x 20 m, 40 x 40 m and 60 x 60 m) were collected using GPS-based tracking system at the orchards of Umsaitining Ribhoi district of Meghalaya. These samples were drawn after application of

farmyard manure based on production zones. The fruit yield varied as 21.2-142.3 kg tree^{-1}, 16.4-151.4 kg tree^{-1}, 15.2 – 148.2 kg tree^{-1} and 18.2 – 112.4 kg tree^{-1} under different grid sizes of 10 x 10 m, 20 x 20 m, 40 x 40 m and 60 x 60 m, respectively, with corresponding soil pH of 3.2 – 6.8, 3.4 – 6.2, 3.3 – 6.2 and 3.4 – 6.0 (not much variation). Organic carbon on the other hand displayed a variation of 1.17 – 3.10 g kg^{-1}, 1.11 – 2.82 g kg^{-1}, 1.12 – 3.12 g kg^{-1} and 1.32 – 2.92 g kg^{-1} at respective grid size of 10 x 10 m, 20 x 20 m, 40 x 40 m and 60 x 60 m. $KMNO_4$- N showed variation of 142.8 – 168.4 mg kg^{-1}, 148.4 – 172.2 mg kg^{-1}, 141.2 – 162.4 mg kg^{-1}, and 132.1 – 151.2 mg kg^{-1} at grid sizes of 10 x 10 m, 20 x 20 m, 40 x 40 m and 60 x 60 m, respectively, having corresponding variation in Olsen-P as 6.8 – 9.8 mg kg^{-1},6.7 – 10.1 mg kg^{-1}, 6.4 – 9.8 mg kg^{-1}, and 5.2 – 8.2 mg kg^{-1}. NH_4OAc-K compared to base soil test values (before FYM application) maintained comparatively higher test values, recording variation of 138.1 – 561.2 mg kg^{-1}, 140.0 – 572.3 mg kg^{-1}, 138.1 – 561.7 mg kg^{-1} and 150.9 – 382.3 mg kg^{-1} at grid sizes of 10 x 10 m, 20 x 20 m, 40 x 40 m and 60 x 60 m, respectively.

All the four principal micronutrients (Fe, Mn, Cu and Zn) registered an increase in soil test values over pre-manuring stage. DTPA-Fe recorded a variation of 21.4-152.2 mg kg^{-1}, 22.1-146.4 mg kg^{-1}, 23.3-148.6 mg kg^{-1} and 36.2-172.3 mg kg^{-1}, respectively, at grid size of 10 x 10 m, 20 x 20 m, 40 x 40 m and 60 x 60 m with corresponding values of DTPA-Mn 2.1-184.3 mg kg^{-1}, 2.3-190.2 mg kg^{-1}, 2.4-198.2 mg kg^{-1} and 3.1-201.2 mg kg^{-1}. The variation in DTPA-Cu was similarly observed as 0.81-4.82 mg kg^{-1}, 0.86-4.94 mg kg^{-1}, 0.96-4.62 mg kg^{-1}, and 0.96-2.10 mg kg^{-1}, across 4 grid sizes of 10 x 10m, 20 x 20 m, 40 x 40 m and 60 x 60 m, respectively, with DTPA-Zn as 0.26-5.82 mg kg^{-1}, 0.31-5.72 mg kg^{-1}, 0.33-5.12 mg kg^{-1} and 0.28-3.81 mg kg^{-1}. The spatial variograms of these parameters based on data generated through soil tests under different grid sizes were developed using geographical information system (GIS) and interpreted for working out the optimum grid size for soil fertility evaluation in Khasi mandarin. The spatial variogram suggested the optimum grid size for precise soil testing is 40 m x 40 m under hilly terrain of northeast India. Further interpretation is in progress.

A Nagpur mandarin orchard at Ladgaon (Katol) area of Nagpur district in Maharashtra was identified. A total of 56 soil samples in grid sizes of 20 x 20 m, 40 x 40 m and 60 x 60 m grid were collected and subjected to analysis of available nutrients. Irrespective of grid size, the

spatial variation in different nutrients was observed as available N 96.2 – 130.7 mg kg^{-1}, available P 7.8 – 16.9 mg kg^{-1}, available K 104.2 – 201.4 mg kg^{-1}, available Fe 6.4 – 16.2 mg kg^{-1}, available Mn 4.2 – 11.4 mg kg^{-1}, available Cu 0.38 – 0.86 mg $kg^{-1}$and available Zn 0.45 – 1.14 mg kg^{-1}in relation to fruit yield of 10.4 – 79.2 kg $tree^{-1}$. In the light of these soil fertility variations using GIS, there is a strong possibility of establishing a databank of millions of alternatives of soil fertility analogues in relation to fruit yield. The soil test value at given site can be effectively blasted (what is done in case plant genomics to match the genome with global genomic library) with these analogues to quantify the level to which different soil test values need to be elevated in order to accomplish the targeted fruit yield and consequently, the amount of fertilizers to be applied. Such novel possibilities lies in an entirely new field called nutriomics, although right now, this concept is in a nascent stage.

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ii. Production and characterization of cellulose from *Gluconacetobacter xylinum*

An advanced type of purple bacterium *viz*. the vinegar bacterium, *Gluconacetobacter xylinus* (Syn. *Acetobacter xylinum)* is a rich source of "Eco-friendly" pure cellulose. It is an aerobic, Gram negative, non-photosynthetic organism that can utilize glucose, sugar, glycerol or other organic substrates and secretes an extracellular product, cellulose which is spun like a membrane. This cellulose has high mechanical strength, high water absorption capacity, high crystallinity, ultra-fine and highly pure fibre network structure which is more important for the production of good quality archival and currency papers, adhesives, food thickeners, stabilizers, wound care products, immobilization materials, water purifying membranes and acoustic diaphragms *etc*., Bacterial cellulose produced by *A. xylinum* at the air-liquid interface of mature coconut water (coconut liquid endosperm) is popularly known as Nata-de-coco. It is a traditional and popular dessert food in oriental countries.

In the present investigation an attempt was made to isolate cellulose producing *A. xylinum* from different sugary rich fruits and juices. About 43 cellulose producing isolates were obtained. They were biochemically and phenotypically characterized. The best isolate was screened and selected based on the thickness of the cellulose pellicle formed on the Hestrin and Schramn medium. Of

all the isolates, sugarcane juice isolate yielded cellulose of 13 mm thickness with weight of 14.14 g/L. The cellulose formed was purified by alkali treatment using 0.1 % NaOH. The moisture content and water holding capacity was recorded as 92.27% and 84.44%. The tensile strength and Young's Modulus was recorded as 120 MPa and 4.9 GPa. The purified cellulose was characterized by scanning electron microscope and Fourier Transforming Infra Red Spectrophotometer. A strong absorption peak at 1644 cm^{-1} and 1428 cm^{-1} confirmed the presence of carboxylic acid group and carbonyl group in bacterial cellulose. The band at 1163 cm^{-1} and 1068 cm^{-1} showed the possibilities of C-O-C functionalities and presence of more quantities of cellulose type Iα. The thickness of the fibrils was from 128 nm to 207 nm at 8000 X magnification. The fibrils were tightly packed and conferred morphological features similar to that of pure microcrystalline cellulose.

The wet form of bacterial cellulose can be converted into a value added juicy food product called as nata. This can be popularized in our country also. Further the product owing to its high water holding capacity and mechanical strength can be exploited for the production of absorbent pads and hydrogels in agriculture.

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iii. A fast and versatile molecular tool for detection and quantification of phytoplasma in root (wilt) affected coconut palms

The root (wilt) disease of coconut is caused by phytoplasma and it is currently threatening the coconut plantations in South India. The disease was first recorded during 1882 in Kerala (India), now it is fast spreading to Tamil Nadu and nearby area of Kerala state and cause production constraints in many districts of Tamil Nadu. A survey was undertaken to assess the incidence of root (wilt) disease in different districts of Tamil Nadu. The maximum disease incidence was observed in Theni (Cumbum) followed by Tirunelveli district (Thenkasi). Accurate detection and identification tools are essential for this pathogen since it is phloem inhabitation organism at low concentration, it has an uneven distribution in woody plants and it could not be cultured under *in vitro* conditions. The nested PCR has been attempted with the

primer combinations of p1/p7 followed by fU5/rU3 and it offered a sensitive detection of phytoplasma from root wilt affected coconut palm samples viz., leaves, trunks, roots and embryo and not in endosperm. The real-time PCR proved the specificity rather than commonly used and more laborious than nested PCR for the detection of phytoplasma in coconut. The qPCR based method can be automated easily and preliminary results indicated that it is efficient for quantitative estimation of phytoplasma concentration in coconut palms. In the study, DNA - based quantitative PCR (qPCR) analysis was also done to quantify phytoplasma concentration in different treatments imposed palms. From the field trials, it was concluded that there was a less concentration of phytoplasma in palms treated with oxytetracycline hydrochloride @ 1000 ppm/palm as root feeding compared to untreated control palms. The qPCR approach was much faster, more convenient, sensitive and accurate. Therefore, it is an excellent tool for in planta quantification of phytoplasma and can be used for epidemiological and host resistance studies.

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iv. Genetic analysis of fungal pathogen and biological disease management in tea plant

Tea *(Camellia sinensis* L.) is one of the oldest and most popular beverages in the world. Tea plant belongs to the family *Camelliaceae* which contains 82 species of the genus *Camellia.* The plant is highly susceptible to diverse microbial infections. Identification of the microbes causing infection is a critical for crop management. In the present study, the disease causing pathogen was isolated from infected tea leaves collected from different planting areas of Valparai region and cultured on potato dextrose agar (PDA). The pathogen was phenotypically identified as fungi based on the morphology on PDA and by lactophenol cotton blue staining. The staining revealed the presence of two types of conidia (smaller and larger) with septae and the mycelia. The smaller conidia had an average of 3-4 septae, while the larger conidia had 5-6 septae. Both the conidia were of 2µm in breadth. The average lengths of smaller and larger conidia were 3-12 µm and 15-35 µm respectively. The mycelium had an average of 12 hyphae with the length of 15 µm and 2 µm diameter. The culture characteristics of the pathogen were

studied by slide culture technique. The results showed an average radial growth of 8.8 cm on PDA plates; 6.5 cm, 5.5 cm and 5.1 cm on potato carrot agar (PCA), potato sucrose agar (PSA) and carrot extract agar (CEA) respectively. *In vivo* pathogenicity testing was carried out with susceptible tea plants. The isolated pure culture of selected pathogen was layered on surface of the leaves and maintained under greenhouse condition for the disease surveillance and progression. Black patches on the leaf surface were noted within 8 -10 days. Within a period of 15 days, fruiting bodies were also visualized on the surface of the infected leaves. The fungal spore germination was readily visualized when 1% sucrose and 1% glucose solutions were used as a carbon source. The maximum length of the germination tube was 30µm at the second hour of incubation.

The molecular identification of the unknown fungal pathogen was performed by 18s rDNA gene sequencing. The genomic DNA of the unknown pathogen was extracted and subjected to PCR amplification using 18S rDNA internal transcribed spacer regions (ITS 1 and ITS 2) gene. The 1100 bp ITS 1 and ITS 2 regions were sequenced using automated DNA sequencer (Progen Biotech Private Limited). The gene sequence obtained was analyzed with standard nucleotide BLAST and the results were studied for similarity using pairwise alignment using needleman–wunsch algorithm and Blosum 62 matrix. The sequences showed 97% similarity with *Ascomycota* species. The isolated pure culture was used for further studies like characterization and biological control measures. Biocontrol studies were performed by dual culture technique and antibiosis method. The isolated pathogen was co-cultured with *Trichoderma* spp., *Pseudomonas* spp., and *Actinomycete* species. The pathogen was effectively controlled by the *Trichoderma* spp. in co-cultures, followed by *Pseudomonas* spp. The actinomycetes antagonist showed less response when compared to the other two biocontrol agents. Parallel with the duel culture technique, the antibiosis method also established similar observations.

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v. HIV RNase H inhibitory activity of Novel Isatin derivative (SPIII-5H)

HIV RNase H is an important enzyme for HIV replication and validated target for designing potential anti-HIV agents. We identified isatin derivative (SPIII-5H) as potential inhibitors of HIV RNase H (IC_{50}: 8.4 μM) with an objective to study a molecular modeling of SPIII-5H with HIV RNase H to understand the mechanism.

The AutoDock (Version 4.0) program was chosen to dock the SPIII-5H into HIV RT explore the binding mode between the SPIII-5H and the receptor. The 3D coordinates of HIV RT complex with ligand were taken from the Brookhaven Protein Databank (PDB code: 2I5J) [2]. AutoDock tools (ADT) were used to prepare the ligand, protein (deleting all water molecules, adding polar hydrogens and loading Kollman United Atoms charges) and also to perform docking calculations. A grid box with the dimensions60 X 50 X 50 points was constructed around the binding site, based on the location of the co-crystallized ligand. All bond rotations and torsions for the ligand were automatically set in the ADT. Considering the flexibility of the protein during the ligand–receptor interaction process, the active site residues were defined as flexible residues in the docking process. The Lamarckian genetic algorithm (LGA) procedure was employed and the docking runs were set to 50. The rest of the parameters were taken as default.

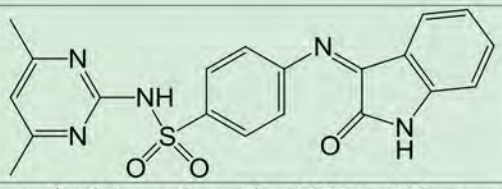
The computer simulated automated docking studies were performed using the widely used molecular docking software, AutoDock 4.0. Energy minimized SPIII-5H from Dundee PRODRG2 server were docked with HIV RT. The SPIII-5H specifically binds to HIV RT of RNASe H region amino acids, Thr296, Ala261, Ser265, Asp498 and Ala538 (Fig. 1). Results were obtained under 298.15 K temperatures with solvation of water molecule as the solvent parameter. AutoDock binding affinities of the SPIII-5H were evaluated by free energies (ΔGb, kcal/ mol), inhibition constants (*Ki*), hydrogen bonds and RMSD values. The success rates of AutoDock is highly excellent where the docked SPIII-5H binding free energies -10.42 kcal/mol at 0.02 A^{o} RMSD (Tabel 1) and predicted hydrogen bond forms between SPIII-5H and MEKK1 of Thr296, Ala261, Ser265, Asp498 and Ala538 (Fig. 1)

Table 1: Docking energies of SPIII-5H with HIV-1 RT

Protein	Inhibitors	Cluster[a]	RMSD[b]	Lowest Binding Energy[c] (Kcal/mol)	Inhibition Constant[d] (*Ki*)	Amino acids involved in H bond formation
HIV-1 RT	SPIII-5H	05	0.02	-10.42	21.879nM	Thr296, Ala261, Ser265, Asp498 and Ala538

[a]Indicative of the total number of binding modes produced
[b]Heavy atoms root-mean-square deviation with respect to the experimental structure.
[c]The change in binding free energy is related to the inhibition constant using the equation: $\Delta G = RT$ in *Ki*, whereR is the gas constant 1.987 cal K-1 mol-1, and T is the absolute temperature assumed to be 298.15 K.
[d]Estimated inhibition constant at 298.15 K.

Effect of* SPIII-5H *compounds on HIV-1 RNase H activity

Compound	*Structure*	*HIV-1 RNase-H* $^{a}IC_{50}$
SPIII-SH		8.4

[a]Compound concentration required to reduce the HIV-1 RT associated Ribonuclease H (RNaseH) activity by 50%.

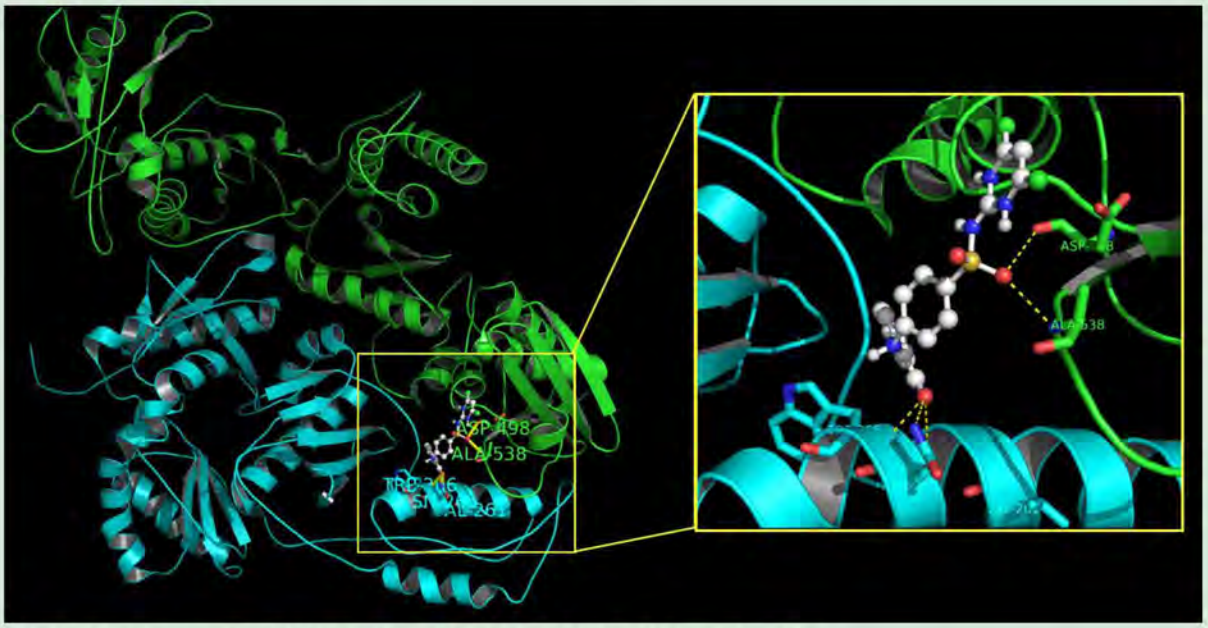


Fig.1: Binding mode of SPIII-5H with HIV-1 RT at RNase H region.

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vi. Optimization of food consumption and nutrient intake in koppal district, Karnataka state: An economic analysis

Food consumption, mainly governed by poverty or income levels, reflects on standard of living of the society. Estimation of optimum food consumption pattern given the income constraints of the households is vital for meeting the nutritional standards recommended by the Indian Council of Medical Research (ICMR). Secondary data were collected from various published sources of Government of Karnataka, Government of India, NSSO, ICMR and FAO. The requisite primary data were collected by using a well designed and pre-tested schedule. The sample of respondents consisted of 120 households consisting of 60 from rural area and 60 from urban area spread across all the four talukas of the district. Tabular analysis, various forms of Engel's functions, multiple linear regression and linear programming techniques were used to analyse the data.

The monthly per capita consumption expenditure on food and non-food items in Karnataka for the year 2009-10 revealed that the households of urban Karnataka consumed more food as compared to rural Karnataka. The expenditure elasticities were positive and less than one for cereals in both rural and urban areas but were more than one for almost all other commodities. The energy derived from consumption of all the food items was higher in urban areas as compared to rural areas across different income groups. The quantity of food items to be consumed as suggested by the optimum food consumption plan was highest in the case of milk followed by jowar, brinjal and potato. The monthly income and number of consumption units per household exerted positive and significant influence on food consumption expenditure in both rural and urban areas. The respondents opined that groundnut, fruits and nuts, vegetables, milk and milk products, egg and meat were expensive. 'Taste and preference' was also an important factor influencing consumption in addition to nutritive value.

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vii. Cyanobacterial phytohormones – An alternative to hormone supplementation in plant tissue culture

Cyanobacteria are an impressive community of microbial world strongly tuned accordingly to vast range of circumstances and have been broadly practiced for increasing the soil quality and enriching the soil structure, as well as enhancing crop yields, particularly in rice. It has been demonstrated that 40% of nitrogen fixed by cyanophyta is used by rice fields. The ability of cyanobacteria to produce biologically active growth promoting substances such as the phytohormones (IAA) has notable application.

Variety of cyanobacterial strains were isolated and identified from rice fields of Thanjavur District, Tamil Nadu. The most potent cyanobacterial members were screened by initial examination with salkowski assay. Among the isolated strains, *Aphanothece* sp. MBDU 515 showed maximum yield of phytohormone like compounds. Both the exogenous and endogenous (cell extract) soup showed positive color reaction in the assay. Plant growth potential of cyanobacterial extracellular and endogenous soup was primarily tested on the model plant tobacco. MS basal media supplemented with 10% of the cyanobacterial grown medium showed almost two fold increase in shoot and root formation compared to the commercial phytohormones BAP and IBA in two of the commercial plants *Arachis hypogaea* and *Moringa oleifera*. MS medium supplemented with 10% of cyanobacterial extracellular product increased the shoot development by 70%. The cyanobacterial phytohormone treatment also showed marked difference in the number of roots formed and in root length compared to IBA treatment.

It is interesting to note that there was no phenolic secretion in shoot and root induction during CEP treatment in *Arachis hypogaea*. It is well known fact that browning and blackening are major impediments of i*n vitro* culture of many economically important plants, which is correlated with excessive accumulation of phenolics. When cells are damaged, the contents of cytoplasm and vacuoles are mixed and phenolic compounds can readily become oxidized by air, which may inhibit enzyme activity and result in darkening of the culture medium and subsequent lethal browning of explants. In our study, CEP readily inhibited the accumulation of phenolics compared to the control treatment.

Phytohormones production by cyanobacteria was chemically authenticated using HPLC and GC/MS. Mass chromatogram of the tested cyanobacteria showed the IAA molecule precursor ion at *m/z* 175.2 and product ion at *m/z* 129.6. The true identity of IAA in the cyanbacterial medium and endogenous extract was hereby verified. This research work draws attention on the phytohormones producing capability of cyanobacteria. The modern day crop cultivation requires a suitable growth regulator of low cost and it's better if it is a microbial origin and eco-friendly. Our data revealed that free-living cyanobacteria *Aphanothece* sp. MBDU 515 isolated from rice filed of Thanjavur District, Tamil Nadu are able to accumulate and release the phytohormone indole-3-acetic acid and that the exogenous and endogenous soup stimulates the *in vitro* propagation of the economically important plants most efficiently compared to the commercial phytohormones tested.

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viii. Antimicrobial activity of fruit waste

The Fruit and Vegetable Summit organized by Confederation of Indian Industry (CII) mentioned that 72 per cent of the fruit and vegetable production in India goes unutilized because of lack of proper retailing and adequate storage facility. From the environmental view point, recycling of these plant residues has a common interest *in lieu* of reduction of contaminant load as well as formulation of value added products through the excretion of active compounds having several health benefits. Because of the success found in citrus industry for extraction of pectin from peel, it is of interest to explore pectin extraction from the rotten and underutilized parts of some fruits like *Musa* sp (Banana), *Citrus limetta* (Mosambi), *Citrullus lanatus* (Watermelon), *Solanum lycopersicum* (Tomato) and *Psidium* sp (Guava).

The shredded fruit peel or dejuiced pulp was soaked in hot water for a 10 minutes followed by addition of mineral or organic acids to get a range of pH values in the mixture. After a desired time period, the solids were separated from the pectin containing liquid through either filtration or centrifugation. The solution was then mixed with equal volumes of isopropylalcohol for pectin

precipitation. The precipitated pectin was washed with alcohol to remove impurities. The extracted pectin was powdered. The quality of the pectin was determined on the basis of its gel forming ability (methoxyl content) with sugar.

The pectin yield was maximum from the peels of *Musa* sp. (78.6gm/ kg of peel) followed by *Psidium* sp. (62.3gms/ kg of waste), *Citrus limetta* (26.79g/kg of peel), *C. lanatus* (15.5gm/kg of peel) and *Solanum lycopersicum* (7.5/kg of waste). The gel grade of *Psidium* sp pectin (200) was maximum followed by *C.limetta* (189), *C. lanatus* (150) and *S. lycopersicum* (100). The residual waste obtained after pectin extraction was processed for extraction of antimicrobial proteins both Total Soluble Proteins (TSP) and Heat Stable Protein (HSP) with suitable extraction buffer. TSP and HSP from *S. lycopersicum* showed highest protein content and that from *Musa* sp showed the lowest.

The HSP showed antimicrobial activity against common disease causing microbes like *E. coli*, *Pseudomonas* and plant pathogen, *Fusarium*. The HSP from *C.limetta* waste showed highest suppression of *F. oxysporum,* followed by *Musa* sp, *S. lycopersicum*, *Psidium* sp, and *C. lanatus*. HSP from *Musa* sp and *C.limetta* waste showed highest suppression of *Pseudomonas sp.,* followed by *Psidium* sp., *S. lycopersicum* and *C. lanatus* wastes. The HSP from tomato waste showed highest suppression of *E. coli.* Hence, recycling of fruit and vegetable waste is one of the most important means of utilizing it in a number of innovative ways for value added products and meeting the requirements of essential products required in human, animal and plant nutrition as well as in the pharmaceutical industry.

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ix. Standardization of *Bacillus subtilis* EPCO 16 liquid formulation against *Fusarium* wilt of tomato

A study was undertaken to develop liquid formulation of *Bacillus subtilis* EPCO 16 for the management of tomato *Fusarium* wilt under laboratory, pot culture and field conditions. The carrier based bioinoculants generally suffer from shorter shelf life, poor quality carrier, high contamination and low field performance. Therefore, it is necessary to develop an alternative new formulation of inoculants where liquid inoculants can play a significant role. Liquid formulation of *B. subtilis* EPCO 16 was developed by adding chemical amendments *viz.*, trehalose (10 mM), PVP (2%) and glycerol (10 mM) to the Super Optimal Broth with catabolic repressor separately and the survival was studied up to 365 days under room temperature. Addition of these amendments enhanced and maintained the population level up to 8 months of storage. Standardization of dosage of liquid formulations of *B. subtilis* EPCO 16 for various methods of inoculation and their survival were studied. The inoculum level of 10 ml/kg seeds, 500 ml/ha seedlings were found to be optimum dose for seed treatment and seedling root dipping respectively. Biochemical analysis of *B. subtilis* EPCO 16 in liquid formulation showed more similarity up to 365 days. Different treatments *viz.,* seedling dip, soil application and foliar spray with talc and liquid either individually or combined application tested for their efficacy against *F. oxysporum* f. sp. *lycopersici.* Among the various formulations tested under glass house conditions, seedling dip + soil application + foliar spray of liquid was found to be highly effective in reducing the disease incidence of *Fusarium* wilt (17.46%) when compared to untreated control (28.86%). In addition, the same treatment significantly increased the yield of tomato (280.46 g/plant) as compared to control (120.86 g/plant). The present study indicated that seed treatment, soil application, seedling dip and foliar spray of *B. subtilis* EPCO 16 liquid formulation significantly reduced *Fusarium* wilt in tomato plants under field conditions besides enhancing the fruit yield.

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6. An appeal to contribute for Corpus Fund

You are aware that the Corpus Fund for Prof. S. Kannaiyan Memorial Award is being mobilized. We profusely thank all the 50 members who have contributed to the cause. We earnestly appeal to all the rest of the Life members, NABS Fellows / Associate Fellows, Corporate Life Members, Corporate Fellows and well wishers to contribute to this noble cause. The amount may be paid as Cash directly or through a Demand Draft / Multicity Cheque drawn in favour of **National Academy of Biological Sciences** payable at Chennai.

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