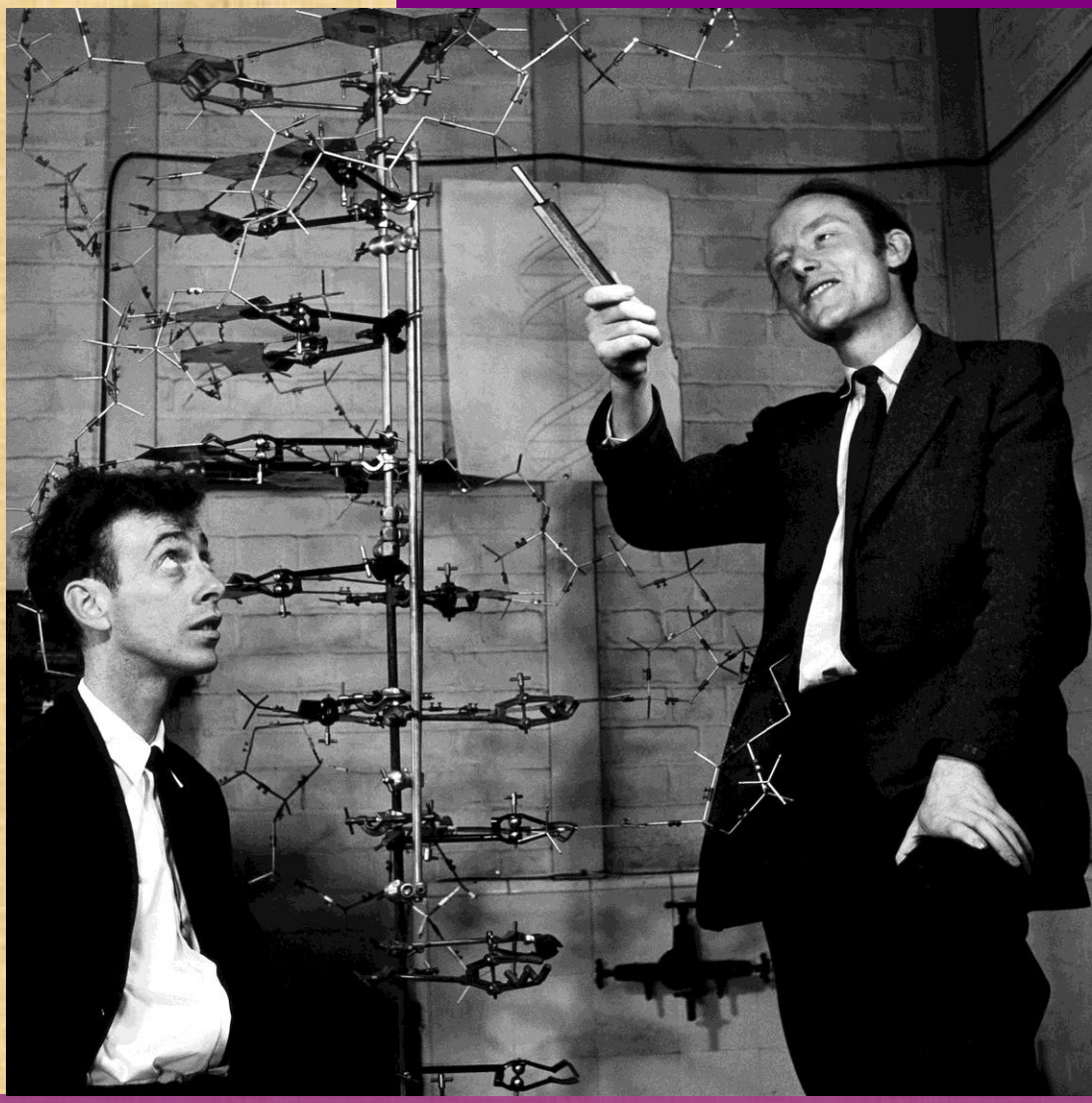
AMITY UNIVERSITY GWALIOR

BIOSPARK

E-Newsletter

Amity Institute of Biotechnology

July, 2016; Volume I Issue I



In this Issue

Cover Image: 1953 – Watson and Crick's 3D Model of DNA

Message from Editor-in-Chief ……

It is my great pleasure to introduce the first issue of AIB Newsletter, **BioSpark**. It intends to propagate the latest happenings in life science including Biotechnology, Biochemistry, Microbiology, Zoology, Botany etc. Biotechnology is contributing significantly towards improving social and economic quality of life in the 21st Century. This multidisciplinary science incorporates basic and applied sciences, namely; Biology, Physics, Chemistry, Mathematics and Computer Science to understand and solve the problems related to human health, environment, agriculture and industry. Allied branches of biotechnology such as Pharmaceuticals, Genetic Engineering, Agriculture Biotechnology, Biochemistry, Microbiology, Post Harvest Technology, Animal Husbandry, Material Science, Environment Science, Energy, Biosensors, Nanobiotechnology etc, provide broad spectrum career opportunities for youngsters to carve their future.

This is an endeavour to achieve biotechnological advancements for the benefit of science and society at large. We have tried to include articles on cutting-edge research in Biotechnology in particular and science in general. Notable achievements by our students, alumni and institute have also been highlighted in this newsletter.

I hope this newsletter will acquaint students, researchers and academicians with recent research and innovations in life sciences. I take this opportunity to thank the editorial team for putting in their efforts to bring a wonderful and informative newsletter.

We welcome your inputs for forthcoming edition in October 2016.

Prof. (Dr.) R. S. Tomar
Editor-in-chief
BioSpark
AIB, AUMP e-Newsletter

E-NEWS LETTER BioSpark

Editorial Board

Editor-in-Chief

Prof. (Dr.) Rajesh Singh Tomar,
Director, AIB & Dean (Academics), AUMP, Gwalior

Editors

Dr. Raghvendra Kumar Mishra
Associate Professor

Dr. Vikas Shrivastava
Associate Professor

Dr. Shuchi Kaushik
Assistant Professor

Dr. Anurag Jyoti
Assistant Professor

Reviewers

Dr. Raghvendra Saxena
Assistant Professor

Dr. Pratistha Dwivedi
Assistant Professor

Dr. Manish Kumar
Assistant Professor

Mrs. Sharmistha Banerjee
Assistant Professor

Expert Opinion

Harnessing the Power of Biotechnology for Human Health

Biotechnology is the new wonder of science. It is truly multidisciplinary in nature and encompasses several disciplines of basic sciences and engineering. The Science disciplines from which biotechnology draws heavily are microbiology, chemistry, biochemistry, genetics, molecular biology, immunology, cell and tissue culture and physiology etc. In the industry, it leans heavily on process chemical and biochemical engineering since large scale cultivation of microorganisms and cells, their down stream processing are based on them.

Biotechnology is a very vast field and its applications are used in various fields of science such as medicine, agriculture etc. Biotechnology is involved in diagnosing and treating different diseases. It also gives opportunities for the people to protect themselves from wide spread diseases. With the cutting-edge research, Gene therapy has emerged as a potential tool for modifications of DNA within cells in an organism to cure a disease.

Biotechnological approaches are now widely used by industries to produce commercially important products especially for research, pharmaceutical and other health care purposes. A non-pathogenic strain of *Escherichia coli* bacteria, modified with the gene of human insulin, has ability to produce insulin at industrial scale, which can be purified and used to treat diabetes in humans. Microorganisms can also be exploited to produce digestive enzymes and could be colonized in the intestinal tract of persons with digestive enzyme insufficiencies.

Another very important applications of biotechnology lies in the DNA fingerprinting. It is the process of cross-matching two strands of DNA using a reference. In forensic investigations, DNA samples of hair, body fluids or skin at a crime scene are compared with those obtained from the suspects. The incorporation of Polymerase Chain Reaction (PCR) technique has revolutionized the rapid and accurate diagnosis of the presence of infectious diseases such as AIDS, Hepatitis, Typhoid, Swineflu, etc.

The Indian Biotechnology sector is now gaining visibility around the world and is being tracked for promising field for investment opportunities. Biotechnology is a powerful technology that can revolutionize the next wave of technological change through employment generation, intellectual wealth creation, expanding entrepreneurial opportunities and industrial growth.

Prof. Sangeeta Shukla
Vice Chancellor
Jiwaji University, Gwalior

Researcher develops new, non-invasive method to wipe out cancerous tumors

Published in Medical express on June 27, 2016 by Joanna Carver

Matthew Gdovin, an Associate Professor in the UTSA Department of Biology, has developed a newly patented method to kill cancer cells. His discovery, described in a new study in the ***Journal of Clinical Oncology***, may tremendously help people with inoperable or hard-to-reach tumors, as well as young children stricken with cancer. "There are so many types of cancer for which the prognosis is very poor," he said. "We're thinking outside the box and finding a way to do what for many people is simply impossible."

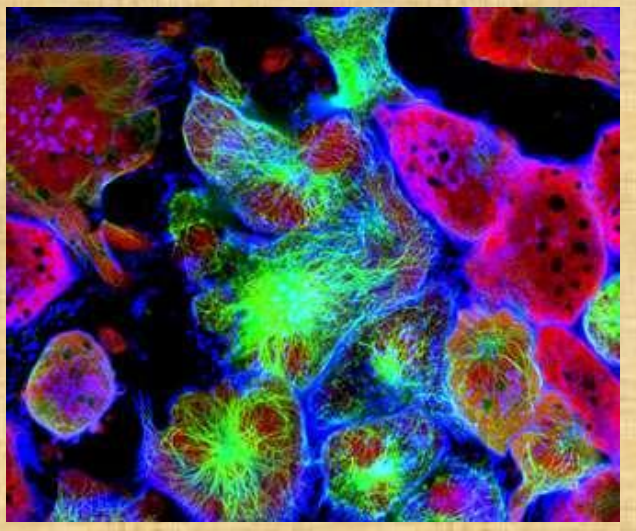
Gdovin's top-tier research involves injecting a chemical compound, nitrobenzaldehyde, into the tumor and allowing it to diffuse into the tissue. He then aims a beam of light at the tissue, causing the cells to become very acidic inside and, essentially, commit suicide. Within two hours, Gdovin estimates up to 95 percent of the targeted cancer cells are dead.

"Even though there are many different types of cancers, the one thing they have in common is their susceptibility to this induced cell suicide," he said.

Gdovin tested his method against triple negative breast cancer, one of the most aggressive types of cancer and one of the hardest to treat. The prognosis for triple negative breast cancer is usually very poor. After one treatment in the laboratory, he was able to stop the tumor from growing and double chances of survival in mice.

"All forms of cancer attempt to make cells acidic on the outside as a way to attract the attention of a blood vessel, which attempts to get rid of the acid," he said. "Instead, the cancer latches onto the blood vessel and uses it to make the tumor larger and larger."

Chemotherapy treatments target all cells in the body, and certain chemotherapeutics try to keep cancer cells acidic as a way to kill the cancer. This is what causes many cancer patients to lose their hair and become sickly. Gdovin's method, however, is more precise and can target just the tumor.



Cancerous tumor cells. Credit: University of Texas at San Antonio

In the past two years, he's developed his photodynamic cancer therapy to the point where it's non-invasive. It now requires just an injection of the nitrobenzaldehyde fluid followed by a flash of an ultraviolet light to cause the cancer-killing reaction. Gdovin has now begun to test the method on drug-resistant cancer cells to make his therapy as strong as possible. He's also started to develop a nanoparticle that can be injected into the body to target metastasized cancer cells. The nanoparticle is activated with a wavelength of light that it can pass harmlessly through skin, flesh and bone and still activate the cancer-killing nanoparticle.

Gdovin hopes that his non-invasive method will help cancer patients with tumors in areas that have proven problematic for surgeons, such as the brain stem, aorta or spine. It could also help people who have received the maximum amount of radiation treatment and can no longer cope with the scarring and pain that goes along with it, or children who are at risk of developing mutations from radiation as they grow older.

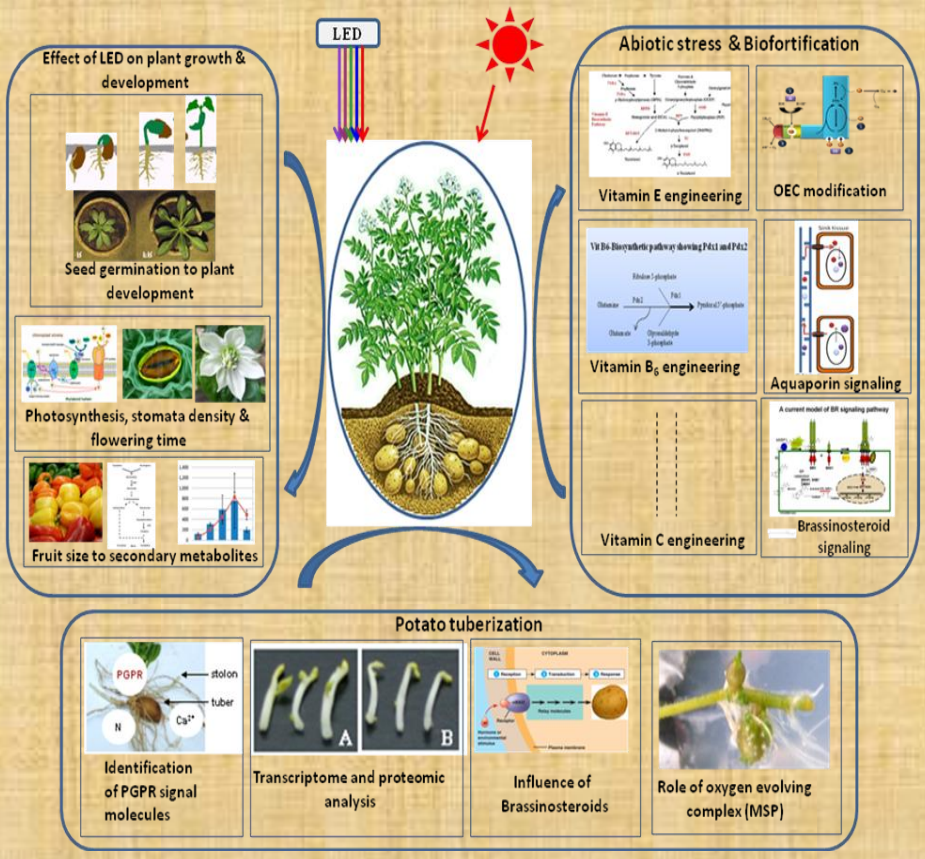
Articles from Contributors

Light Emitting Diode: A promising tool for horticulture crops

Environmental conditions are changing very rapidly because of several reasons like natural causes, human interference, Short-lived and long-lived climate forcers. In this condition it is very difficult to obtain desire quality and quantity of plant products, specially horticulture crops. As we know optimal environmental conditions have always been crucial for proper growth and development of plant. The three primary and most important ecological factors for plant growth are (a) Light, (b) Temperature, and (c) Water. Light, being the sole source of energy, plays a major role in plant growth and development. Hence, it is not surprising that plants have developed the capability to sense various factors of ambient light signals, including quality and quantity of light. Plant responses to various effects of light occur in terms of multiple developmental processes such as seed germination, seedling, plant shape and size, flowering and fruit development. The intensity and exposure time of light can alter the primary and secondary metabolites of plant.

The conventional light sources used in greenhouses are fluorescent lamps, metal halide, high-pressure sodium, and incandescent lamps. However, these light sources have certain limitations like mixture of impractical wavelengths, high cost and heating that is not suitable for plant growth especially in case of India. In recent days, Light emitting diodes (LEDs) are replacing conventional light sources. Now days LEDs has become more popular and effective source of light because of the following features: DC power, small mass/volume, specific wavelength, adjustable light intensity/quality, low thermal energy output, and long life, and low electric cost. Various effects of different LEDs have been studied in some food and horticultural crops such as cymbidium and lettuce. Most of these studies emphasized the role of blue light on chloroplast development, chlorophyll formation, and stomatal opening.

Red light was found to be critical for induction of stem elongation, leaf expansion, and photosynthesis. It was also reported that red and blue light have an effect in seedling photo morphogenesis in lettuce and cymbidium. Although previous studies were able to determine the physiological and morphological effects of light quality, responses may vary according to plant species.



One cannot determine specific effects of light quality, therefore, this could not be quantified. However with the help of different LEDs (blue, red, red plus blue) light, primary and secondary metabolites (total sugar, reducing sugar, starch, protein, and free amino acid) may be altered as per need.

Dr. Raghvendra Kumar Mishra
Associate Professor,
Amity Institute of Biotechnology

Kitchen garden spices for sustainable health!!!

Kitchen garden spices are used as additives to flavor, color or preserve food since ancient time in India. These are pungent or aromatic substances obtained from dried seeds, fruits, roots, bark or leaves. Spices can be defined as "A strongly flavored or aromatic substance of vegetative origin, obtained from tropical plants". These are the potential source of natural products and naturally derived compounds. These compounds show the antioxidant, antimicrobial properties therefore, it can considered as traditional source of medication. Since last few years there has been an exponential growth in the field of herbal medicine and these drugs are gaining popularity both in developing and developed countries because of their natural origin and lesser side effect.

India is the largest producer of the medicinal herbs and spices. It is historically known as a land of spices and aromatic plants, it continues to be one of the leading producers of spices and medicinal plants in the world.

The World Health Organization (WHO) has listed 21,000 plants, which are used for medicinal purposes around the world. Among these 2500 species are in India, out of which 150 species are used commercially on a fairly large scale.

Today, many ethnic cuisines are recognized for their reliance on "signature" herbs and spices. Turmeric in Indian cuisine; basil, garlic, and oregano in Italian and Greek cuisines and lemongrass, ginger, cilantro, and chilli peppers in Thai food represent some of the cultural diversity in the use of herbs and spices. According to available literature kitchen spices can play a major role in healthy digestion and can be used in medication. Food can be medicine by adding delicious herbs. Following are a few common kitchen spices with their medicinal affects:

Anise (*Pimpinella anisum*) – treats flatulence, Bay (*Laurus nobilis*) – prevents gas and indigestion, Caraway (*Carum carvi*) – prevents gas, colic, indigestion, and nervous conditions, Cardamom (*Elettaria cardamomum*) – treats indigestion, gas, colic, and diarrhoea, Cayenne (*Capsicum anuum*) – aids circulation, indigestion, calms gas, Cinnamon (*Cinnamomum zeylanicum*) – treats diarrhoea, cramps, abdominal pains, indigestion, and gas, Cloves (*Syzygium aromaticum*) – improves digestion, calms flatulence, stops vomiting and nausea, Cumin (*Cuminum cyminum*) – relieves gas, Fennel (*Foeniculum vulgare*) – carminative, and antispasmodic, Fenugreek (*Trigonella foenumgraecum*) – soothes ulcers and inflammations of the stomach and intestines, Garlic (*Allium sativum*) – antibiotic, relieves gas , Ginger (*Zingiber officinale*) - aids digestion, prevents nausea, aids intestines in detoxification , Marjoram (*Origanum majorana*) – aids upset stomach, and colic, Rosemary (*Rosmarinus officinalis*) – aids indigestion, colic, nausea, and gas, Sage (*Salvia officinalis*) – relieves diarrhoea, Thyme (*Thymus vulgaris*) – treats intestinal worms, gas, and diarrhoea.

In India many of these spices are used in everyday cooking and significant quantities may be consumed in a single meal. It is estimated that an adult in India can consume 80-200 mg/day of curcumin the bioactive component of turmeric. Few scientist have reported that some Indians consume up to 50 g of garlic in a week. This data suggests that therapeutic doses of the active ingredients in spices can be taken by dietary consumption alone. However, for many patients, treatment with nutraceuticals present in food with enhanced concentrations of the active ingredients of the spices can be done. There is a widespread effort in India to define the potential health benefits of herbal medicines, including spices, and identify the active ingredients, especially compounds with antioxidant and anti-inflammatory properties

Thus Spices are the major natural products used to add flavor and aesthetic, aromatic and therapeutic treatments to food, drink and other items. However valued for more than just taste and appearance, spices have nutritional and medicinal merits, as well as, they are sometimes better known as home remedies than proven treatments in medicine. Recently, the general acceptance of traditional medicine for health care and the development of microbial resistance to several available antibiotics have thus led researchers to investigate the activity of medicinal plants against infectious diseases.

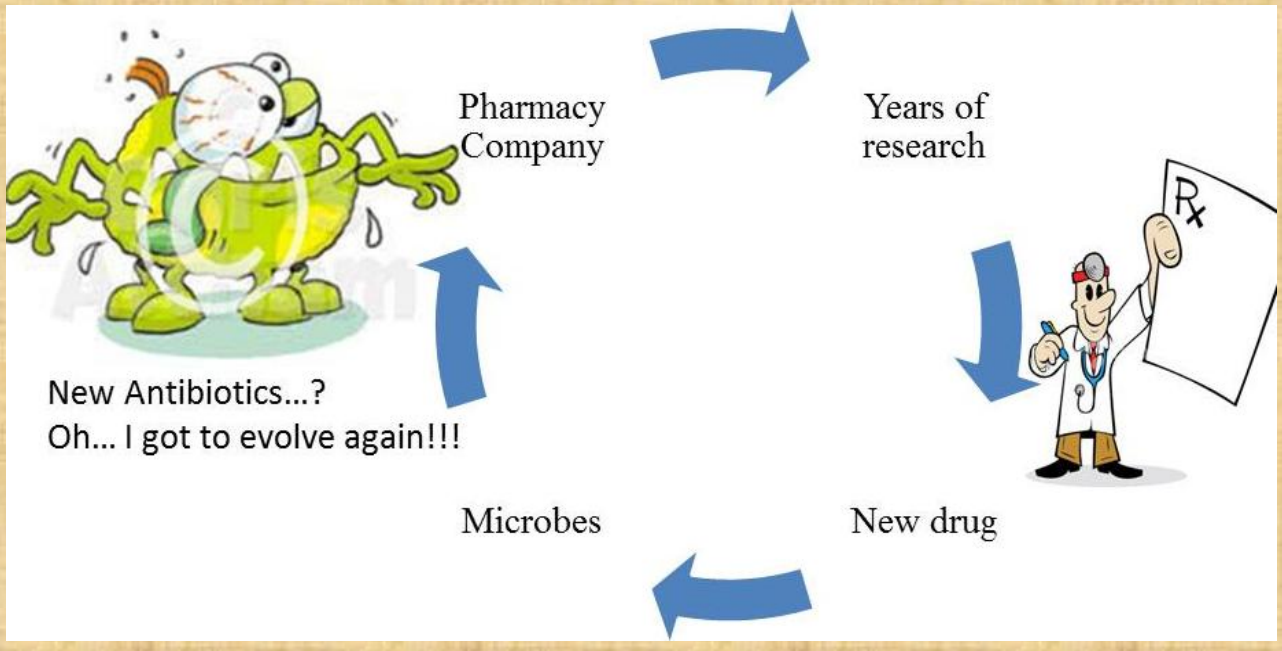
Thus this article attempts to spread lights on the multi-chemo therapeutic uses of the spices, grown in Indian kitchen gardens chosen along with the aroma and taste they provide to food. This can play a big role in preparation of different cuisines with the major benefits to health.

Dr. Vikas Shrivastava
Associate Professor,
Amity Institute of Biotechnology

Antibiotic Resistance: A Global Concern

A century ago, the top three causes of death were infectious diseases. Today, they account for a few percent of deaths at most. We owe much of that, of course, to antibiotics. The discovery of prontosil, the first synthetic modern antibiotic, earned Gerhard Domagk the Nobel Prize in 1939. Mass-produced penicillin earned Alexander Fleming, Ernst Boris Chain and Howard Walter Florey one in 1945.

It is hard to overstate how much less of a threat infectious diseases pose to us today. But we take antibiotics for granted. We use them inappropriately and indiscriminately. This has led many to worry that our days of receiving benefits from them are numbered.



Earlier infection with Methicillin-Resistant *Staphylococcus aureus* (MRSA) is almost exclusively contained to health care facilities. However, it has started to appear in the wider community. Concern about the rise of resistance often focuses on overuse of antibiotics. There's plenty of evidence that we, the users, are the problem. Every time we use antibiotics, we increase the chance for resistant strains to develop. Bacteria are very good at the evolution game, and killing off more susceptible strains leaves the more resistant ones to fill the gap. Bacteria have also become good at transmitting resistance abilities through plasmids, small, circular DNA molecules that can be transferred from bacteria to bacteria.

In a recent multi country study conducted by the World Health Organization, almost two-thirds of people believed that antibiotics could be used to treat colds and the flu, which are, of course, caused by viruses. Antibiotics kill bacteria, not viruses.

Methicillin-resistant *Staphylococcus aureus* bacteria is untreatable with most commonly used antibiotics. The most common way bacteria become resistant to antibiotics is through horizontal gene transfer. Small bits of DNA, called plasmids, contain the resistance and can hop from one bacteria to another. There is a reservoir of antibiotic resistance out there which bacteria can pick and choose from. Antibiotic resistance can work in different ways. There may be different mechanisms of resistance as either selfish or co-operative. A selfish drug resistance only benefits the individual cell with the resistance while a co-operative antibiotic resistance benefits both the resistant cell and surrounding cells whether they are resistant or not.

Until very recently, even as some *E. coli* have become resistant to nearly every antibiotic, they have remained susceptible to colistin, an old but rarely used (in humans) drug. Being old, though, the drug is cheap, and for that reason it has become popular to add colistin to animal feed in some countries, like China, in order to produce cheaper pork and other meats.

In a recent report published in Lancet Infectious Diseases, scientists discovered colistin-resistant *E coli* in 21 percent of slaughtered pigs in China. They found isolates in 15 percent of meat sold from those animals in retail sites. They even detected resistant E coli in more than 1 percent of hospitalized patients.

Most horrifying, it appears that the resistance is transmitted by plasmids. That means the bacteria don't just pass on resistance to their "children"; they can pass it among one another and to completely different strains of bacteria. Scientists were also able to detect colistin resistance from the same gene in *Klebsiella pneumonia* in hospitalized patients. The accompanying editorial to the colistin report called this "a major breach in our last line of defense." and Imipenem, released in 1985, saw resistance in 1998. It's also in this game of catch-up that we are failing. While 19 new antibiotics were approved by the F.D.A. from 1980 to 1984, only 13 were approved from 2000-2014. We aren't keeping pace with resistance.

A recent study conducted in mouse cells suggest that targeted antibiotic can eliminate infections caused by microbes that are resistant to most drugs. A team at biotechnology company Genentech in South San Francisco, California, borrowed a concept used in cancer treatment, in which an antibody — a protein designed to attach to particular cells — is connected to a cancer-fighting drug. Such 'antibody–drug conjugates' include Genentech's Kadcyla (trastuzumab emtansine), which docks onto breast-cancer cells before deploying its cancer-killing payload.

Sanjeev Mariathasan, an immunologist at Genentech, and a large team of co-workers adapted this strategy — which they tested in mouse cells — by gluing an antibody against *Staphylococcus aureus* (*Staph*) bacteria to an antibiotic, a modified version of the drug rifampin, which is used to treat tuberculosis. MRSA is thought to be deadly because after *Staph* invades the body, it quickly enters cells, where it becomes hard to kill with antibiotics.

The research team found that its antibody–antibiotic combination drug was highly effective at doing this. The team infected mice with MRSA, then treated them with a control drug, vancomycin — most often used to treat internal MRSA infections — or with its experimental combination drug. The experimental drug was approximately a thousand times more effective against MRSA than was vancomycin, the team reports in *Nature*.

The work "suggests a new approach to eliminate subpopulations of bacteria that are protected by virtue of location or physiological state", says physician Henry Chambers at the University of California, San Francisco. He adds that there is a long way to go before proving that the drug helps people with *Staph* infections, but if it does it could be an important new weapon against bacterial infections: "It could change treatment if it can be demonstrated to improve outcomes as well," says Chambers.

Mariathasan says that the treatment works like a stealth bomb. First, the antibiotic component docks onto *Staph* bacteria that are floating freely in the mouse's body. Then, the bacteria invade cells, carrying the therapy with them. Once inside, enzymes break the connection between the antibody and the antibiotic, activating the antibiotic precisely where it is needed to kill the bacteria.

If the experimental drug works in humans, it also could help drug companies and researchers to find new uses for old drugs. Many experimental antibiotics fail in trials because they are toxic at the doses needed to produce a therapeutic effect, or because they do not work when they are given through pills, intravenous lines or injections that do not deliver the drug directly into cells. In principle, targeted antibiotics could be given at lower doses because they reach precisely the cells in which they are needed, and thus might be less likely to cause side effects.

Furthermore, "new classes of antibiotics tend to be put into the drawer", to prevent them becoming overused, Hardt says. "Antibody conjugates could help us revisit drugs and thereby help to fill the empty pipeline."

The best outcome is preventing infections through vaccination or public health measures so that we improve human health without increasing resistance to antibiotics.

Dr. Shuchi Kaushik
Assistant Professor,
Amity Institute of Biotechnology

Nanomaterials: Boon or Bane for Human Health

Nanotechnology involves the creation and manipulation of materials at the nano-scale level (1-100 nm) to produce unique products with novel properties. Nanomaterials are being explored to present countless opportunities to develop new and improved consumer products for the societal benefits. In recent past, technology has advanced with a rapid pace and resulted into exciting new discoveries in engineered nanomaterials and their applications. In particular, engineered nanomaterials and the advancements in biotechnology are making rapid changes in our everyday life. Some of these include diagnostic aids, targeted site-specific drug delivery of anticancer drugs, imaging, biomedicine and sensing.

Recent developments in nanotechnology have generated a degree of apprehension concerning potential human health risks and environmental safeguards associated with engineered nanomaterials following their high volume use and potential for release. Health risk assessment involving different animal species for multi-organ toxicity complimented with molecular investigations in cells is essential for investigating the potential toxic effects of nanomaterials.

Exposures can occur from direct exposure or from the use of commercial products made of nanomaterials. Safe manufacturing guidelines for prevention of exposures and recommendations on safe handling and use need to be established on a proactive basis to prevent adverse outcomes. The purpose of this review is to present the potential applications of nanotechnology and current state-of-knowledge regarding the adverse effects of nanomaterials on human health.

Dr. Anurag Jyoti
Assistant Professor,
Amity Institute of Biotechnology

Exogenous Anti-oxidants: Its role in Combating Cancer and a good Chemoprotective agent

Cancer is unnatural cell growth, in which cells lose their normal function and spread throughout the blood or lymph in the entire body. Oxidative Stress is involved in the process of the development of cancer and tumors, ROS (Reactive Oxygen Species) damage the biomolecules such as lipids, which react with metals (such as free iron and copper) and produce aldehydes and synthesize malondialdehyde-inducing mutations or cause breaks in the double chain, generating modifications in guanine and thymine bases, and sister chromatid exchanges, which ultimately affects signal transduction, transcription factors, and gene tumor suppressors such as p53, a gene that plays an important role in cell cycle control and apoptosis. The inactivation of p53 gene can increase the expression of proto-oncogenes which can produce major damage. Oxidative damage or genetic defects that result in some defective enzymes are incapable of repairing the mutations increase the incidence of age-dependent cancer.

On the other hand, treatments with anticancer drugs and radiation increase ROS and decrease antioxidants content, producing a state of severe oxidative stress and causing apoptosis, resulting in side effects, while persistent oxidative stress at sublethal levels can result in resistance to apoptosis.

Antioxidants are chemicals that interact with and neutralize free radicals, thus preventing them from causing damage. Antioxidants are also known as “free radical scavengers”. The body makes some of the antioxidants it uses to neutralize free radicals. These antioxidants are called endogenous antioxidants. However, the body relies on external (exogenous) sources, primarily the diet, to obtain the rest of the antioxidants it needs. These exogenous antioxidants are commonly called dietary antioxidants. Fruits, vegetables, and grains are rich sources of dietary antioxidants. Examples of dietary antioxidants include beta-carotene, lycopene, and vitamins A, C, and E (alpha-tocopherol). Exogenous antigens are obtained from plant and animal sources.

Many researchers are working with different types of natural antioxidants with the aim of finding those with the greatest capacity to inhibit the development of cancer both *in vitro* as well as *in vivo*, because these compounds have exhibited high potential for use not only in the treatment of this disease, but they also act as good chemoprotective agents.

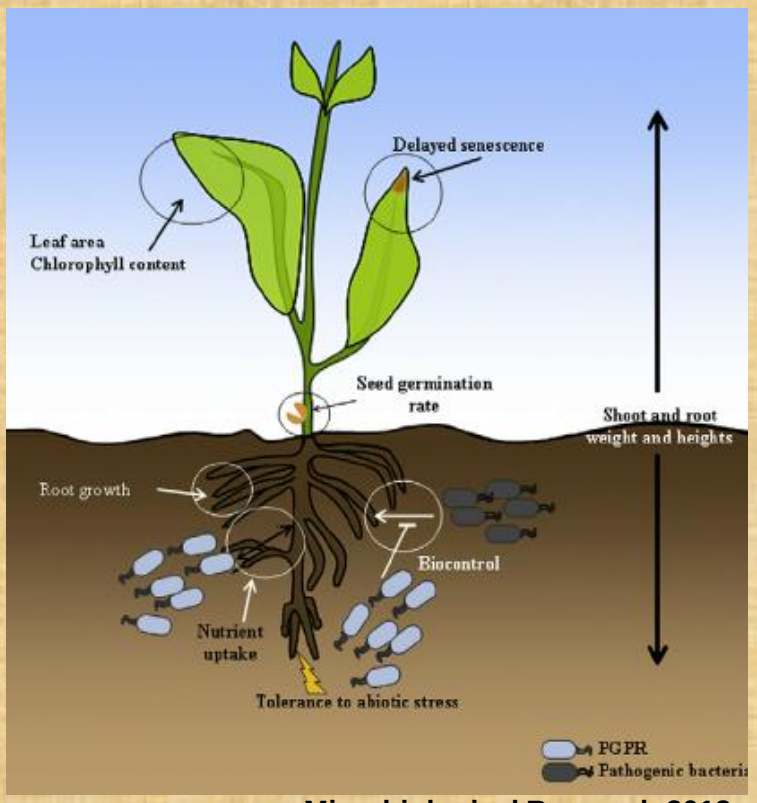
Different types of natural antioxidants are present in fruit and vegetables; they have synergistic interactions that are important due to their activity and regenerative potential. For example, ascorbate can regenerate into α-tocopherol , and the ascorbate radical is regenerated into other antioxidants via the thiol redox cycle. Taken together, all of these interactions are known as the "antioxidant network". Vitamin E is an antioxidant that penetrates rapidly through the skin and is incorporated into the cellular membranes, inhibiting lipid peroxidation; specifically, α-tocotrienol, the vitamin E isoform, demonstrates greatest protection. Additionally, vitamin E possesses antiproliferative properties that interfere in signal transduction and in inducing cell cycle arrest.

Sharmistha Banerjee
Assistant Professor,
Amity Institute of Biotechnology

Drought mitigation in crops by implementation of plant growth promoting rhizobacteria (PGPR)

Due to climate change, there are frequent incidences of various abiotic stress especially drought around the world are predicted. Therefore, Plants' tolerance to drought stress needs specific attention in order to develop crops that can perform better (Growth and Production) under limited water resource availability. Several strategies are available that can augment plant tolerance under drought stress. For instance, conventional plant breeding methods are time consuming and restricted to various factors, whereas genetic engineering of crops with improved tolerance to drought could, theoretically, be faster, but it would come with its own set of challenges including time consuming, labour intensive and social acceptance. But such approaches may overlook the ecological context of the soil environment in which the crops are grown. In the recent years microbes associated approaches are gaining central attention towards sustainable agriculture. Since plant-associated microbes can influence plants' responses to the environmental conditions, including drought stress. Therefore, application of microbial based approaches to mitigate drought stress in crop plant could be an approach of difference.

Various plant-associated microbial communities i.e., mycorrhizal fungi, nitrogen-fixing bacteria, and plant growth-promoting rhizobacteria (PGPR), currently have received increased attention for enhancing crop productivity and providing stress resistance in crop plants. Although the roles of PGPR in plant growth promotion, nutrient management, and disease control are well known, their roles in the management of abiotic stress such as drought has more recently gained importance. The advantages of using PGPR to help plants mitigate stress include their ability to confer drought tolerance to many plant hosts such as monocotyledonous and dicotyledonous row and vegetable crop species and their ability to confer more than one type of biotic and/or abiotic stress tolerance. Plant-growth promoting rhizobacteria (PGPR) are usually associated with roots and are capable enough to extend sufficient and effective tolerance to plants from deleterious effect of drought stress and other abiotic stresses, probably by modulating various physiological and biochemical responses against drought stress. When plant experiences the harsh environmental stresses, PGPR usually facilitates improvement in tolerance by adapting different strategies. Some of the way by which PGPR improves stress tolerances in plants by activating phytohormones like ethylene, auxin, abssiccic acid (ABA), gibberllic acid. Enzymes like 1-aminocyclopropane-1-carboxylate (ACC)-deaminase activity and production of bacterial product like exopolysacchride (EPS), formation of biofilm and secretion of volatile organic compounds (VOCs) . Ultimately, plant adaptations to drought stress is a key step for the development of drought tolerant varieties and cost efficient management practices. So looking forward the benefits of rhizobacteria (PGPR), which can provide comparatively low cost alternative strategies to improve plant growth, production and facilitate protection against harsh environmental conditions make them a viable tool and which may help agriculture adapt to continued climate change.



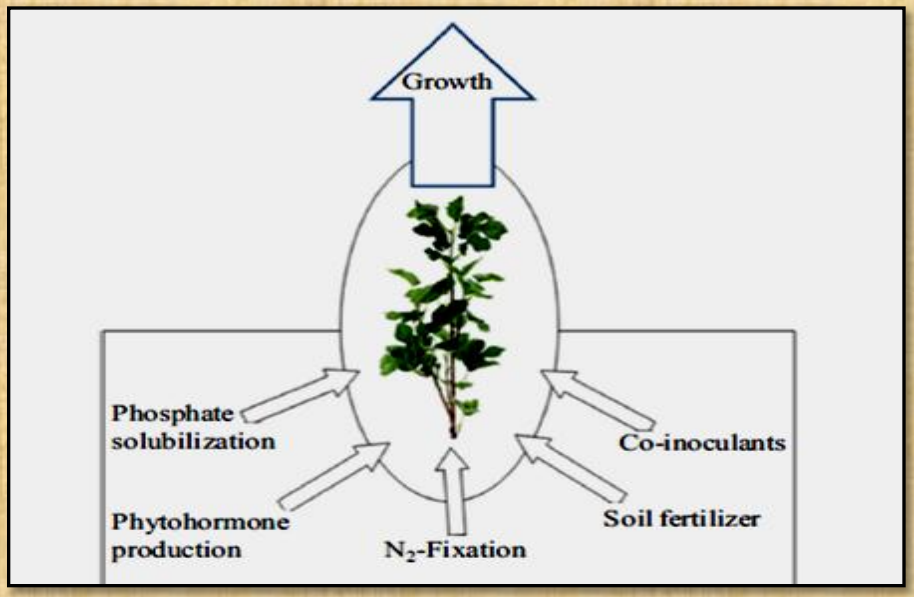
Microbiological Research 2013

Dr. Raghvendra Saxena
Assistant Professor
Amity Institute of Biotechnology

Methylotrophs: an important microbial source in sustainable agriculture

Methylotrophic bacteria are known to play a significant role in the biogeochemical cycle in soil ecosystems, ultimately fortifying plants and sustaining agriculture. Methylotrophs also improve air quality by using volatile organic compounds such as dichloromethane, formaldehyde, methanol, and formic acid. Additionally, methylotrophs are involved in phosphorous, nitrogen, and carbon cycling and can help reduce global warming. Here, different aspects of the interaction between methylotrophs and host plants are discussed, including the role of methylotrophs in phosphorus acquisition, nitrogen fixation, phytohormone production, iron chelation, and plant growth promotion, and co-inoculation of these bacteria as biofertilizers for viable agriculture practices.

The use of chemical fertilizer has an "environmental footprint": It diminishes crop yield, destroys the soil nutrient balance, leads to poor soil quality in terms of physiochemical properties, and gives rise to a variety of plant diseases. The use of chemical fertilizers is not only costly but also hazardous for both the environment and humans. In addition, manufacturing of such fertilizers deplete non-renewable natural resources. Methylotrophs on plant surfaces can be a major sink of volatile organic compounds (VOCs) such as methanol and other C1-VOCs, thus improving air quality (Fall 1994). Some facultative methylotrophs are reported to oxidize methyl bromide, while a few methanotrophs degrade volatile trichloroacetic acid (TCE) (Shukla et al. 2009; Schaefer and Oremland 1999). Biocapture of C1-VOCs from the plant phyllosphere has also been reported (Bringel and Coue´e 2015). Moreover, methylotrophs regulate carbon cycling and therefore may reduce global warming.



Methylotrophs mediated plant growth promotion

Rhizospheric and non-rhizospheric methylotrophs associated with plant growth can be exploited for eco-friendly and cost-effective practices to promote sustainable agriculture. The application of methylotrophs as bioinoculants and in microbial sprays to crops is common, and their use as alternatives to chemical fertilizers is also increasing. Methylotrophs employ multiple mechanisms to promote plant growth, which makes them a suitable and promising candidate for use in sustainable agriculture. They regulate and govern biogeochemical cycling in soil ecosystems, making the land more amenable to crop production. Additionally, phytohormone production, plant growth promotion, nodulation, nitrogen fixation, and nutrient acquisition all make methylotrophs a promising substitute to chemical fertilizers for crops. In summary, methylotrophic bacteria offer the alternative of biological control, plant growth enhancement by nitrogen fixation, phosphate solubilization, phytohormone production, and ACC deaminase production in the rhizosphere, along with balanced carbon cycling. These beneficial methylotrophs can play a significant role in sustainable agriculture.

Dr. Manish Kumar
Assistant Professor,
Amity Institute of Biotechnology

ROTEM-based diagnostics: Technology for Patient Blood Management

Patient Blood Management (PBM) is an international initiative in best practice for transfusion medicine. The concept was highlighted in 2010 by the World Health Assembly as an important concept to improve patient safety. All WHO member states were requested to implement this concept in a timely manner to optimize use of blood products by taking clinical decisions informed by evidence and thereby save scarce blood.

India, as of now, has not developed or launched a protocol for Patient Bleeding Management (PBM) though the concept is in use in a limited way. A mind set change is critical to move towards PBM. This is a major challenge.

Happily, there is an emerging interest in India in PBM. The PBM growth drivers in India are (i) increasing realisation that transfusion needs to be evidence-based and not behaviour-based as currently done; and (ii) scarcity of blood in India – shortage of 3 million units annually. India, with its population of 1.2 billion people, needs 12 million units of blood annually but collects only 9 million - a 25% deficit and in summer the shortfall often hits 50%. This shortage has led to a spurt in professional donors cashing in on the needs of desperate patients, and to a flourishing black market.

Rotational thromboelastrometry (ROTEM) is a point of care (POC) testing device measuring the viscoelastic properties on multiple aspects of blood coagulation in a sample of citrated whole blood. ROTEM can also monitor the substitution requirement for either fibrinogen or platelet, and heparin and protamine dosage. The information can then be used by clinicians to assess the cause of bleeding and to improve the diagnosis and subsequent management of patients who experience unexplained blood loss resulting from surgery or trauma.

ROTEM-based diagnostics related to excessive bleeding is targeted and evidence-based that helps doctors in judicious use of blood transfusion and use of blood products thereby minimizing use of blood transfusion. This in turn minimizes risks of mortality, morbidity, hospital acquire infection – sepsis – arising from RBC transfusion. It also leads to reduction in costs to patient, hospitals, and other stakeholders like medical insurance companies and blood banks. Also, the ROTEM technology helps doctors/surgeons/anesthetists in assessing and controlling bleeding and bleeding risk in patients undergoing liver transplantation, cardiac surgery, trauma treatment, and women affected with postpartum haemorrhage (PPH) during/after childbirth.

ROTEM®-guided bleeding management significantly reduces bleeding, transfusion requirements and improved outcomes in patients undergoing the above procedures. In obstetrics, the major advantage of ROTEM® testing is that the obstetric and anesthetic team can rapidly identify whether the bleeding has a purely obstetric cause, or if the bleeding is being exacerbated by abnormal haemorrhage. As per WHO, 25% of all deaths due to postpartum haemorrhage (PPH) occur in India – i.e. women die per minute in India due to PPH. A scientifically developed Patient Bleeding Management protocol and use of Rotational thromboelastrometry (ROTEM) can significantly reduce PPH related deaths as it has done in Sri Lanka.

Our country has gone through thromboelastography (TEG), an old technology, that has a few similarities with ROTEM that is a new technology and vastly different from the earlier technology. In fact, the device is highly cost effective. Applying the concept of PBM, the devices helps hospitals save millions of dollars annually on blood products, optimizes patient healthcare and most importantly, ensures efficient use of blood, a scarce resource, avoiding wastage and promoting blood conservation.

Other evidence-based benefits as reported in medical journals based on studies in EU, USA, among other countries are (i) reduction of hospital length of stay by 16-33%; (ii) reduction of total hospital costs by 10-24%; (iii) reduction of mortality by up to 68%; (iv) reduction of infection rate by 81%; (vi) reduction of morbidity by up to 41%; (vii) reduction of reoperation rate by up to 43%; and (viii) reduction of hospital re-admission rate by up to 43%.

Dr. Pratistha Dwivedi
Assistant Professor,
Amity Institute of Biotechnology

Alzheimer's Disease: Greatest Threat to Productive Aging

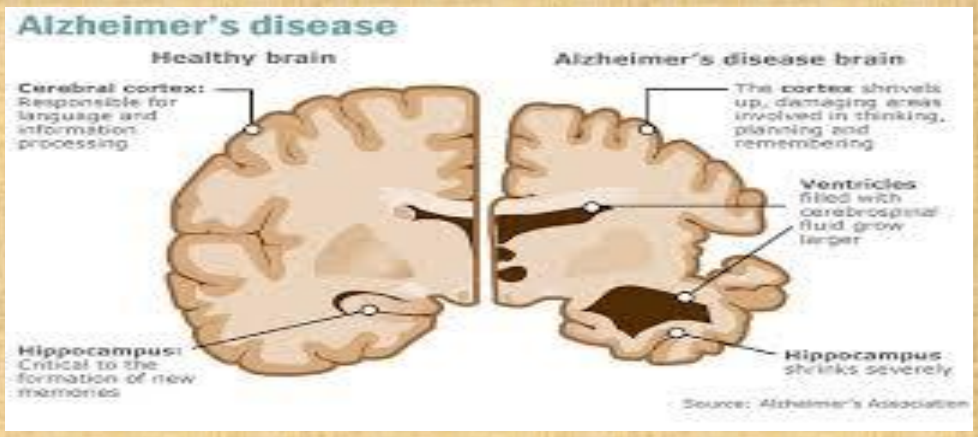
Neurodegeneration is progressive loss of structure or function of neurons, including death of neurons. Many neurodegenerative diseases including Parkinson's, Alzheimer's, Huntington's, occur as a result of neurodegenerative process. Many similarities appear which relate these diseases to one other on a subcellular level. Discovering these similarities offers hope for therapeutic advances that could ameliorate many diseases simultaneously.

Among all neurodegenerative disease Alzheimer's disease (AD) is the most common type of dementia, accounting for 60-80% of cases. It is estimated that every 71 second someone in America develops AD; by 2050, it is expected to occur every 33 second, and globally there is a new case every 07 second.

AD has traditionally been defined as disease in which normally soluble proteins accumulates in the extracellular space of various tissue as insoluble deposits of 10nm fibrils that are rich in β-sheet structure and have characteristic dye binding properties. AD-related pathology manifests as changes in behavior and memory loss, amongst other symptoms. Effective treatments are limited and disease management consists of life-style adjustments. Several hypotheses have been suggested to explain the molecular basis of AD. Metabolism of the amyloid precursor protein (APP), an 87 kDa product (NCBI Accession Number: BAA22264.1) of a single gene, located on chromosome 21 in humans, has been implicated as a potential cause of AD. APP is a membrane protein, with a large extracellular domain. The fate of APP is committed to one of two catabolic pathways, catalyzed by either α-secretase, which is active under normal conditions, or β-secretase, which is linked to AD progression. Sequential enzymatic cleavage of APP by the enzymes β-secretase, in the extracellular domain, and γ-secretase, within the transmembrane domain, yields short, 38-43 residue products of proteolysis called the amyloid β-protein (Aβ), which undergo self-association and aggregation to form plaques, which has been associated with AD-related neuropathy].

Treatment of AD may be designed against one or more steps of APP metabolism. The first committed catalytic-step leading to AD is APP cleavage by the enzyme β-secretase, as discussed above. Following processing by β and γ-secretases, Aβ aggregation takes place to form plaques. Hence, AD-control can be exercised at the level of β–secretase activity and/or Aβ-plaque formation, which does not interfere with normal processing of APP by α and γ-secretase. A recent report suggests that small-molecule dyes, which are known to bind protein aggregates, may possess the ability to stimulate *in-vivo* aggregate-removal, thereby prolonging the life of the host. Descampas et al., identified a bioflavonoid nutritional supplement as a molecular

lead that acts as an AβPP-Selective BASE Inhibitor (ASBI) in cell models, and show that increasing brain levels of this bioflavonoid through a pro-drug approach leads to reduction of $A\beta_{42}$ in an Alzheimer's disease mouse model. Additionally, antibodies designed against the Aβ plaque represent a potent target for disease control. Anti-acetylcholine-esterase drugs have also been implicated in providing a moderately effective treatment option with significant side-effects.



Natural extracts offer an alternative strategy to control AD, with potentially fewer side-effects. A natural product, which represents a potentially effective therapy, including disease-prevention, against AD and disorders caused by oxidative damage, is the crude extract of cyanobacteria. Oral administration of the cyanobacterium *Spriulina* has been shown to mediate several protective effects. Specifically, the pigment molecule phycobilin, bound to the light-harvesting multi-subunit protein PBP has been implicated in anti-oxidative effects. Oxidative-stress is reported to be involved in up-regulation of *β*-secretase leading to the formation of Aβ, and hence causing AD. It has been suggested that the cyanobacterial protein-pigment complex PBP's may possess the capacity to regulate the oxidative-stress to reduce Aβ-related pathology. However, it is not known if the anti-oxidative and anti-AD effects are restricted exclusively to the pigment phycobilin, or to the intact PBP complex exerts possess anti-AD activity.

Aayushi Agrawal
Alumni, AIB

Researchers Design *E. coli*-Based Transport Capsule to Help Fight Pneumococcal Disease

The harmless strains of *E. coli* are being experimented- yes, the majority of *E. coli* is safe and important to healthy human digestion. Distinctively, researchers have developed an *E. coli*-based transport capsule designed to help next-generation vaccines do a more efficient and effective job than today's immunizations.

The research, described in a study published recently in the journal *Science Advances*, highlights the capsule's success fighting pneumococcal disease, an infection that can result in pneumonia, sepsis, ear infections and meningitis.

It's a bit counterintuitive given what you hear about *E. coli*, but there are many strains of the bacteria, most of which are perfectly normal in the body that have great potential to fight disease," said Blaine A. Pfeifer, Associate Professor of chemical and biological engineering in the University at Buffalo School of Engineering and Applied Sciences.

The core of the capsule is harmless *E. coli* around the bacteria, the researchers wrapped a synthetic polymer - called poly (beta amino ester) - like a chain link fence. The positive-charged polymer, combined with the negative charged bacteria cell wall, create a sort of hybrid capsule. To test the capsule, the researchers then inserted a protein-based vaccine, also being commercialized by Abcombi, designed to fight pneumococcal disease. The results, when tested in mice, were impressive.

The capsule's hybrid design provided:

• Both passive and active targeting of specific immune cells called antigen-presenting cells that trigger and immune response.

• Natural and multi component adjuvant properties, which enhance the body's immune response.

• Dual intracellular delivery mechanisms to direct a particular immune response.

• Simultaneous production and delivery of the components (antigens) required for a vaccine.

• Strong vaccination protection capabilities against pneumococcal disease.

• It's also relatively inexpensive to create and flexible in terms of use. For example, the capsule could be used as a delivery device for therapies that target cancer, viral-based infectious disease and other illnesses.

Priya Dulani
Alumni, AIB

BIOCON: An Endeavour in Indian Biotechnology

Biocon is India's largest and fully-integrated, innovation-led biopharmaceutical company. Biocon committed to reduce therapy costs of chronic diseases like autoimmune, diabetes, and cancer. Biocon is committed to develop research - driven cutting edge therapies, tryst with innovation enabled us to address the relatively unmet needs of patients through differentiated products in challenging therapeutic spaces. They earned the trust of patients and doctors through new emerging products that are safe, efficacious and affordable.

Biocon constantly engaged in pursuit of excellence to find solutions that heal the world. Through innovative products and research services we are constantly enabling access to affordable healthcare for patients, partners and healthcare systems across the globe. They have successfully developed and taken a range of novel biologics, biosimilars, differentiated small molecules and affordable recombinant human insulin and analogs from 'Lab to Market'.

They have a rich pipeline of biosimilars and novel biologics at various stages of development including a high potential Insulin Tregopil. Biocon is considered as the largest Indian Insulins Company and it is believed that they have made a huge difference to millions of diabetic patients in India. Over the years Biocon has also emerged as a leading Indian oncology company making cancer-care 'affordable' and 'accessible' to patients in India.

Biocon's key innovations include an indigenous recombinant human insulin based on proprietary fermentation technology, INSUGEN, insulin analogue Glargine, BASALOG, ALZUMAb™(Itolizumab), a 'first in class' anti-CD6 monoclonal antibody and India's first indigenously produced monoclonal antibody BioMAb-EGFR®, for head & neck cancer. INSUPen® is a next generation affordable insulin delivery device introduced in India by Biocon.

Over the decades, Biocon has successfully evolved into an emerging global biopharma enterprise, serving its partners and customers in over 100 countries.

About Amity Institute of Biotechnology

Biotechnology has emerged as a major discipline not only in industrial terms but also as academics. The frontier areas of biology are being integrated to enhance the quality of Food products, Agriculture, Medical and Environmental conditions. Integration of advanced aspects of traditional biological sciences of Zoology, Botany, Biochemistry, Genetics and Microbiology, this course has been evolved to meet the demands of the Research and Industry based world. The interdisciplinary approach and the emphasis on research and publication is the novel method used in this course to make it more contemporary and relevant. The global developments in Biotechnology need to be understood and harnessed by the Research Scientists in India at all the levels viz. undergraduate, postgraduate students, Ph.D. With these objectives Amity Institute of Biotechnology, was established at the Amity University Madhya Pradesh, Gwalior (M. P.) in 2011 for teaching and research in the areas of Biotechnology.

The academic programs of AIB are well integrated with Research & Development. High quality research work is being carried out in frontier topics like bioremediation, bionanotechnology, environmental biotechnology, microbial and molecular genetics, natural products, etc. AIB is dedicated to provide quality education, so we can empower talented and balanced human young minds with the required theoretical and technical knowledge that is necessary to take on the challenges offered in the highly competitive field of biotechnology.

Institute Overview & Vision

Amity University Madhya Pradesh is established by the Ritnand Balved Education Foundation (RBEF), New Delhi to promote professional, industry-oriented education in the state of Madhya Pradesh. Amity University Gwalior, located on 100 acres of land opposite Gwalior Airport, imparts modern, practical and research-based courses which will lead to the development of manpower which is employable and ready for industry. The Amity Institute of Biotechnology in AUMP was established in 2011. The main focus of AIB is to promote high quality research and develop technically skilled human resources in the area of Biotechnology. Our vision is to achieve excellence at the National/International level in research and manpower development in the field of Biotechnology. Development of cutting edge technologies, imparting high quality education and conducting research in forefront areas are the main features of the Institute. The Institute faculties have also been contributing to high quality research in the front line areas of Biotechnology in the form of publications and patents. The department organizes the regular visit of eminent Professors & Scientists of National and International repute from Institutes/University in India and abroad.

Due to this excellent quality of teaching and research program, the Department will be able to generate excellent human resources in Biotechnology. Department aims to nurture the potential of all the students. The department is well equipped with modern and sophisticated instruments. They make the students competent not only for achieving good records in their degree but also to qualify for national competitive examinations like NET for JRF/Lectureship.

Infrastructure:

Amity Institute of Biotechnology has fully equipped, centralized air conditioner Class rooms with wi-fi connection and audio visuals facility. The Institute has establish well equipped Laboratories for different streams like Microbiology, Molecular Biology, Immunology, Biochemistry, Plant tissue culture, Animal cell culture, Bioprocess Technology, Bioinformatics etc.

Ph.D Scholar enrolled: Six Research scholars are pursuing Ph.D in AIB.

Summer Internship by AIB Students

• AIB Students carried out their summer internship in various reputed Institute/Universities like JNU New Delhi, Delhi University, Banaras Hindu University (BHU), Jamia Milia Islamia New Delhi, Jamia Hamdard New Delhi, NII New Delhi, IIT Delhi, IIT Indore, IIT BHU, IISER Bhopal, IISER Kolkata, MANIT Bhopal, NIIT Allahabad, NIIT Rourkela, etc.

• **Aayushi Agrawal student of B.Tech VIII** Sem. Selected for International fellowship (Summer course "The soil plant atmosphere continuum in arid regions – Agricultural management and environmental aspects" at Ben-Gurion University of the Negev, The Jacob Blaustein Institutes for Desert Research, Sede-Boker campus at Israel).

• **Palak Rawat student of B.Tech VIII** Sem. Selected for International fellowship (Major Project) at Department of Education and Research: UFR Ecologie, Adaptations, Interactions, Department Sciences de la Vie et Santé, AgroParisTech, Paris, France.

• 03 Students of AIB, namely **Nidhi Singh, Jyoti Kumari** and **Nikita Gupta** selected for two months summer Internship fellowship conducted by **Indian Academy of Sciences, New Delhi**. Priya Dulani selected for 02 months summer internship organized by CCMB Hyderabad

Conferences, Workshops and Lectures organised by AIB, AU MP

(A) International Conference on Recent Advances in Biotechnology and Nanobiotechnology

A three day International Conference on Recent Advances in Biotechnology and Nanobiotechnology (Int-BIONANO-2016) was organised by Amity Institute of Biotechnology, Amity University Madhya Pradesh on 10-12 February, 2016. Renowned speakers from different countries delivered their talks on recent cutting-edge researches in biotechnology. Participants across all over the India from different institutes presented their papers and shared their views. The Conference was financial assisted by DBT, New Delhi.

(B) National Conference on Recent Advances in Biotechnology and Nanobiotechnology

A two day National Conference on Recent Advances in Biotechnology and Nanobiotechnology was organised by Amity Institute of Biotechnology, Amity University Madhya Pradesh on 29 and 30 October 2013. Event attracted eminent scientists, scholars and researchers from across the premier institutes of India The Conference was financial assisted by DBT and ICMR New Delhi.

(C) National Workshop: DBT and MPCST sponsored National Workshop cum Hand-on-Training on "Latest Techniques in Molecular Biology, Genetic Engineering and Computational Biology" from 13th October 2014 to 17th October 2014.

(D) DBT sponsored Popular Lecture Series: Amity Institute of Biotechnology, Amity University, Gwalior organised three days lecture of Popular Lecture Series, sponsored by DBT, New Delhi on 23rd Sep, 30th Sep and 1st Oct 2014.

(E) DBT sponsored Popular Lecture Series: Amity Institute of Biotechnology, Amity University, Gwalior organised three days lecture of Popular Lecture Series, sponsored by DBT, New Delhi on 3-5 Nov. 2015

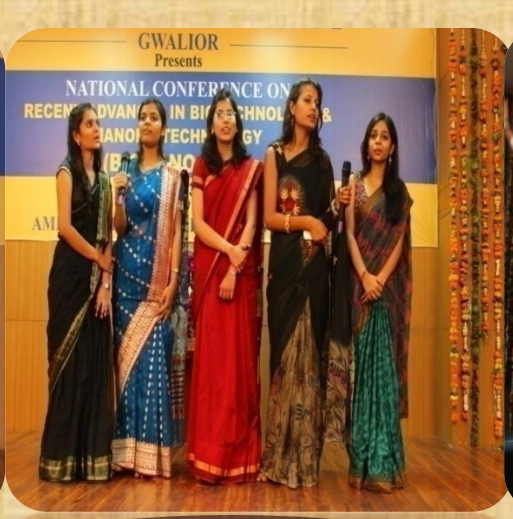
Forthcoming Events

Amity Institute of Biotechnology, Amity University Gwalior (M.P.) is organizing two events:

(a) **National Workshop Cum Hands-on-training on Advance Techniques in Molecular Biology, Medical Biotechnology, Industrial Microbiology and Bioinformatics** on October 12-18, 2016 (Seven days)

(b) Popular Lecture Series on Biotechnology on September 7-9, 2016 (Three days).

Glimpses of AIB Events



Int-BIONANO-2016

BIONANO-2013