



The **Department of Biotechnology at Jaypee Institute of Information Technology (JIIT), NOIDA**, in association with **Scientity Inc.**, organised an International Conference "**Bioproducts and the OMICS Revolution**", March 16-17, 2013, as part of the Biotechnology Conference Series - an effort to strengthen and enhance research informed teaching.

Continuing the theme of drug discovery and recognising rising threat from multi-drug resistant bacteria, presentations were devoted to strategies to discover/develop newer antimicrobial molecules/antibiotics, industry approach to drug development, application of Omics, and new generation sequencing technologies. **Prof. Sanjeev K. Sharma**, Department of Biotechnology, JIIT, moderated the discussions.

**Prof. Michael Goodfellow**, Newcastle University, U.K., in his Keynote lecture "Anti-Infective agents from Desert Actinomycetes: Back to the future", expanded on the theme of antibiotic discovery-bioprospecting for novel antibiotics from actinomycetes, the richest source of discovered antibiotics. He explained the importance of focussing attention on extreme habitats as sources of new actinomycetes and novel antibiotics. He stressed the point that there have been many reports of novel chemistry from such studies and provide encouragement that such an approach is likely to be successful in development of new drugs.

This echoed Prof. Sharma's views in the introductory note that microbes are our best bet (bacteria, simply put are champions of evolution and prolific inventors) in the continuously worsening scenario of antibiotic "research and development" pipeline. We only need to harness their genetic plasticity/potential and jokingly suggested granting "patents" to microbes. India (one of the 17 mega diversity countries in the world) and Indian scientists can play a proactive role in ensuring accelerated drug discovery.

**Prof. Rup Lal** of Department of Zoology Delhi University in his speak demonstrated how biosynthetic plasticity can be elegantly exploited for production of Rifamycin analogues by genetic mutation of polyketide biosynthetic gene cluster. Prof. A.K. Srivastava, IIT-Delhi and Dr. Amit Saxena from Reliance Life sciences, Mumbai, covered the journey of bioproducts/biologicals from laboratory to the market; scale-up considerations in Cell culture Bioprocesses, regulatory regimes and phases of drug development.

**Dr. Gulshan Wadhwa**, Department of Biotechnology, Government of India, summarised various facets of Omics characterised by high throughput or large-scale experimental methodologies, generating a vast amount of biological information.

**Dr. Sanjay Shahi** of Xcelris Genomics, Ahmedabad described the fast moving area of next-generation sequencing (NGS) platforms and discussed how advances in NGS technology are improving the understanding of how the genome impact on the diagnosis and mining the microbial resources. **Dr. Jyoti Bajpai Dikshit** of Strand Life Sciences, Bangalore addressed the data analysis challenges and optimization of NGS pipelines, data sharing and archiving and demonstrated "AVADIS NGS"- a next generation sequencing analysis software".

Opportunity was provided to students to showcase their talent through poster presentation and interaction with subject area experts, students taking their place as contributors to the university academic environment and level of engagement ensuring high satisfaction levels and the sense of achievement. In his concluding remarks Prof. Sharma hoped that exposure to the way scientists work would motivate students to pursue careers in research.

Around 200 faculty and student delegates from various academic institutions participated in the conference. Overall, a picture emerged that it is imperative to re-focus attention on bacteria/microbes as counter strategies for emerging drug-resistant bacteria utilizing the advanced "Omics" technological platforms of 21st century that complement traditional approaches. Back to the future.

## **Simulation of Algal Growth by CO<sub>2</sub> Removal from Wastewater**

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Micro-algae in consortium with the bacterial species give a unique result in wastewater treatment. Micro-algae release significant amount of oxygen, the excess of which is discharged to the atmosphere. The aerobic bacteria in-turn release additional CO<sub>2</sub> which is utilized by fast growing micro-algae. The aim of this work was to study the various factors affecting the growth rate and lipid production of different micro-algae by consumption of CO<sub>2</sub> and nutrients from wastewater for the production of bio-fuels. The micro-algae were modelled using NetLogo software. The effect of CO<sub>2</sub> concentration, light intensity and reproduction ability on algal growth was modelled. Comparative study of how different micro-algae behave with respect to these variables was done by running the model with assigning selected values for these variables. It was found that under these assigned conditions of the variable features the two species effect each other's growth and/or lipid production.

**Keywords:** Simulation, Micro-algae, NetLogo, Bio-fuels, Bacteria

## **Variation analysis in DNA gyrase subunit A using *in-silico* techniques**

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DNA gyrase enzyme catalyzes the seemingly complex reaction of DNA supercoiling. DNA gyrase consists of two subunits A & B where, subunit A nicks the DNA strand, subunit B introduces negative supercoils, and then subunit A reseals the strands during the process of DNA replication. DNA gyrase is an essential enzyme in prokaryotes and its absence in humans makes it an important drug target for antimicrobial agents. DNA gyrase subunit A has been reported to be an important drug target in most of the pathogenic microbes using network biology. In this study, DNA gyrase subunit A protein from 51 pathogenic organisms across phylum Proteobacteria has been studied to understand the variations in the sequence. Complete sequence and functional domain analysis has been performed and rate of divergence has been evaluated. This study will be helpful to understand the variations, functional implications and the mutation rate of DNA gyrase protein.

**Keywords:** Proteobacteria, Variation, DNA Gyrase, Functional domain

# All the authors have contributed equally

**Antioxidant and antimicrobial activity of *Nardostachys jatamansi*,  
*Boerhaavia diffusa*, *Cephalandra indica* and *Adhatoda vasica*  
against *Escherichia coli***

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In underdeveloped and developing countries alternate medicine practitioners are equivalent or outnumbered than allopathic practitioners, which help in meeting the primary health care in these parts of the world. However, there are very few supported documents for the use of traditional medicine in management of microbial infections. Despite screening of many novel and known compounds from plant sources there are still very few compounds which have been recommended safe for administration in human. There is vast diversity in the medicinal plant and numerous plants have not been screened for their biochemical composition or for their pharmacological properties even though being in use in alternate medicinal practice. In the present study, we evaluated the antimicrobial activity of four Indian medicinal plant extracts (*Nardostachys jatamansi*, *Boerhaavia diffusa*, *Cephalandra indica* and *Adhatoda vasica*) against *Escherichia coli* using disc diffusion and anti-oxidant potential was determined by DPPH free radical scavenging method. The crude ethanolic extracts of *Nardostachys jatamansi* and *Cephalandra indica* showed very potent activity against *E. coli*; 10µl of 100 ppm *Cephalandra indica* showed almost equivalent zone of inhibition as to 2µg ampicillin; hence this plant can be further subjected to isolation of the therapeutic antimicrobials and pharmacological evaluation against *E. coli*.

**Keywords:** Antibacterial, antioxidant, zone of inhibition, pharmacological, *E. coli*.

## **An overview: Current understanding of Preeclampsia**

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Pre-eclampsia (PE), a pregnancy-specific medical condition and a prelude to early delivery, affects up to 10% of pregnancies. The relatively asymptomatic onset of PE and lack of proven prophylaxis have meant high maternal and fetal-neonatal morbidity and mortality. Current medical diagnosis relies on the manifestation of the two most prominent symptoms of the disease, proteinuria ( $\geq 300$ mg of protein excretion in a 24-hr urine) and development of hypertension (blood pressure exceeding 140/90) after 20 weeks of gestation in previously normotensive women. The identification and development of pre-emptive objective biochemical marker (s), which would be of value in predicting at-risk patients or identification of subclinical disease is desirable. The difficulties associated with identifying markers for predicting patients at risk of PE are compounded by the facts that the pathophysiologic etiologies of PE are heterogeneous, with numerous predisposing factors and, that the mechanisms that underlie PE are poorly understood. We do know however that delivery of placenta remains the only known treatment for this condition. It is thus reasonable to assume that the placenta plays a central role in the origin of PE. The pathogenic pathways implicated in PE (abnormal cytotrophoblast invasion of uterine spiral arteries, antiangiogenic response and altered immune response) cross-regulate each other. Interaction and cumulative effect of regulatory mediators identified and being investigated is thus likely and multiple marker approach may better capture the risk of PE.

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**Phytochemical analysis and antimicrobial activity of *Mentha piperita* and *Ocimum sanctum* against *Pseudomonas aeruginosa* and *Staphylococcus aureus***

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There are several medicinal plants used traditionally in Alternate System of medicine (Ayurveda, Siddha and Unani) for disorders as immunomodulation, antibacterial, anti-inflammatory, anti-viral, anti-parasitic, viral hepatitis, antiseptic, anti-oxidant, snake antidote and to improve cardiac irregularity. Many plants of Indian origin or plants which have been traditionally used in Indian System of Medicine have shown potent activity against many microbial infections. In India and other developing countries traditional folk medicine obtained from plant resources is still used; the use of ethno pharmacological data enhances the probability of identifying new bioactive compounds from plants. Based on local use of plants in common diseases and ethnobotanical knowledge, an attempt has been made to assess the antibacterial properties of methanolic extract of *Mentha piperita* and *Ocimum sanctum* against *Pseudomonas aeruginosa* and *Staphylococcus aureus* using disc diffusion and p-iodonitrotetrazolium chloride (INT) method. The plant extract used for study was standardized previously for total phenolics and flavonoids content, anti-oxidant potential was determined by DPPH free radical scavenging method and TLC was developed. *Mentha piperita* and *Ocimum sanctum* showed the antibacterial activity against *Staphylococcus aureus* but was ineffective against *Pseudomonas aeruginosa*, later was also resistant against tetracycline and ampicillin; hence these plants can be further subjected to isolation of the therapeutic antimicrobials and pharmacological evaluation against *Staphylococcus aureus* and *Pseudomonas aeruginosa*.

**Keywords:** Antibacterial, antioxidant, *Mentha piperita*, *Ocimum sanctum*, INT, TLC, DPPH.

## **Protective effect of polyphenols in organophosphorous induced toxicity**

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Oxidative stress by increased production of reactive oxygen species has been implicated in the toxicity of many pesticides. Polyphenoles are well known for their potent antioxidant activity. In the present study, protective effects of polyphenols against organophosphate induced cardiotoxicity in H9C2 cardiomyocytes have been evaluated. Malathion is a widely used organophosphate in India. Dose for Malathion, Gallic acid and curcumin was optimized by MTT assay and analyzed morphologically. Cells were induced with 60 $\mu$ M Malathion. Giemsa and Propidium iodide staining were done to analyze nuclear deformities. ROS production was seen through DCFH-DA assay. Gallic acid was shown to significantly reverse the damage sustained by pesticide exposure more than curcumin. Our study suggests that supplementation with polyphenols protects against the free radical mediated oxidative stress in cardiac myocytes upon pesticide exposure.

**Keywords:** Oxidative Stress, Reactive oxygen species, Polyphenols, Cardiotoxicity, Organophosphate

# All the authors have contributed equally.



**Antimicrobial activity of *Nardostachys jatamansi*, *Boerhaavia diffusa*,  
*Cephalandra indica* and *Adhatoda vasica* against *Pseudomonas  
aeruginosa* and *Staphylococcus aureus***

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The great surge of public interest in the use of plants, as well as some animal products as medicine is based on the assumption that the plants will be available on a continuing basis. However, no concerted effort has been made to ensure this in the face of the threats posed by the increasing demand of vastly increasing human population and extensive destruction of plant rich habitats. Antibiotic resistance has become a global concern in recent years. This problem is of great significance especially in developing countries because infectious diseases are one of the major causes of morbidity in these countries. Therefore, there is a continuous need for new drugs which can overcome the difficulty faced by the current drug regimen. In the present study, we evaluated the antimicrobial activity of four Indian medicinal plant extracts (*Nardostachys jatamansi*, *Boerhaavia diffusa*, *Cephalandra indica* and *Adhatoda vasica*) against *Pseudomonas aeruginosa* and *Staphylococcus aureus* using disc diffusion method and total phenolics and flavonoids content was determined. The crude ethanolic extracts of *Nardostachys jatamansi* and *Adhatoda vasica* showed very potent activity against *P. aeruginosa*; they showed high zone of inhibition even as 2µg ampicillin was resistant; hence this plant can be further subjected to isolation of the therapeutic antimicrobials and pharmacological evaluation against *Pseudomonas aeruginosa*.

**Keywords:** Antibacterial, antioxidant, zone of inhibition, pharmacological, *Pseudomonas aeruginosa* and *Staphylococcus aureus*

## **Phylogenomics of Indian *Drosophila* species**

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Although traditional taxonomy based on morphological and anatomical features has been well accepted, the advent of molecular biology techniques had revolutionized the field recently. The evolution of no other animal genus has been studied as intensively as that of *Drosophila* as it addresses a diverse set of questions, thus understanding their phylogenomic relationships is of significant importance. India harbors many species of *Drosophila*, endemic to different eco-climatic zones. The present proposal thus aims to establish phylogenomic relationship among Indian *Drosophila* species with multi-locus approach. *Drosophila* flies have been sampled from different eco-geographic regions of India and isofemale lines were established in the laboratory and later on subjected for species identification by classical taxonomy method. Multiple molecular markers were selected from both nuclear and mitochondrial region and primers were designed manually and with bioinformatics approach. DNA was extracted from single individual *Drosophila* fly. The selected markers were amplified using Polymerase Chain Reaction (PCR) technique. To obtain the consensus sequences for each fragment of interest in each species, DNA samples were extracted from three individuals. The sequencing work is in progress. The sequence analysis will generate knowledge on the evolutionary history of Indian *Drosophila* species and their phylogenomics relationship. Such studies in a *Drosophila* model system will pave ways for other organisms of health and agriculture importance, e.g., insect pests and human pathogen carrying vectors.

**Keywords:** *Drosophila*, phylogenomics, molecular markers, multi-locus approach

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## **Phytochemical and Antibacterial Screening of Cassia fistula**

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Plants have been used in medicines from the time immemorial. This is because they are easily accessible, inexpensive and do not have serious side effects. Moreover plant secondary metabolites are not only useful as potential drugs in their natural unmodified form but also suitable as synthetic intermediates for the production of useful drugs. Cassia fistula is one such plant that has large number of uses and is used worldwide as a highly effective moderate laxative. The objective of our research is to identify some novel chemical agents present in this plant and to investigate its uses in the treatment of infectious diseases by assessing its potency on some selected microorganisms. In the present study, young unripe pods of Cassia fistula were taken, dried and extracted with hot methanol. The extract was loaded on silica gel column which was eluted with solvents with increasing polarity starting from 100% Petroleum ether to methanol-Ethyl Acetate (1:19). Four new compounds were isolated and all the compounds were subjected to IR, <sup>1</sup>HNMR and Mass spectroscopy. The invitro antibacterial activity was carried out against 24 hours old pure cultures of eight bacteria. Hexane (50%), Chloroform, Acetone and Aqueous extracts in the percentage 50, 75 and 100 were screened for antibacterial activity. The activity was performed by Agar disc diffusion method. It was found that most of the activity was from acetone and aqueous extracts on the pus forming bacteria namely Bacillus and staphylococcus species.

**Keywords:** Cassia fistula, Polarity, Column, Disc Diffusion method, Bacillus, Staphylococcus.

## **Bioprocess Parameter Optimization for Bacterial Cellulose Production**

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Cellulose is the most abundant biopolymer on earth with vascular plants being the major source. Commercially, cellulose is used in the manufacturing of paper and textiles for decades. Growing globalization and industrial demand of cellulose based products has imposed extreme negative pressure on the delicate ecological balance of the plant world causing deforestation; a major global environmental issues. A great deal of interest has been created worldwide on the production of cellulose by using alternative sources, to reduce the environmental impact to a minimum. Existing reports suggest that bacterial cellulose (BC) may be a suitable alternative technique. Current research work is focused toward cell growth and BC production from one such bacterial isolate. Results also show unique properties of bacterial cellulose over commercial cellulose. Bioprocess optimization for improving the yield of bacterial cellulose, is reported.

**Keywords:** Bacterial cellulose, Biopolymer, yield, Optimization, Parameters

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**Sequence and Structural comparison of Wheat Early Salt-stress Response gene (WESR3) and proteins of Mlo gene family in *Triticum aestivum***

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Proteins are the most versatile macromolecules in living systems and serve crucial functions in all biological processes. They function as enzymes, transporters, provide mechanical support and immune protection, etc. Various characteristics that affect function of a protein are determined by the protein structure. In our study the sequence and secondary structural comparison of two proteins WESR3 (Protein encoded by Wheat Early Salt-stress Response gene) and proteins of TaMlo gene family of wheat (*Triticum aestivum*) was done. WESR3 protein is involved in abiotic stress pathway while proteins of TaMlo gene family are involved in response pathway to fungal pathogen attack i.e. in response to biotic stress. In wheat seven TaMlo gene family members have been identified. The sequence and secondary structure comparison has been carried out by using blastp, Motif Search Tool and PSIPRED servers. During our analysis we observed 100 percent identity of WESR3 with TaMlo2 member having E-value  $1e-59$  and many common domains were there between both the proteins. Secondary structure comparison revealed alpha helices were same except two extra  $\beta$  strands were observed in WESR3. The comparative study affirmed that apart from involvement of WESR3 in abiotic stress it may also play role in biotic stress.

**Keywords:** WESR3, *Triticum aestivum*, TaMlo, Gene family, Abiotic stress

## **Microbial Production of Vanillin**

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Aromatic plants are a major source of commercially important fragrances, flavors, cosmeceuticals, health beverages and chemical terpenes. One such commercially viable flavoring component is 'Vanilla flavor or Vanillin', produced by *Vanilla planifolia* G. Jackson (syn. *V. fragrans* Andrews), a tropical climbing orchid. Vanilla flavor (3-Methoxy-4-hydroxy-benzaldehyde) is one of the most expensive spices, traded in global market after saffron. However, studies report that improper cultivation practices, seasonal availability of fruit, artificial pollination practices and endangered status of the plant limits cost effective production of the flavor from plants. Research, the world over, proposes production of natural vanillin at a lower price using biotechnological approaches viz. bioconversion of natural compounds by means of microorganisms or isolated enzymes. Previous reports propose efficient role of various microorganisms (e.g. *Bacillus fusiformis*, *Pseudomonas fluorescens*, *Pseudomonas acidovorans*, *Penicillium simplicissimum*, *E. coli*, *Corynebacterium glutamicum*, *Saccharomyces cerevisiae*, *Pycnoporus cinnabarinus*, *A. niger*) in conversion of natural phenylpropanoids precursors, viz. ferulic acid, eugenol, isoeugenol, coniferyl alcohol, and vanillyl alcohol into vanillin. All these precursors have the same aromatic substitution pattern as vanillin and thus, they only require a chemical modification in the aliphatic carbon side chain. Scientific reports proposing the role of strain improvement techniques and metabolic engineering on improving the yield of vanillin will be presented.

**Keywords:** Vanilla, flavor, Fragrance, Microbial, Natural

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**Metabolomics reviewed: "Omics" technology for systems biology and implications for natural products research**

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Metabolomics is the study of global metabolite profiles in a system (cell, tissue, or organism) under a given set of conditions. The analysis of the metabolome is particularly challenging due to the diverse chemical nature of metabolites. Metabolites are the result of the interaction of the system's genome with its environment and are not merely the end product of gene expression but also form part of the regulatory system in an integrated manner. Metabolomics has its roots in early metabolite profiling studies but is now a rapidly expanding area of scientific research in its own right. Metabolomics (or metabonomics) has been labeled one of the new "omics", joining genomics, transcriptomics, and proteomics as a science employed toward the understanding of global systems biology. Metabolomics is fast becoming one of the platform sciences of the "omics". In this review metabolomic methodologies are discussed briefly followed by a more detailed review of the use of metabolomics in integrated applications where metabolomics information has been combined with other "omic" data sets (proteomics, transcriptomics) to enable greater understanding of a biological system. The potential of metabolomics for natural product drug discovery and functional food analysis, primarily as incorporated into broader "omic" data sets, will be discussed during presentation.

## **Production and Characterization of fungal chitosan extracted from soil fungal isolates**

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Chitin, the second most abundant biodegradable biopolymer on earth and its deacetylated form chitosan and its derivatives has been used in vast array of widely different products and applications, ranging from cosmetics, pharmaceuticals, food additives to application as occlusants, chelating agent for metals, plant protection and in medical applications and drug delivery systems. Conventionally, chitosan is commercially produced by the deacetylation of chitin obtained from shrimp, crabshell and lobster by strong alkalis at high temperatures for long periods of time. However, heterogeneity of final product, inconsistent yield of chitosan limits application of the biopolymer. In order to overcome this limitation, fungal Chitosan provides a suitable alternative. Current research work is focused towards, isolation and characterization of soil fungal isolates followed by fermentation and downstream processing for recovery and purification of chitosan thereof. Chitosan, thus obtained was characterized for different physico-chemical properties using analytical techniques.

**Keywords:** Chitin, Chitosan, Production, Fungal chitosan, Fungi.

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## **Study the functional characterization of microarray data using gene ontology**

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Microarrays are one of the latest discovery in experimental molecular biology that allow monitoring the expression levels of tens of thousands of genes simultaneously. It is independent of the platform and the analysis methods used, and the result of a microarray experiment, in most cases, is a list of differentially expressed genes. Our objective is to study the functional characterization of gene expression profiles associated with Parkinson's disease. Here, we study and discussing the basic principles behind a microarray experiment and an overview of different methods for clustering genes with similar expression profiles. It focuses on various bioinformatics tools used for microarray data mining tasks with its underlying algorithms. In order to suggest common biological processes and functions for these genes, GO annotations are widely used. We are using tools *viz* DAVID , GOEAST, MAGIC , GORILLA and BINGO, etc. for gene annotations using semantic similarity for Gene Ontology terms combined with clustering. The methodology allows rapid identification of genes sharing the same Gene Ontology cluster. We also include a discussion of some of the issues like non-coherence and consistencies associated with the current ontological analysis approaches. Since all existing tools implement the same approach, these drawbacks are also associated with all tools listed and represent conceptual limitations of the current ontological analysis.

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## **Synbiotic Food: The Future Ahead**

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The intestinal microflora, including probiotic bacteria, has unique composition in each individual and is beneficial for the maintenance of good health in humans. Understanding the gut ecosystem has elucidated detailed understanding of the mechanism of therapeutic and immunomodulatory effect of gut microflora. Manipulation of the gut flora to enhance its protective and beneficial role represents a promising field of new therapeutic strategies. Last few decades have seen a rapid surge in the understanding of the metabolism and immunomodulatory effect of gut microflora in mammals, specifically human. Variations in cell growth rate, metabolism and therapeutic activities have been seen by culturing the cells, in *in-vitro* and *in-vivo* models, in response to prebiotic components. Reports suggest that probiotic and prebiotics (together called synbiotics), have shown improved viability of probiotics in gut, their enhanced growth rate and immunomodulatory action. Based on surveyed literature, role of synbiotic food on its therapeutic activities will be presented.

**Keywords:** Probiotic, Prebiotic, Synbiotic, Gut microflora

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## ***Syzygium cumini*: A boon for the heart**

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Cardiovascular diseases are the leading cause of deaths in India and worldwide. Natural extracts from plants that exhibit the anti-ageing activities might have the great therapeutic potential for treating various diseases. *Syzygium cumini*, a traditional Indian medicinal plant and a well known antidiabetic, has been widely applied in Ayurvedic and Indian medicines for centuries. The potential of *S. cumini* was evaluated in reduction of myocardial injury and preservation of cardiac function following oxidative damage. An increased oxidative damage was observed in the vicinity of advanced glycation end products formation under high glucose conditions in H9C2 cardiomyocytes while *S. cumini* seed extract showed the protection. Being a natural source of polyphenols (phytocontents), *S. cumini* show the protective mechanisms against cardiac diseases under high glucose conditions. The effect of *S. cumini* on antioxidative enzymes activities were also examined. Thus, our study concludes the inhibitory effect of *S. cumini* on various targets of cardiovascular diseases which may contribute in the prevention of cardiotoxicity.

**Keywords:** Polyphenols, antidiabetic, AGEs, oxidative damage, cardiotoxicity

## **Biopolymeric Membranes for Membrane Bioreactor**

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There has been a surge in the production of therapeutically important biologics using *in-vitro* animal cell culture in bioreactors. Large scale production of these biologics requires successful process design for economization. Considering the limitation of conventional bioreactors for large scale applications such as cell density, product concentration & recovery, removal of byproduct, low shearing of cells, membrane bioreactor offers a solution large scale mammalian cell culture. The main advantages of membrane bioreactor technology includes its mechanism for simultaneous cell culturing and separation, modular design with good expandability, ease of product purification and validation, thus reducing equipment costs and the number of processing steps. Efficiency of membrane bioreactor is a function of membrane design with defined microstructure and physicochemical properties along with the importance of transport and physicochemical properties of membrane such as porosity, elasticity, chemical structure, polymer crystallinity, glass transition temperature. Biopolymeric membranes serve a support for anchorage-dependent cells and also allow the transport of nutrients and metabolites across the membrane. The recent developments in biopolymeric membranes and their implications in future of membrane technology will be discussed

**Keywords:** Biopolymeric, Cell lines, membrane, Bioreactor, Therapeutics



## **Genetics of food preferences in two *Drosophila* species: *Drosophila melanogaster* and *Drosophila ananassae***

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One of the primary challenges facing ecological genetics is bridging the boundaries of ecological context, phenotypic expression, gene function and molecular variation. Many organisms including *Drosophila* provide tremendous genetic and genomic resources; our knowledge of the ecological significance of these features is still very limited. Several *Drosophila* species share the common eco-geographic zone, very little is known about their food preference, oviposition and pupation sites and it remains obscure the degree to which these species are competing. Present study aims at differential chemosensory behavior (food preference) in two most common *Drosophila* species, *Drosophila melanogaster* and *Drosophila ananassae*. To address this, experiments have been designed in two ways: First, to observe food preference for different colors such as orange, yellow, green and control (no colour) without changing the ingredients and secondly, the experiment was conducted in combination of both colour and sucrose concentration. For each experiment, 20 virgin females and 20 males of same age were allowed to breed in a mating chamber containing control and specific colored supplemented food media and/or with sucrose concentration. Flies were observed for 48 hours and fecundity rate was calculated. The results obtained showed significant difference in both species. *Drosophila melanogaster* preferred orange color food with a high fecundity rate whereas *Drosophila ananassae* preferred green colour food and relatively low fecundity rate as compared to *D. melanogaster*. Interestingly, the results were quite different when color was used with different sugar concentration. *Drosophila* species used in these experiments were maintained for at least six months before the experiments conducted in corn-yeast-molasses media. The results indicate the presence of innate sensation towards chemosensory behavior, the genetic architecture underlying it needs to be explored.

**Key words:** *Drosophila*, genetics of food preference, chemosensory behavior

## **Effect of *Punica granatum* and *Glycine max* on calcium phosphate mineralization**

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Rate of occurrence of osteoporosis is more in women than in men. Deficiency of estrogen in postmenopausal women is one of the most important reasons for osteoporosis. Prevention of osteoporosis is done by using bisphosphonate or hormonal replacement therapy. There are various adverse effects of this treatment. An alternative way to prevent osteoporosis is the use of natural products. Now a days phytoestrogens for example isoflavones, lignans, coumestanes, stilbenes, flavonoids are being used to prevent osteoporosis. In the present study *Punica granatum* juice and aqueous extract of *Glycine max* was used to see their effect on calcium phosphate mineralization. Increasing volumes of *Punica granatum* juice and aqueous extract of *Glycine max* was added in calcium phosphate mineralization assay system. There was an increase in the percentage of mineralization with the increase in volume of *Punica granatum*. The same trend was observed in case of aqueous extract of *Glycine max*. *Punica granatum* and *Glycine max* are suggested to have phytoestrogen. It may be possible that the phytoestrogen present in these plants are increasing the calcium phosphate mineralization with the increase in their volume.

**Keywords:** Osteoporosis, phytoestrogen, mineralization, postmenopause, hormone replacement therapy.

# All the authors have contributed equally.

## **Insight into the role of phytase in aquaculture**

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Phytase [*myo*-inositol (1,2,3,4,5,6) hexakisphosphate phosphohydrolase, represents a subgroup of phosphatases which is capable of dephosphorylating phytate, the most abundant storage form of phosphate (upto 80% in plants), in nature. Having a wide range of applications in animal and human nutrition, phytase enzyme also finds a potential role in fish feed industry. A major obstacle associated with the usage of plant proteins in fish feed is the presence of anti-nutritional factors, phytate being a major example. Free phosphate from phytate is not readily available for monogastric or agastric aquatic animals as they do not produce intestinal phytases. Therefore, most of the phytate-phosphorous ends up being excreted into the water leading to pollution, mostly algal growth. Therefore, use of phytase is an ideal approach to counter the negative impacts of phytate. In the present study, phytase- producing bacteria was screened and isolated from soil samples. The potential phytase producing bacterial isolate was identified based upon biochemical and morphological characteristics in accordance with bergey's manual of systematic bacteriology. The bacterial isolate was grown in culture media containing various phytate sources such as rice flour, corn, wheat flour, almond and Jatropha (seed coat). Result showed the maximum enzyme activity in corn (154.10 U/ml) then almond (78.71 U/ml) followed by wheat flour (62.05 U/ml) rice (61.53 U/ml) and Jatropha (61.025 U/ml).

**Keywords:** Phytate, Phytase, Aquaculture

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## **Cadmium and Arsenic-induced genotoxicity**

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Cadmium and arsenic are ubiquitous environmental contaminants that enter the body through various sources like sea-food, drinking water, agriculture insecticides, run-off from chemical and electronic industries and cigarette smoke. Cadmium and arsenic do not cause direct DNA damages, however Reactive Oxygen Species are formed due to oxidative methylation of inorganic arsenic and cadmium containing compounds. This inhibits various DNA repair mechanisms leading to DNA damage, double strand break, base modification and inhibition of DNA replication which interfere with cell signaling. Cadmium and arsenic mediated inhibition of repair mechanism, cell cycle checkpoints and apoptosis leads to the accumulation of unrepaired DNA damages which increases the mutation rate and causes genomic instability. The uncontrolled growth of altered cells lead to various carcinogenic diseases like breast, kidney, bladder, skin cancer caused by absorption of these metals from food in gastrointestinal tract and lungs. In conclusion, we can say that cadmium and arsenic show a high degree of genotoxicity and cytotoxicity.

**Keywords:** Reactive Oxygen Species (ROS), Antioxidants, genomic instability, apoptosis, mutation rate.

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## **MicroRNA signature for CML and potential applications**

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MicroRNA's (miRNAs) are small non-coding RNAs which originate from endogenous DNA genome sequences. They regulate cellular functions including cell differentiation, progression, development and apoptosis by cleavage and repression of mRNA. The miRNA sequences have also shown to play an important role in cancer development and progression by acting as tumor suppressors or oncogenes. Research is currently being focused on to study expression levels of miRNA in various cancers which can act as potential markers for diagnostics or targets for development of new treatment strategies. Chronic myelogenous leukemia (CML) is caused due to BCR-ABL chromosomal translocation but now anomalous expression of miRNAs has been linked to the disease. Aberrant expression of BCR-ABL dependent miRNA17-92 cluster was observed for the first time and linked to the disease. In addition, the expression levels of miRNAs, miR-10a, miR-31, miR150, miR-155 and miR-564 have been found to be down-regulated in CML cell lines as well as its patients. These miRNAs can be potential markers to follow the pathogenesis, disease progression, and response to therapy of CML. Attempts have also been made to restore levels of these essential molecules to their normal levels. Thus miRNAs associated with CML can be the potential therapy targets.

**Keywords:** BCR-ABL, CML, miRNA, pathogenesis, marker

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## **Antidiabetic potential of natural plant $\alpha$ amylases inhibitors**

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The predominance of type 2 diabetes mellitus has led to the investigation of new therapeutic approaches. One therapeutic approach for its treatment is to decrease the postprandial hyperglycaemia through the inhibition of amylase and glucosidase. The use of naturally available  $\alpha$ -amylase enzyme inhibitors with less adverse effects could be a possible strategy to block dietary carbohydrate absorption via control of starch breakdown. Alpha glucosidase inhibitors decrease postprandial hyperglycemia. Mechanism of inhibition occurs through the direct blockage of the active centre at several subsides of the enzyme. These enzyme inhibitors delay carbohydrate digestion time, causing a reduction in the rate of glucose absorption and consequently blunting the postprandial plasma glucose rise. Several plant extracts have antidiabetic potential. Present is for novel antidiabetics from natural occurring plant sources, which could be further pharmacologically exploited for the presence of amylase inhibitors which prevent the dietary starches from being digested and absorbed. Pancreatic alpha-amylase inhibitors from traditional plant extracts are a promising tool for diabetes treatment.

**Keywords:** Antidiabetic, amylase inhibitors, postprandial hyperglycemia, Natural plant

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## **Management of osteoporosis through medicinal plants**

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Osteoporosis has become a health hazard, affecting millions of people around the globe. Osteoporosis is a silent, age-related and progressive systemic disease characterized by increased risk of fractures, which results in substantial morbidity and mortality. Estrogen deficiency is considered to be the most important cause of the disease in postmenopausal women but other risk factors are also present. There are several synthetic drugs like denosumab, bisphosphonates, SERMs which are effective against osteoporosis but on the same hand have adverse effects like osteonecrosis of jaw, musculoskeletal pain, hypersensitivity reactions etc. Thus there is a need to move towards an approach which have fewer side effects, and that can be achieved by the usage of medicinal plants. Many medicinal plants such as *Cissus quadrangularis* (Hadjod), *Punica granatum* (Pomegranate), *Cinnamomum zeylanicum* (Cinnamon), *Pleurotus eryngii* (Mushroom), *Emblica officinalis* (Amla), and *Prunus domestica* (Dried plum) have been worked upon by several research groups. Recent work on *Piper sarmentosum* (Daun kaduk) has revealed its antioxidant properties. All these natural products are known to show fracture healing properties with different modes of action. Thus phytochemicals can be developed as a potential therapy for improving fracture healing process. Other benefits such as low cost, easy availability and high market demands are also associated with the usage of such natural bioproducts.

**Keywords:** Osteoporosis, medicinal plants, phytochemicals, synthetic drugs, antioxidant

# All the authors have contributed equally

## **Bioprospecting for Actinomycetes in Indian Arid Desert**

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Actinomycetes have been documented to account for 70% of natural bioactive compounds discovered till date. In order to avoid rediscovery of known bioactive metabolites, there exists an urgent need for exploring underexplored/unexplored environments for microbial producers of natural products. Thar Desert in India is an arid region with mean annual rainfall to mean annual evaporation (MAR/MAE) ratio of 0.07-0.09. In the present study, the main objectives were to selectively isolate actinomycetes from desert soil samples and characterize them for anti-microbial property. Selective isolation procedures were adopted in the screening phase. After dereplication, 20 isolates were used in primary screening against selected Gram positive and Gram negative bacteria. Overall, 77% of isolates were active against Gram positive and 23% against Gram negative bacteria. TD061 and TD070 showed antibacterial activity against all the six target organisms. These isolates were further analyzed for presence of 2, 6-Diaminopimelic Acid (DAP) isomer in the cell wall. Detection of LL-isomer indicates presence of *Streptomyces* sp. Secondary screening and identification of the isolates is in progress.

**Keywords:** Actinomycetes, Thar Desert, antimicrobial, DAP

# All the authors have contributed equally

## **Cyclic plant peptides as biopesticides**

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Naturally occurring circular proteins were not known till 1990s but discovery of cyclotides provided a new angle. Cyclotides are circular plant peptides of approximately 30 amino acid residues having three di-sulfide bonds and cysteine knot motif. This cyclized arrangement gives cyclotides exceptional stability, resistance to enzymatic proteolysis and thermal degradation. Originally discovered in *Oldenlandia affinis*, they are primarily produced by plants as host defense mechanisms which include insecticidal, nematocidal, molluscicidal and anti-microbial activities. The hydrophobic patches present on their surface help them in interaction with the pest. They bind to the membrane, form pores, alter the permeability of the membrane and disrupt them with significant mortality rate. They can be synthetically produced and directly used as pesticides in the field. Solid phase chemistry is a preferred synthetic method to produce cyclotides. Cyclotides can be produced recombinantly in bacteria and plants as well as by chemo-enzymatic methods or biological approaches involving modified inteins.

**Keywords:** Cyclic Peptides, Biopesticide, Cyclotide, Insecticide, Solid phase chemistry.

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## **Screening and isolation of laccase producing fungi**

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Laccase (EC 1.10.3.2), copper containing enzyme, catalyses the oxidation of various aromatic compounds specifically phenols and anilines while concomitantly reducing molecular oxygen to water. Promising industrial and environmental applications of laccase include textile-dye decolourization, pulp bleaching, food industry, bioremediation of soils and water, polymer synthesis, the development of biosensors and biofuel cells, pharmaceuticals & cosmetic industry. Solid state fermentation holds tremendous potential for large scale production of enzymes. In current study, an attempt has been made for isolation of potential laccase producers from different sources. A total of ten fungal isolates has been obtained and were screened for laccase production on screening media containing guaiacol as indicator compound. Laccase production by selected fungal isolate MARC-1 in submerged and solid state fermentation was compared. Maximum laccase activity of 0.15 U/ml was obtained on 4<sup>th</sup> day of incubation in synthetic medium. High relative humidity, pH 5.0 and 30°C temperature resulted in maximum laccase activity of 1.1 U/gds in solid state fermentation using wheat bran as substrate after 5 days of incubation in comparison to 1.68 U/gds from *P. chrysosporium* under similar conditions.

**Keywords:** Laccase, Solid state fermentation, Bioremediation, Relative humidity, Dye-decolourization

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## **Approaches in Bioprospecting of Natural Products**

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Natural products from microbial sources have served as the most promising leads for development of drug molecules. However, identification of novel bioactive natural products is not an easy process; effective purification and identification steps are the major bottlenecks. Based on survey of relevant literature, we present here some of the techniques in common use involving identification of novel candidate organisms and compounds produced by them which have further served as templates for development of therapeutic molecules. The initial steps involve diversity studies (culture-dependent and culture-independent approaches) for identification of potentially novel microorganisms. Novel biodiversity suggests potential chemodiversity. Subsequent steps target the natural product biosynthetic pathways namely the Polyketide Synthase (PKS) and Non-Ribosomal Peptide Synthetase (NRPS) in these organisms (identified by both approaches). Further steps involve expression of these pathways and elicitation of the products, all the above approaches facilitated by bioinformatics tools.

**Keywords:** Natural products, Polyketide Synthase, Non-Ribosomal Peptide Synthetase.

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## **Docosahexaenoic acid (DHA): Modern food for human brain**

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Nutraceutical is an umbrella term used for food having myriad of health and medical benefits. They range from herbal products to dietary supplements and more recently genetically engineered food. Fatty acids especially PUFAs (poly unsaturated fatty acids) form a major category of the nutraceuticals. Nowadays Docosahexaenoic acid (DHA) is receiving major attention in maintenance of adult brain health and infant brain development. It has been frequently touted to be an essential nutrient for proper functioning of human brain. It is also a key player in the development of infant brain during the last trimester of pregnancy and during the initial years after birth. It has to be essentially present in the diet as infants do not have developed systems for elaborate procedure of DHA production. Absence of DHA in post natal years seriously jeopardises the brain health and functioning of children. DHA is considered to be rich source for the development of brain tissue and retina in the infant but now days, it is a concern, for ongoing preservation and proper functioning of the brain and retina tissues even in the old age. Many positive effects of DHA have been observed in many Neurodegenerative diseases. Conclusive evidences of recovery have been found especially in case of Alzheimer's disease. The derivative of DHA, Neuroprotectin D-1 (NPD-1) functions in protection from the various age –related neurodegenerative diseases. So, DHA should be regularly included in one's diet for healthy aging.

**Keywords:** Nutraceutical, Docosahexaenoic acid (DHA), Brain, Retina, Neuroprotectin D-1 (NPD-1)

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## **Evaluation of antimicrobial potential of *Cymbopogon citrates***

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Plants have been a tremendous source of traditional medicine since ancient times. India is a land of rich biodiversity with 6000-7000 plant species estimated to have medicinal usage in folk and documented systems of medicine including Ayurveda, Siddha, Unani and Homoeopathy. There is global resurgence in traditional and alternative health care systems resulting in world herbal trade expected to reach US\$ 7 trillion by 2050. WHO estimated that over 80% of the people depends on traditional medicines for their primarily health needs. *Cymbopogon citratus* (lemon grass) is known to have tremendous therapeutic potential. The aim of the present study is to evaluate the antimicrobial potential of various plant leaf extracts on five different microorganisms (*Micrococcus luteus*, *Staphylococcus epidermidis*, *Staphylococcus saprophyticus*, *Aspergillus parasiticus*, *Rhizopus oryzae*). Antimicrobial activities of ethanolic and methanolic extracts were highest against *S. saprophyticus* (13±1.5 mm and 11±1 mm) followed by *M. luteus* (12±1.25 mm and 10±1 mm). Aqueous extract showed no activity against test organisms.

**Keywords:** *Cymbopogon citratus*, antimicrobial activity, medicinal plant, leaf extract



## **Intranasal route of anti-epileptic drug delivery**

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Status epilepticus is a neurological disorder associated with high mortality rates. The delay in initiating the treatment is the main cause of the high mortality rates. Parenteral use of benzodiazepines (Diazepam, Midazolam and Lorazepam) has been first line of treatment for status epilepticus necessitating hospitalization of patients. In emergency conditions like SE the patient is in unconscious state and considerable time goes into providing the patient with the treatment. Intranasal route provides for a non invasive outpatient option for treatment since drug delivery through intranasal route has comparable onset of action to intravenous injection. Drug Delivery through nasal route is an active area of research as nasal Mucosa offers a large surface area for absorption and rich blood supply that enables rapid absorption of drug into the blood resulting in, enhanced bioavailability of the drug. Besides drug delivery through olfactory region of nasal cavity provides for a direct pathway for nose to brain delivery. Antiepileptics given through nasal route enables direct delivery to CNS resulting in reduced peripheral circulation and hence reduced dosage. Irritability and formulation passing to systemic circulation need to be controlled when considering intranasal approach.

**Keywords:** Intranasal, Anti-epileptic, Benzodiazepines

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## **Antimicrobial and antioxidant activities of *Ginkgo biloba* EGb 761**

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*Ginkgo biloba* is considered as living fossil. In recent years, *Ginkgo biloba* extract has been extensively studied due to its various medicinal properties in the world. *Ginkgo* contains a number of biologically active compounds for its defense against insects, bacteria, and fungi. The main bioactive constituents are terpeno trilactones and flavonoid glycosides which are considered responsible for the pharmacological activities of the standardized leaf extract. *G. biloba* exhibit protective effect on cardiovascular diseases, diabetes, aging and several cancer types which is mainly attributed to its antioxidant activity. The focus of our study was to evaluate antimicrobial and antioxidant activity of different extracts of EGb761. The antibacterial activity of aqueous, methanol, ethanol, acetone, and chloroform extracts of EGb761, standardized extract of *G. biloba*, was assessed against six strains (*Micrococcus luteus*, *Staphylococcus epidermidis*, *Staphylococcus saprophyticus*, *Bacillus subtilis*, *Pseudomonas putida*, *Pseudomonas fluorescense*) employing disc-diffusion assay. The methanol extract showed the highest activity against *M. luteus* (zone of inhibition of 16±2 mm) followed by ethanol extract against *P. fluorescense* (23±3 mm), acetone extract against *M. luteus* (15±2 mm) and chloroform extract against *M. luteus* (17±3 mm). Antioxidant activities of different extracts were analyzed using ABTS assay.

**Keywords:** *Ginkgo biloba*, Antimicrobial, Antioxidant, Bioactive, ABTS

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## **Molecular Chimerism**

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As per Greek mythology, chimera is a fantastical beast; a fire releasing animal with goat's body, lion's head and snake's tail. In context of molecular chimerism, molecule made up of two different subunits from different organisms is regarded as molecular chimerism. Molecular chimerism basically includes chimerism of genes and proteins because only they are the ultimate targeted molecules in the cell. Mitochondrial genome which is an example of natural chimera, contain a number of chimeric genes in itself which vary greatly within species. On the other hand, cancerous cells also contain many chimeric proteins in themselves which arises due to chromosomal translocation and tandem duplication due to mutation. Now the concept of molecular chimera constructs find its applications in wide variety of fields to produce it synthetically. For example development of chimeric monoclonal antibodies to reduce the immunological rejection of administered mono clonal antibodies to humans which were manufactured using a different host species. These constructs are also necessary in the study of disease development as these molecules are used as biological probes and bioactive agents, for example in detection of leukemia by using chimeric protein construct. Pharmaceutical field also require chimeric constructs to deal with the disease; Molecular chimera is also used to enhance the graft acceptance ability of an organism and reducing its dependency on the immune-suppressants. The formation of chimeric protein construct is also used to study protein folding and protein structure of individual protein. Several molecular chimeras are generated to increase the nutritional quality of food products (crops) by introducing specific amino-acid rich proteins combined with their own secretory proteins. Thus, molecular chimeras are the potential source for the future development of new molecules and enhancement of existing ones to develop the new hidden forms of molecules.

**Keywords:** chimera, monoclonal antibodies, probes.

## **Naturally Derived Histone Deacetylase Inhibitors in Breast Cancer Therapy**

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Breast cancer is the second most common type of carcinoma among Indian women and very common amongst worldwide. There are many traditional therapies available like chemotherapy, radiotherapy etc for the treatment but these have severe side effects. Recently, there is much interest in modulating histone acetylation as a new class of drugs, histone deacetylase (HDAC) inhibitors as anti-cancerous agents. HDAC activity is associated with transcriptional repression. Aberrant recruitment of HDAC activity has been associated with the development of certain human cancers. HDAC inhibitors provide an alternative therapeutic approach for the treatment of breast cancer with lesser side effects. Although the use of HDAC inhibitors holds a potential for effective treatment, all of them are synthetic chemical molecules like Trichostatin A, Scriptaid, Sodium Butyrate etc and the use of natural products as HDAC inhibitors can have great therapeutic potential. There is a need for a natural anti-cancer agent or HDAC inhibitor with fewer side effects. Several plant derived products have been reported as useful anti-cancerous therapeutic agents. Present study aims at the detailed study of potent role of natural products like curcumin (Turmeric), Diallyl Disulfide (Garlic), Sulforaphane (Broccoli) etc to suppress breast carcinoma and early diagnosis.

**Keywords:** *Breast cancer, Natural products, HDAC inhibitors, Cancer therapy, Toxicity.*

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## **Lignocellulosic biorefinery: creating value from waste**

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Biorefinery is a collection of processes that utilizes a renewable biological or bio-based source to produce an end-product, or products resulting in zero- waste production, leading to sustainable resource utilization. Lignocellulose, the most abundant biomass produced from photosynthesis, has the potential to serve as sustainable supply of fuels and chemicals. A report released by Ministry of New and Renewable energy has reported 610 MT of lignocellulosic agricultural residue production every year. The National Biofuels Policy has projected a target of 20% blending of petrol and diesel with bioethanol and biodiesel by the year 2017. Lignocellulosic biomass derived biofuels can significantly reduce the green house emission and addressing the issue of energy security and environmental concerns. In recent years, research has been focused to evaluate the usefulness of lignocellulosic crops/ agro-industrial residues for biorefining purposes. The economics of the conversion processes and logistics is a major challenge for lignocellulosic biomass due to the lack of cost effective process technologies and enzymes involved.

**Keywords:** Bioethanol, Biorefinery, Lignocellulose, Agro-residue, Sustainable

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## **mAb-QDs and their Applications**

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There is a need to develop highly specific and sensitive techniques to diagnose cancer at very early stage. Monoclonal antibodies (mAb) against specific biomarkers/antigens of cancer, are being obtained from hybridoma technology as a bioproduct. These antibodies can be used for bioimaging and can even be used to detect very small amounts of antigen(s) present in the body fluid(s) in *in vitro* assays. Recently, Quantum dots (QD) are being developed as effective fluorescent probes for diagnosis of various diseases. QD show robust fluorescence, size tunable optical properties, exceptional photo stability, and allow multi-color imaging of biological samples over the conventional fluorescent probes. QDs conjugated with mAb can identify and target cancer cells with high sensitivity. The aim of current study is to identify specific biomarkers for breast cancer which can further be used to develop mAb for QD conjugation and also to figure out better methods for QD construction. HER2 and CA125 are two of the breast cancer specific biomarker which can be used for developing mAb conjugated QDs. In conclusion, there is still a need to identify new specific biomarkers for specific cancers which will help us to detect cancer more specifically and at an early stage.

**Keywords:** Quantum Dots, Biomarkers, HER2 and CA125, Breast cancer, Monoclonal antibody

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## **Role of chitosan as nutraceutical and its potential applications**

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Nutraceuticals refer to natural function or bioactive phytochemicals that have health promoting and disease suppression properties. They may range from isolated nutrients, herbal products, dietary supplements and diets made from genetically engineered food. Chitosan has achieved much attention as a nutraceutical because of its biomedical applications. It is obtained from deacetylation of chitin which is a biopolymer of 2-acetamido-2-deoxy-D-glucose residues linked by  $\beta$ -(1-4) bonds. Chitin is obtained from the hard outer exoskeleton of crustaceans including crab, lobster, and shrimp which are considered as a marine waste. The biological activities of chitosan are dependent on its molecular weight and degree of deacetylation. Chitosan being polycationic in nature binds with the anionic groups on the cell surface, hence designing an impermeable membrane around the complete bacterial cell which prevents the transportation of essential solutes therefore inhibiting the growth and infection of microbial cells. Another biological characteristic of chitosan is its antioxidant property which is highly dependent on its degree of deacetylation. In the acidic medium, the  $\text{NH}_2$  group at C2 position of chitosan is protonated to  $-\text{NH}_3^+$ , where it donates its hydrogen to the respective reactive oxygen species and detoxifies it effects. Chitosan has also been reported to be having anti-inflammatory, anti-cholesterol, anti-tumor and anti-hypersensitive activity. Hence, chitosan possess tremendous potential and can be considered as a primary source of nutraceutical in future.

**Keywords:** Nutraceutical, Chitosan, Antioxidant, Phytochemicals

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## **Organization of biofilm associated gene cluster in *Pseudomonas spp.***

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*Pseudomonas* is a genus of gram-negative, rod shaped bacteria which belong to the family Pseudomonadaceae. *Pseudomonas aeruginosa* has become an important cause of infection, especially in patients with compromised host defense mechanisms. It is a frequently related to nosocomial infections such as pneumonia, urinary tract infections (UTIs), and bacteremia. The severity of infection increases due to biofilm formation. The biofilm allows the micro-organisms to adhere to any surface, living or nonliving and thus infections due to *Pseudomonas* can involve any part of the body. Further the adaptive and genetic changes of the micro-organisms within the biofilm make them resistant to all known antimicrobial agents making the *Pseudomonas* infections complicated and life threatening. *P. aeruginosa* has three biofilm associated clusters: Pel operon which has seven genes and PsI and Alg operons with twelve genes each. They are responsible for the biosynthesis of extracellular polysaccharide (EPS) which play an important role in cell-cell and cell-surface interactions during biofilm formation. Understanding the genes responsible for biofilm formation is essential to know the potential drug targets for future studies.

**Keywords:** Biofilm, gene cluster, EPS, infection, *Pseudomonas aeruginosa*

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## **Network Biology: Drug target identification in Microbes**

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Drug target identification in pathogenic microbes has been always a challenging task. Several computational methods viz. subtractive genomics, phylogenetic profiling, grid techniques, etc. have been reported with the limitation of one drug one target. The emerging cases of antibiotic resistance in the microbes has alarmed and raised the problem to a previous concept of “one drug one protein”. To comprehend the above, gene-gene & protein-protein interaction network have been mapped on graph based approach and developed the mathematical models viz. scale free, random, and hierarchical in the network biology. These biological networks (Gene regulatory network, Protein-protein Interaction, Metabolic network and Signaling network etc.) utilize different set of algorithms mainly clustering methods to identify the basic properties of the graph viz, centrality, betweenness (bottleneck-ness), degree and hub analysis for motif detection, key connector proteins, shortest path and sub-graph identification and subsequently, the potential drug target identification in the network. Recently, with an improved understanding and availability of ample amount of protein-protein interaction dataset, the role of network biology has been widely studied & applied to identify the novel drug target identification in microbes.

**Keywords:** Antibiotic resistance, Network biology, Drug target, Phylogenetic profiling, Subtractive genomics