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Prof. D. K. Sinha 78 th Indian Science Congress 1991, Indore	Coping with Natural Disasters : An Integrated Approach

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As per decision of Council meeting held on May 3, 2014, Presidential Addresses will not be printed henceforth in Everyman's Science as they are already printed in the above mentioned book.

EDITORIAL**SCIENCE AND TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT**

Creation & destruction is a continuous natural process of evolution. Sustainable development is an inbuilt phenomenon of the nature. These natural development processes are so perfect that in such course of action the nature does not yield any waste and every component of the product is recyclable and usable. These phenomena are so designed that they do not causes any depletion of natural resource and thus maintaining all ecological balances. Modern technological advancements in every field of our life as brought out by our scientist and technologist is also indebted and inspired by the nature. But the science and technology which we are doing now days for development of our industrial growth to benefit society is in true sense any way close to the biomimetic technology and sustainable or not? We should certainly pay attention to it so that it should not be too late to cause imbalance in nature.

In fact, most of the problems which every one of us facing today, like health hazards due to environmental, soil and water pollution, natural disasters *viz.*, earth quakes, flood, draught, landslides and greenhouse effect etc., are our own creation due to our life style and imbalanced industrial development. The irony is that we have even spoiled the two most essential gifts i.e., water and air, given by nature free of cost with inbuilt sustainable mechanism, on the name of development. We are crying for the energy which has also been gifted abundantly in the form of sun by the

nature. But the fact is that it is only the human being who is responsible for these problems. No other living being on earth has ever created natural imbalance and are living with natural cycle yet they are also sufferer because of our deeds.

Environmental issues are one of the primary causes of disease and other health issues and long term livelihood impact for India. So, we have to use our knowledge in a proper scientific manner with all in built element of Biomimetic Technology to make sure that neither present generation nor future generation should face any problem for their survival and livelihood. Our predecessors have taken due care for such imbalance and time to time preached the society for its protection. *Yajnavalkya Smriti*, a historic Indian text on statecraft and jurisprudence, suggested to have been written before 5th century AD, prohibited the cutting of trees and prescribed punishment for such acts. Kautalya's *Arthashastra*, written in Mauryan period, emphasized the need for forest administration. Ashoka went further, and his Pillar Edicts expressed his view about the welfare of environment and biodiversity as given below-

"Happiness in this world and the next is difficult to obtain without much love for the dhamma, much self-examination, much respect, much fear of evil, and much enthusiasm. [...] Beloved-of-the-Gods, King Piyadasi (Ashoka), speaks thus: Animals were

declared to be protected – parrots, mainas, aruna, geese, wild ducks, nandimukhas, gelatas, bats, queen ants, terrapins, boneless fish, vedareyaka, gangapuputaka, sankiya fish, tortoises, porcupines, squirrels, deer, bulls, okapinda, wild asses, wild pigeons, domestic pigeons and all four-footed creatures that are neither useful nor edible. Also protected were nanny goats, ewes and sows which are with young or giving milk to their young, and so are

young ones less than six months old. Cocks are not to be caponized, husks hiding living beings are not to be burnt, and forests are not to be burnt either without reason or to kill creatures. One animal is not to be fed to another. Our king killed very few animals.”

So, we have to be very cautious to generate and use our knowledge of science and technology which should not cause any depletion of natural resources, ecological imbalances and pollution.

Dr. Arvind Kumar Saxena
DMSRDE, Kanpur

“Imagination is more important than knowledge”

—Albert Einstein

SULPHA DRUGS AND THEIR ACTION

Md. Rashid Tanveer and Lokeash Bhatt

This is entirely a review article intended to promote further research over sulpha drugs. Sulpha drugs are highly effective on a number of bacterial infections, but it is found to be resistant on *Mycobacterium tuberculosis*, *Typhoid and Paratyphoid bacilli* etc. In fact, those bacterial cells which can utilize performed folic acid from the host's diet, will not be affected by sulphanilamide drugs. The most characteristic feature of sulpha drug is that its effectiveness varies from person to person. For one person a sulpha drug may be suitable against a particular disease but for the same disease on another person the same medicine may show reactions and may cause deadly side effects. A literature review was done to present a summary of relevant literature on sulpha drugs and their actions. The review addresses the classification, mode of action on human body and side effects of sulpha drugs. The review also identifies potential areas of further research on sulpha drugs.

INTRODUCTION

The sulpha drugs are the derivatives of sulphanilamide^{1,2}. These were the first effective chemotherapeutic agents to be widely used for the cure of the bacterial infection in human³⁻⁵. Sulpha drugs have broad spectrum activity against both gram-positive and gram-negative bacteria. They are active against certain gram-positive and gram-negative cocci, gram-negative bacilli and protozoa. The Sulpha drugs are highly sensitive against *Streptococci*, *Staphylococci*, *corynebacterium*, *E. coli*, *salmonella*, *klebsiella*, *pasteurella* etc.

Sulpha drugs are used to treat some types of bacterial pneumonia, urinary tract infections, shigellosis, *Nocardia* infections (a type of bacterium with an unusual waxy cell wall) and specific protozoal infections.

Sulpha drugs are said to be bacteriostatic in nature because they prevent growth and multiplication of bacteria. PABA (para-aminobenzoic acid) is needed for the growth and multiplication of bacteria. Sulpha drugs compete with PABA due to similarity in its structure and thus cut down the food supply for bacteria. Thus the microorganism gets "starved" of food and cannot reproduce. The recovery from the disease is due to natural healing and immune system of the patient.

Sulpha drugs brought a new revolution in the field of chemotherapy due to following reasons :

- It has low cost.
- Their relative efficacy in many common bacterial diseases.
- pK_a for sulpha of therapeutic interest ranges from 4.79 to 8.56.

* St. Andrew's College, Gorakhpur (U.P.)-273001
Email : rashidtanveer1@gmail.com

- Sulphas have low water solubility & in body, they are more or less acetylated and become more or less soluble in water.
- Many highly soluble sulphas are retained in lumen of gut for prolonged periods and are called "gut active sulphas".
- Synergistic action of sulpha with specific diaminopyrimidines has added a significant dimension to the sulpha therapy.

HISTORY

Sulpha drugs were the first antimicrobial drugs and paved the way of antibiotic revolution in medicine. The first sulpha drug was prontosil. Experiments with prontosil began in 1932 in the laboratories of Bayer AG, at that time a component of the huge German Chemical Trust I.G. Farben. The Bayer team believed that coal-tar dyes able to preferentially bind to bacteria and parasite might be used to target harmful organisms in the body. After years of fruitless trial and error work on hundreds of dyes, a team led by physician and researcher Gerhard Domagk who was working under the general direction of Farben executive Heinrich Hoerlein finally found one suitable dye. It was a red dye synthesized by Bayer chemist of Joseph Klarer that had remarkable effects on stopping some bacterial infections in mice.⁶

Prontosil, as Bayer named the new drug, was the first medicine ever discovered that could effectively treat a range of bacterial infections inside the body. It had a strong protective action against infections caused by *Streptococci*, including blood infections, child bed fever, erysipelas and a relatively lesser effect on infections caused by other cocci.

Later, it was accidentally discovered by a French researcher team, led by Ernest Fourneau, at the Pasteur Institute that the

drug was metabolized into two pieces inside the body, releasing from the inactive dye portion a smaller, colorless, active compound called Sulphanilamide.⁷

The discovery helped to establish the concept of "Bioactivation" and dashed the German corporation's dream of enormous profit; the active molecule sulphanilamide (popularly called sulpha) had first been synthesized in 1906 and was widely used in the dye making industry; its patent had since expired and the drug was available to anyone.⁸

The result was a sulpha craze.⁹ For several years in the late 1930s, hundreds of manufacturers produced tens of thousands of myriad forms of sulpha. This nontoxic testing requirements led to their elixir sulphanilamide disaster in the fall of 1937, during which at least 100 people were poisoned with diethylene glycol. This led to the passage of the Federal Food, Drug and Cosmetic Act in 1938.

As the first and only antibiotic available in the years before Penicilline, sulpha drugs continued to thrive through the early years of World War II¹⁰. They are credited with saving the lives of tens of thousands of patients, including Winston Churchill and the son of President Franklin Delano Roosevelt, Franklin Delano Roosevelt, Jr. in 1936. Sulpha had a central role in preventing wound infections during war. American soldiers were issued a first-aid kit containing sulpha pills and powder and were told to sprinkle it on any open wound.

During the years 1942 to 1943, Nazi doctors conducted sulphanilamide experiments on prisoners in concentration camps. The sulphanilamide compound is more active in the protonated form, which in case of the acid works better in the basic environment. The

solubility of the drug is very low and sometimes can crystallize in the kidneys, due to its first pK_a of around 10. This is a very painful experience, so patient are told to take the medication with copious amounts of water. Newer compounds have a pK_a of around 5-6, so the problem is avoided.

Many thousands of molecule containing the sulphanilamide structure have been created since its discovery by 1945, yielding improved formulations with greater effectiveness and less toxicity. Sulpha drugs are still widely used for the conditions such as acne and urinary tract infections and are receiving renewed interest for the treatment of infections caused by bacteria resistant to other antibiotics¹¹.

Objectives for developing newer Sulphas :

- More soluble at urinary pH
- To prolong their half life
- In a mixture of sulpha, each component of drug shows its own solubility, therefore a combination of Sulphas is more water soluble than a single drug at the same total concentration.

CLASSIFICATION OF SULPHA DRUGS

Sulpha drugs or sulphas are classified into several types, based mainly on indications and duration of action in body¹² :

(a) Rapidly absorbed and rapidly excreted sulphas : These include Sulphadiazine, Sulphapyridine, Sulphathiazole, Sulphamerazine, Sulphamethazine, Sulphamethoxazole, etc.

(b) Rapidly absorbed and slowly excreted sulphas : These include sulphamethoxy pyridazine, sulphadimethoxine, sulphamethoxydiazine, sulphaethoxy pyridazine, etc.

(c) Poorly absorbed (enteric) sulphas :

These include sulphaguanidine and succinylsulphathiazole.

(d) Special purpose sulphas : These include sulphaisoxazole (used in urinary infection) sulphaquinoxaline (used in coccidiosis in poultry) and sulphacetamide (used in eye infection).

MODE OF ACTION OF SULPHA DRUGS

Mode of action of sulpha drugs has been widely studied by many workers¹³. This is shown schematically in Fig 1. In 1940, Woods and Fildes discovered that para-amino benzoic acid (PABA) inhibits the action of sulphanilamide. They conclude that sulphanilamide and PABA, because of their structural similarity must compete with each other within the organism even though they cannot carry out the same chemical function. Further studies indicated that Sulphanilamide does not directly kill bacteria but inhibits their growth. In order to grow, bacteria require an enzyme-catalyzed reaction that uses Folic acid as a cofactor. Bacteria synthesize folic acid, using PABA as one of the components. When sulphanilamide is introduced into the bacterial cell, it competes with PABA for the active site of the enzyme DHPS (Dihydropteroate synthetase). DHPS converts PABA to Folic acid.

Sulpha drugs resemble PABA sufficiently well to bind to the active site of the enzyme DHPS. So as sulpha drug binds with his enzyme, no folic acid can be produced by the enzyme for the bacteria. As a result, bacterial growth is arrested until the body's immune system can respond and kill the bacteria.

Antibacterial sulphanilamides target a bacterial metabolic pathway as competitive inhibitors of the enzyme dihydro pterate synthetase, DHPS. Dihydro pterate

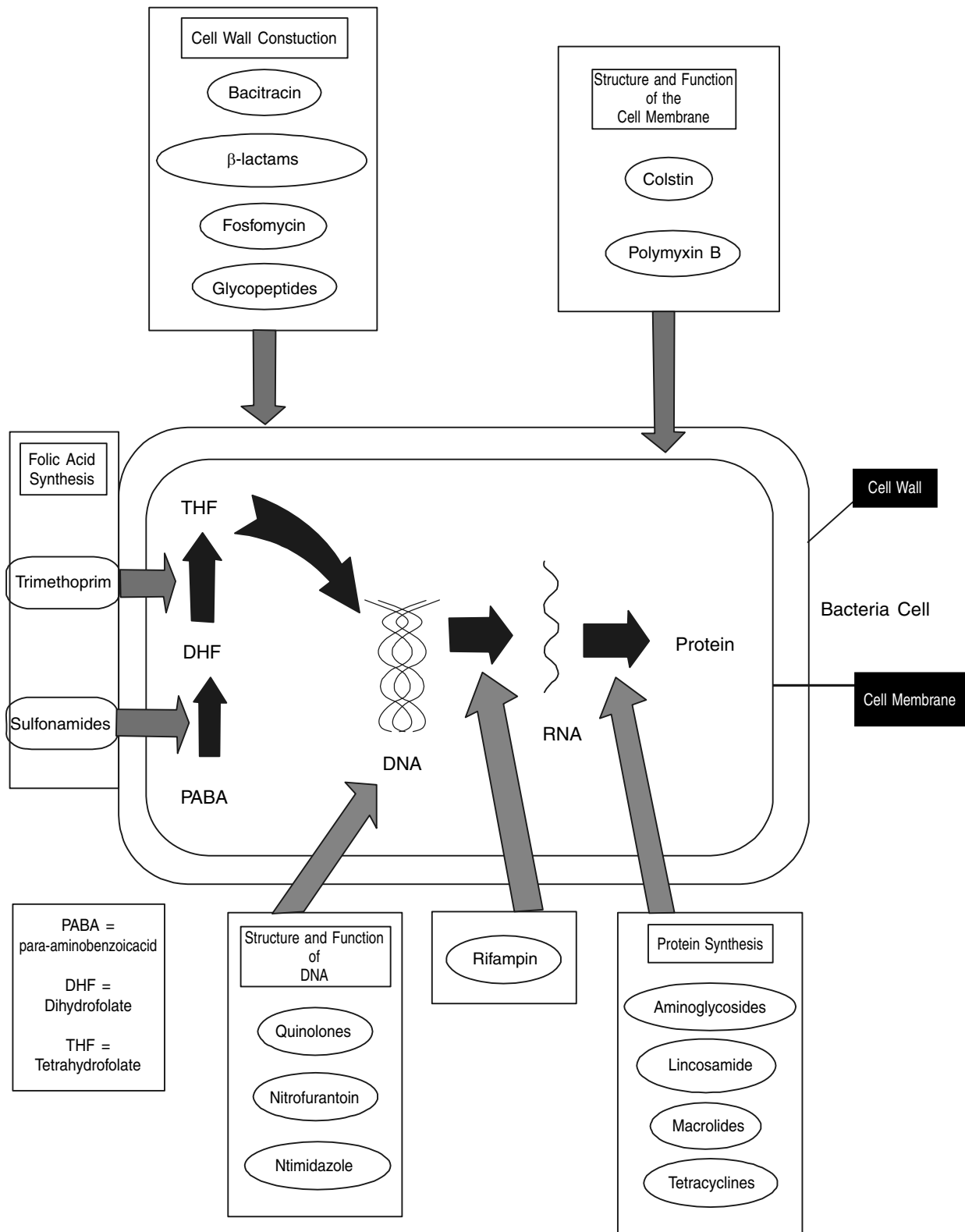


Fig 1. Mode of action of sulpha drug

synthetase activity is vital in the synthesis of folate, and folate is required for cells to make nucleic acids, such as DNA or RNA. So if DNA molecule cannot be built, the cells cannot divide, and the effect is bacteriostatic (rather than bactericidal).

Actually when the bacteria stops dividing, the white blood cells and the reticuloendothelial system of the host comes into action and kills the bacteria and eliminates the infection.

Antibiotics are chemotherapeutic agents used to inhibit or kill bacteria (prokaryotic organisms). Infact Sulphonamides impact bacteria without hurting our cells.

Bacterial cells are prokaryotic primitive cells that differs significantly for human eukaryotic cells. Our cells require performed folic acid, which comes from our diet. However, most of the micro-organism are having such cell membranes which are impermeable to the performed folic acid and thus these micro-organisms need to synthesize folic acid from PABA. PABA is involved in synthesis of folic acid with help of enzyme DHPS. Sulpha drugs act as competitive inhibitors of the enzyme DHPS. So in the presence of sulpha drugs, these micro-organisms cannot synthesize folic acid.

Sulpha drugs cannot cause same effect in our cells because our cells do not synthesize folate. Since we cannot make folate, we need to consume it, and folate is our dietary requirement.

CARDINAL PRINCIPLES OF SULPHA THERAPY

- Should be given to the patients as early as possible.
- Parenteral injection should be preferred in critical cases.

- Maintenance doses should be given to maintain effective concentration in blood.
- Plenty of water and urinary alkalizers should be given.
- In anuria and dysuria sulpha therapy should be stopped.
- Treatment should not be continued for longer than 7-8 days.
- If no response of sulpha is shown within first 2-3 days, treatment by sulpha should be stopped.
- Dosing should be continued for 48 hours even after disappearance of symptoms.

SALIENT FEATURES OF SOME SULPHONAMIDES

(a) **Sulphanilamide** : It is the first sulphonamide applied in vet. Practice. It replaced other medicine because it is more effective and has less toxic effect. It is topical, intrauterine intramammary and are still in use.

(b) **Sulphapyridine** : It is more effective than sulphanilamide. It leads to crystalluria.

(c) **Sulphathiazole** : It is rapidly excreted by kidney. It is less potent. It is administered in DW. It is included in sulpha combinations.

(d) **Sulphaisoxazole** : It is relatively safe. It is used in treating urinary tract infections in dogs and cats. It is rapidly absorbed and rapidly excreted.

(e) **Sulphacetamide** : It is used in aqueous solution on eyes, mammary glands, wounds etc. It is available in 10% soln. and 30% ointment.

(f) **Sulphaquinoxaline** : It is low level feeding, effective in controlling Coccidiosis in poultry.

(g) **Sulphadiazine** : It is used widely in human medicine.

(h) Sulphamerazine : It is effective in systematic chemotherapy. It is synergistic activity with erythromycin. It is currently not in common use.

(i) Sulphamethazine : It is Rapidly absorbed, slowly excreted. It is Available as bolus, crystalline powder and I/V inj.

(j) Sulphamethoxy pyridazine and acetyl sulphamethoxy pyridazine : It is given in the case of dogs and cats, orally. Its absorption is rapid. It is safer, effective and used as long acting sulpha.

(k) Sulphaethoxy pyridazine : It is given in the case of sheep and goats, orally. It is long acting drug.

(l) Sulphadimethoxine : It is well absorbed from GIT. It is available in the form of tablets, boluses and solution. It is used in dogs and cattle.

(j) Trisolizine and Tribriksen : It is a potentiated sulpha. It is combination of sulphadiazine and TMP. It is given rally in calves, foals, sheep, goat, cat and dog. It rapidly achieve plasma level. It is recommended for gut infections.

(h) Trivertin : It is also a potentiated sulpha. It is combination of sulphadoxin and TMP. It is given parenterally. It is recommended in severe systemic infections.

SULPHONAMIDE MIXTURES

These are mixture of sulphamethazine, sulphamerazine, sulphathiazole and sulpha pyrimidine.

POTENTIATED SULPHAS

Sulphas are used in combination with pyrimethamine to treat protozoal disease like leishmaniasis & toxoplasmosis. These are known as potentiated sulphas. For example septran, tribriksen and trivertin. These are

the combination of sulphas like sulphamethoxazole, sulphadiazine and sulphadiazine respectively with trimethoprim (TMP). Some more examples of potentiated sulphas are the combination of sulphadiazine, sulphamethoxazole and sulphadoxine with TMP. There is also a combination of sulphadimethoxine with ormetoprim which has powerful action against bacteria.

Action of Potentiated sulphas

These include the following :

- They belong to group of diaminopyrimidines (Trimethoprim, Methoprim, Ormetoprim, Aditoprim, Pyrimethamine etc.)
- They have proved to be much effective in inhibition of dihydrofolate reductase in bacteria and protozoa.
- They exhibit bactericidal activity with sulphas.
- They act as basic drugs and accumulate in acidic media as urine, milk and ruminal fluid.

ADVANTAGE OF COMBINATION OF SULPHAS WITH TRIMETHOPRIM (TMP)

- Effectiveness of Sulphas can be improved by combining them with inhibitors of bacterial dihydrofolate reductase like TMP.
- The combination decreases amount of sulpha.
- The combination increases therapeutic index.
- The combination widens antibacterial spectrum.

The action of combination is bactericidal and are effective against *Actinomyces*, *Bacillus anthracis*, *Brucella*, *Clostridium*,

Corynebacterium, *E. coli*, *Haemophilus*, *Klebsiella*, *Proteus*, *Salmonella*, *Staphylococcus*, *Streptococcus*, *Vibrio*, etc.

USES OF IMPORTANT SULPHA DRUGS

1. Sulphapyridine : It was found to be very active against pneumonia causing bacteria and once was most popular drug which lowered the mortality rate in those days. It was also used in the treatment of streptococcal and meningococcal infections. However, because of its high toxicity, it has been replaced by more superior, less toxic drugs such as Sulphamerazine.

2. Sulphadiazine : It is highly bacteriostatic and is somewhat less toxic to human being and animals. It is of general use, but is particularly used against all *coccus* infections.

3. Sulphathiazole : It is about 50 times more potent than sulphanilamide. It is highly bacteriostatic. It is of general use, but particularly useful against staphylococcal infections and in bubonic plague. It is relatively less toxic.

4. Sulphamethoxazole : It was approved by the FDA in 1961. According to the FDA database, all brand and generic formulations of Sulphamethoxazole have been discontinued. Although it was once a very useful antibiotic, it is almost absolute as a single agent today due to the development of bacterial resistance to its effects. It is used for the treatment of malaria in combination with quinine sulphate and pyrimethamine. It was once used to treat conjunctivitis and urinary tract infections. Now a day, Sulphamethoxazole is used as a part of synergistic combination with the compound Trimethoprim in a 5 : 1 ratio in co-trimoxazole, also known as Bactrim and Septrin.

5. Sulphaguanidine : It is only slightly absorbed in the intestinal tract and possesses no toxic and after effects, so it is one of best

sulpha drugs against bacillary dysentery. Only in rare cases, slight toxic effects such as rashes and haematuria have been observed that also only when taken in excess.

6. Sulphasuccidine or Succinyl Sulphathiazol: Because of its low absorption and low toxicity, it is useful in intestinal infections such as bacillary dysentery and cholera. It is prepared by refluxing succinic anhydride with sulphathiazole. A long-acting sulphonamide preparation Sulphamethoxydiazine (Durenate) was examined for its antibacterial activity and pharmacological actions. The peak urinary level of Sulphamethoxydiazine 8-2 mg. per ml. occurred after 15 hours and at 48 hours the level was 4-6 mg. per 100 ml, both levels being bacteriostatic to over 80% of all urinary pathogens tested. One hundred and twenty antenatal women with bacteriuria of pregnancy were treated with Sulphamethoxydiazine and 93 (78%) remained clear of infection five weeks after treatment. This group was compared with a similar number of antenatal women treated with sulphadimidine, the cure rate being 91(76%). No side or toxic effects to either the women or the infants were noted.

7. Co-trimoxazole or Septrin : Sulphamethoxazole is most often used as part of a synergistic combination with Trimethoprim in a 5:1 ratio in co-trimoxazole (abbreviated SMZ-TMP and SMX-TMP, or TMP-SMZ and TMP-SMX), also known under trade names such as Bactrim, Septrin, or Septra. In Eastern Europe, it is marketed as Biseptol. Its primary activity is against susceptible forms of *Streptococcus*, *Staphylococcus aureus* (including MRSA), *Escherichia coli*, *Haemophilus influenzae*, and oral anaerobes. It is commonly used to treat urinary tract infections. In addition, it can be used as an alternative to amoxicillin-based antibiotics to treat sinusitis. It can also be used to treat toxoplasmosis and

it is the drug of choice for *Pneumocystis pneumonia*, which affects primary patients with HIV⁹.

8. Trimethoprim : It is a bacteriostatic antibiotic mainly used in the prophylaxis and treatment of urinary tract infections. It belongs to the class of chemotherapeutic agents known as dihydrofolate reductase inhibitors. Trimethoprim was formerly marketed under trade names including Proloprim, Monotrim and Triprim; but these trade names have been licensed to various generic pharmaceutical manufacturers. In clinical use, it is often abbreviated TRI or TMP; its common laboratory abbreviation is W. Trimethoprim acts by interfering with the action of bacterial dihydrofolate reductase, inhibiting synthesis of tetrahydrofolic acid.

SIDE EFFECTS OF SULPHA DRUGS

(a) Allergies to sulpha drugs are common (about 3% of general population). So sulphonamides are prescribed carefully. Hypersensitivity reactions are less frequently seen in non-antibiotic sulphonamides. The most common manifestations of a hypersensitivity reaction to sulpha drugs are rash and hives (Fig. 2). However, there are several



Fig 2. Hives-Urticaria of Hand

life-threatening manifestations of hypersensitivity to sulpha drugs, including Steven-Johnson syndrome (Fig. 3), anaphylaxis (Fig 4), toxic epidermal necrolysis, agranulocytosis, hemolytic anemia, thrombocytopenia and fulminant hepatic necrosis, among others.



Fig 3. A patient suffering from Stevens-Johnson syndrome.

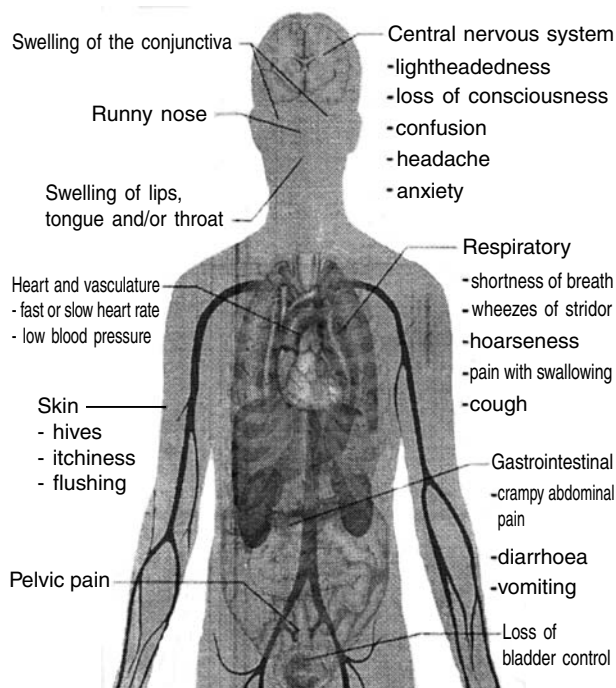


Fig 4. Sign and symptom of anaphylaxis

(b) Sulphonamides have a potential to cause a variety of untoward reactions, including urinary tract disorders, haemopoetic disorders, porphyria and hypersensitivity reactions. When used in large doses, they may cause a strong allergic reaction (Fig. 5). Two of the most serious are Stevens-Johnson syndrome and toxic epidermal necrolysis (also known as Lyell syndrome).¹⁴



Fig 5. Allergic urticaria of the skin induced by an allergen exposure.

- (c) Approximately 3% of the general population has adverse reactions when treated with sulphonamide antimicrobials. Of note is the observation that patients with HIV have a much higher prevalence, at about 60%. People with a hypersensitivity reaction to one member of the sulphonamide class are likely to have a similar reaction to others.
- (d) Hypersensitivity reactions are less common in non-antibiotic sulphonamides, and though controversial, the available evidence suggests those with hypersensitivity to sulphonamide antibiotics do not have an increased risk of hypersensitivity reactions to the non-antibiotic agents.

(e) Symptoms typically include generalized hives, itchiness, flushing or swelling of the lips. Those with swelling or Angioedema (Fig. 6) may describe a burning sensation of the skin rather than itchiness. Swelling of the tongue or throat occurs in up to about 20% of cases. Other features may include a runny nose and swelling of the conjunctiva. The skin may also be blue tinged because of lack of oxygen.



Fig 6. Angioedema of the face such that the boy cannot open his eyes. This reaction was caused by an allergen exposure

CONCLUSION

Even though a number of antibiotics are now a days discovered and they are being used for the treatment of several diseases, sulpha drugs are still proved to be one of the most potential medicines which are found to be much effective in the treatment of many diseases. However, these sulpha drugs are needed to be modified further to improve their action and make them more effective.

Although sulpha drugs are available for many disease, due to its severe side effects, it is always advisable that it should be used only under supervision of a competent doctor. These drugs should not be sold without prescriptions of doctors.

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DOES SCIENCE HAVE A GENDER ?

Paromita Ghosh

Science is idealized as objective hence gender-neutral. But in reality it is gendered in favour of males. Some theories opine that gendering of science emanates from supposedly inborn gender differences which render males more suited for science. But compelling evidence is lacking. Other theories hold gendered socialization and masculine culture of scientific enterprise responsible. Perceived masculinity of sciences differs. Physical sciences are deemed masculine; biology is regarded relatively feminine. Male-bias of science especially physics generally excludes women. Counselling, gender sensitization, overhaul of science curricula, textbooks and institutional policies may redress gender-inequity in science.

The word science originates from the Latin word *scientia*. The Compact Oxford Reference Dictionary mentions two meanings of science. Firstly, it is systematic study of structure and behaviour of physical and natural worlds through observation and experiment. Secondly, it is an organized body of knowledge on any subject. Similar definitions of science abound. Many such definitions have been collated to arrive at the essence of the term science. Thus science is described as an enterprise that builds and organizes knowledge in the form of explanations and predictions about the natural world which can be tested. Besides, the knowledge must be based on observable phenomena. It must be capable of being tested for its validity by other researchers working under same conditions. It is further stated that science involves objective, careful and systematic study of an area of knowledge¹.

* Department of Home Science, University of Calcutta
Kolkata (India)
E-mail : paromita_hsc@rediffmail.com

It is obvious that science is by definition objective. So it is assumed that it is gender-neutral. But in reality science is not immune to gendering. Bias of science in favour of males is not only covert but also frequently quite overt. Physical sciences are strongly gendered in favour of males. Biological sciences appear to be relatively less so. But overall, science is considered a male preserve. It is opined that scientific thought refuses to admit that its own conclusions often depend on unexamined ideas of masculinity and femininity². For instance it is virtually customary to regard all medical problems of men and women as disparate even in the face of overriding similarities in anatomy and physiology. Masculinity and femininity are considered rigid opposites; the underlying continuum is often ignored. Departures from XY chromosomal make-up in males and XX chromosomal make-up in females are considered aberrations. It is all too evident that gender-bias of science has resulted in women's under-representation in and flight

from science. It is a problem of global proportion. But it is particularly evident in India.

Three intertwined strands of theoretical perspectives attempt to explain this phenomenon. The first strand emphasizes inherent biological differences between men and women. According to this viewpoint, these differences render men much more suitable for study of science. The second strand focuses on socialized differences between genders which suggest that females are not meant to engage with science. The third strand holds masculine culture of science responsible for trying, with much success, to exclude women³. These strands need to be examined one by one in greater detail to understand gender inequity in science.

INNATE GENDER DIFFERENCES

This perspective emanates from researches which suggest that genders differ in genetics and consequent brain organization. Males are reportedly superior in visuo-spatial skills while females seem to show greater facility in verbal skills. Noteworthy gender differences have been reported in performance on science test-items that involved visual content and required the application of knowledge acquired through engagement in extracurricular activities. Boys generally perform better on such test-items partly because of their supposedly better visuo-spatial skills. Superior performance of boys is also explained by the argument that they engage more in extracurricular activities that develop science and mathematical skills. It has been found that boys outperform girls in mathematical reasoning. This has been attributed to inherent biological differences between genders. But it was admitted that these differences are somewhat enhanced by

environmental influences. One has to realize that stimulating influence of extracurricular activities is environmental in nature⁴. It indicates that innate gender differences (first strand) are closely linked with socialized differences (second strand).

It has been opined on the basis of research that gender difference in mathematical reasoning may partly explain gender difference in science participation and achievement. Mathematical ability forms the basis of science especially physical sciences. Genders evidently differ in spatial abilities required for mastering mathematics. This may be because normal processes of brain development operate slightly differently in the genders. So neural assemblies used during mathematical thinking tend to be configured differently for males and females. It has been argued that males are more likely than females to acquire optimal configuration of neural assemblies dedicated to mathematics. This arguably endows males with superiority in mathematical reasoning which helps them master science⁵. But gender difference in genetics and resultant brain organization are still not well understood. Many of the research outcomes presented to reinforce the perspective emphasizing innate gender differences are essentially inconclusive. Besides, role of environment in the so called inherent differences between genders requires probe².

SOCIALIZED GENDER DIFFERENCES

Agents of socialization advocate gender difference. Processes of socialization operate differently for males and females. Through these processes individuals generally internalize *gender schema*. Gender schema is a set of beliefs about gender. It is transmitted through daily practices (including those relating to socialization) of the culture.

It teaches individuals to view everything through the lens of gender. It makes them evaluate their self-worth in terms of their self-perceived masculinity or femininity. Females are socialized to view science as masculine and too difficult to understand. This is particularly the case with physical science. So women tend to experience *fear of success* in choosing to study and doing well in science which is considered masculine. They feel they would be considered less feminine and would lose their popularity if they ventured into the masculine domain^{6, 7}.

Therefore boys generally manifest more positive attitudes towards science and seem to have better understanding of science. They tend to perceive themselves as high achievers in science. Boys generally exhibit more self efficacy in mastering science subjects than girls. Preference for studying mathematics and science is more among boys than among girls. Aspiration for science-oriented careers is pronounced among boys as compared to their female counterparts. These appear to be the outcomes of gender-discriminatory socialization. It is interesting to note that females who have affinity for mathematics and science possess masculine or androgynous self-perceptions. Psychological androgyny refers to combination of conventionally masculine and feminine attributes in an individual⁶.

In patrifocal societies like India, women are actively discouraged from pursuing science education. Parental discouragement, lack of money, involvement in housework, paucity of female role models, early marriage etc. are some stumbling blocks to girls' science education in India. In some educated middle class families especially in urban India, parental encouragement helps girls prepare for careers in science. But this phenomenon is not extensive.

GENDERED CULTURE OF SCIENCE

Science appears to favour males. Male-bias in science curricula, textbooks, teaching-learning-evaluation styles etc. is manifest. Interactions in science classrooms generally favour boys. So girls tend to feel excluded³. A model of the relation between gender and science in schools has been developed. It is based on interactions among six factors: (a) student behaviour in the science classroom, (b) teacher behaviour in the science classroom, (c) observable student outcomes, (d) student beliefs/attitudes (e) teacher beliefs / attitudes and (f) previous experience in socio-cultural educational context for teachers and students⁸. It is obvious therefore that perceived masculine culture of science stems from patrifocal culture of the larger society⁹. This is reflected by gender inequity in functioning of scientific establishments. Successful careers in science demand so much of involvement that women with children usually face problems². Many girls anticipate such problems and either decide against studying science or do not aspire for careers in science.

Thus a theory of sexual division of Indian scientific labour has been proposed. According to this theory, macro-structural features (e.g., educational system, occupational and class structure) intersect cultural models of family, gender and science to frame the academic decision making process. Ultimately a predominantly male scientific community is produced in India. It follows from this theory that females in our country generally avoid or flee from science because pursuing a science course is more rigorous, competitive and costly. So science education for females does not find much of social favour⁹.

EXTENTS OF PERCEIVED MASCULINITY OF SCIENCE SUBJECTS

Although science per se is considered masculine, degrees of masculinity differ for different sciences. Physical sciences are perceived more masculine than biological ones. This may be because physical sciences are regarded as most difficult of the sciences. Among physical sciences chemistry is considered less masculine than physics. Attitudes of high school students towards chemistry are reportedly more positive than towards physics. Biology is rated more feminine by women. Men regard biology as neutral in terms of masculinity-femininity. This may be because biology careers are perceived as humanitarian. It seems that careers in biology agree with conventional, socially prescribed roles of women as care-givers. Besides, among science students, biology is viewed as particularly enjoyable. It is apparent therefore that perceived masculinity of a science is closely associated with its perceived difficulty level. The more difficult or abstract a science seems the greater is its perceived masculinity. Extents of perceived masculinity of science subjects are reflected by gender-specific academic achievement patterns of those subjects. Boys are found to achieve higher than girls in physics and earth sciences. But boys' achievements in biology and chemistry are similar to those of girls. Gender difference in achievement is reported to be widest in physics and earth sciences than in life sciences. Females may even have a slight edge over males in life sciences in school examinations^{3, 4, 5, 10}.

REDUCING GENDER-INEQUITY IN SCIENCE

At this stage of research it is not definitely known whether men are indeed biologically

better suited for science-education. More in-depth and objective research needs to be conducted. Meanwhile, socialized gender differences and male-oriented culture of science require interrogation. Such examination will help in discovering ways of ushering in gender equity in science. Remedial actions may start with consistent school-based counselling programme to boost self confidence and nurture self efficacy among girls. Boys can also be gender-sensitized through such a programme. Parent counselling must also be included as parts of programmes of education initiated by the government so that women's long-term engagement with science is encouraged. Science curricula at different educational levels require revamp to include topics/activities of interest of both genders. Language used in science textbooks should balance precise analytical style with anecdotal and chatty ones to appeal across the board. Classroom teaching in science must aim for greater inclusivity and collaboration. Science and mathematics teachers require being trained to refrain from conveying false notions that science and mathematics are male domains. Institutional policies need to be changed to make them more female-friendly. This will facilitate women balancing family responsibilities and careers in science.

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FOCUS ON HYPERTENSION

Rekha Govindan

Hypertension is an important public health problem in developing countries especially in adults, aged 40-55 years. Prospective cohort and case-control studies conducted in developed as well as developing countries have supported the findings that both systolic and diastolic blood pressure have significant relationships to coronary heart disease, stroke, congestive heart failure, impaired renal function and other mortality risk factors. Increased life expectancy, urbanization, development and affluence show a strong correlation with increased hypertension prevalence in urban and rural populations of India. These modifying factors operate with other risk factors of hypertension in different combinations in different parts of the world. Such socio-demographic and lifestyle factors need to be focused to bring down the hypertension epidemic that is currently sweeping India and other parts of South Asia. The nature of genetic involvement in the development of hypertension also requires more studies.

INTRODUCTION

Hypertension is defined as systolic blood pressure (SBP) which is more than or equal to 140mmHg and diastolic blood pressure (DBP) more than or equal to 90mmHg (WHO, 2001). Hypertension is considered as one of the most frequent contributor to premature death in developing countries. Recent reports indicated that nearly 1 billion adults have hypertension and this is predicted to increase to 1.56 billion by 2025. Borderline hypertension (SBP 130-139mmHg and/or DBP 80-89mmHg) is also an important contributor for the increased mortality rate¹.

DEFINITION AND CLASSIFICATION OF HYPERTENSION

The definition of hypertension is usually measured as the level of arterial blood pressure associated with doubling of long-term cardiovascular risk. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure provides a classification of blood pressure for adults aged 18 years³. The classification is based on the mean of two or more properly measured seated blood pressure readings on two or more office visits⁵.

- Normal : Systolic pressure < 120mmHg and Diastolic pressure < 80mmHg.
- Pre-hypertension : Systolic pressure 120-139mmHg and Diastolic pressure 80-89mmHg.

* Department of Biotechnology, Aarupadai Veedu Institute of Technology, Vinayaka Missions University, Paiyanoor, Kanchipuram, TN – 503604
Email : rekhagovindan2000@yahoo.com

- Stage 1 Hypertension : Systolic pressure 140-159mmHg and Diastolic pressure 90-99mmHg.
- Stage 2 Hypertension : Systolic pressure ≥ 160 mmHg and Diastolic pressure ≥ 100 mmHg.

Hypertension is also classified as Primary and Secondary, based on its underlying cause. Primary hypertension is by far the most common, making up more than 95% of all cases. The exact causes for primary hypertension are still unknown, but a combination of factors may be involved, including genes for high blood pressure, low levels of nitric oxide, insulin resistance and obesity. Secondary hypertension has an underlying treatable cause, which may include for e.g., kidney disorders, endocrine disorders, chronic heavy alcohol and tobacco use^{1,5}.

PREVALENCE OF HYPERTENSION

Hypertension is assuming epidemic proportions in developed and developing countries². It affects nearly 26% of the population worldwide. The prevalence of hypertension among adults in developed countries is 25%. Similar prevalence has also been observed in developing countries ranging from 10% to 20%. The prevalence of hypertension in India is reported as ranging from 10 to 30.9%. The average prevalence of hypertension in India is 25% in urban and 10% in rural inhabitants. Previously a lower prevalence of hypertension was reported from rural Indian populations. However, there has been a steady increase of prevalence over time in rural population studies due to urbanization of villages into mini towns and towns into cities. At an underestimate, there are 34 million in urban and 31.5 million hypertensives in rural populations. A total of 70% of these

would be Stage I hypertension (systolic BP 140–159 and/or diastolic BP 90–99mmHg). With the prevalence of hypertension comparable to other countries like U.S, and with second largest population, in the coming years India will have one of the largest numbers of hypertensive patients. This combined with the growing populations, overthrowing China from its position and a tendency of hypertension to show up a steep rise, will have the largest number of people with hypertension in the world which will justify the title for India as the hypertension capital of the world¹.

EPIDEMIOLOGY OF HYPERTENSION

Epidemiological studies conducted in many parts of the world have consistently identified an important and independent link between high blood pressure and coronary heart diseases, stroke, congestive heart failure and impaired renal function. Hypertension is directly responsible for 57% of stroke deaths and 24% of coronary heart disease deaths in India. The association of blood pressure (BP) with cardiovascular disease risk is continuous. In a study of individuals aged 40 to 69 years for a period of 10 years, the risk doubled with each 20/10mmHg increase in BP. However, large proportions of most populations have non optimal BP values. This fact is important because hypertension can be controlled and a 2mmHg population-wide decrease in BP can prevent 151,000 stroke and 153,000 coronary heart disease deaths in India. Recent reports show that borderline hypertension (systolic BP 130–139 and/or diastolic BP 85–89mmHg) and Stage I hypertension carry a significant cardiovascular risk and there is a need to reduce this blood pressure^{1,4}.

Chronic kidney disease (CKD) is the most occurring form of secondary hypertension. There is evidence both clinically and experimentally that “blood pressure goes with the kidney”. Sodium retention and activation of the renin-angiotensin system have been considered the most important mechanisms involved in the elevation of blood pressure in subject with kidney disease. High blood pressure may permanently damage the narrow blood vessels in the kidney which play a vital role in filtration of blood. Over time, this damage will keep the kidney from working properly⁵.

HYPERTENSION, GENETIC AND MODIFIABLE RISK FACTORS

Significant hypertension risk factors are genetic and environmental. There are a large number of genes that are responsible for hypertension. Single-gene-related hypertension is, however, rare. Intermediate phenotypes are more important and prevalent. Population and animal studies suggest a polygenic or oligogenic model for hypertension, wherein susceptibility imparted by any single gene is modest and quantitative. Such genetic variations would be expected to modulate response to environmental exposure and may only achieve significance through cumulative integration of lifetime experiences. The modifiable risk factors operate in different combinations in different part of the world. Majority of them include age (> 50 years), male gender, socioeconomic group, anthropometric parameters like body weight especially truncal obesity, increased insulin levels, abnormal lipid profile, metabolic syndrome and lifestyle conditions such as alcohol consumption. Other important environmental factors are smoking, physical inactivity, dietary excess of sodium and fat,

deficiency of potassium, fibre intake and psychosocial stress. There is epidemiological evidence that population demographic changes in India have increased hypertension risk factors. There is increasing life expectancy, urbanization, development and affluence in India. Affluence, as measured by evaluation of per capita net domestic product, growth of production and human development index, has also increased sharply in India in the recent years and correlates positively with hypertension. Tobacco production, which is a surrogate for its consumption, is increasing at a very high rate in India. The summation of these socio-demographic and lifestyle factors is accelerating the hypertension epidemic currently sweeping India and other developing countries^{1, 5}.

MEDICATIONS FOR HYPERTENSION

The overall goal of treating hypertension is to reduce hypertension-associated morbidity and mortality. The selection of specific drug therapy is based on evidence that demonstrates risk reduction. Non-pharmacologic therapy includes modifications in lifestyle, food habits and physical activity. These approaches are recommended by the JNC 7 but provide only minimal control over blood pressure. This mode of treatment chiefly restricts salt intake, alcohol consumptions and focuses on weight reduction in case of overweight and obese patients. Pharmacologic therapy is based on the different classes of anti-hypertensive drugs. The important ones are diuretics, ACE inhibitors, angiotensin II receptor blockers, calcium channel blockers, alpha blockers, beta blockers, central alpha agonists and vasodilators. The JNC 7 recommends thiazide type diuretics as the first line of treatment. Thiazide diuretics control hypertension by inhibiting Na^+ and Cl^- absorption in the

kidneys by blocking the sodium-chloride ion symporter. The ACE inhibitors work by inhibiting the conversion of angiotensin I to angiotensin II, thereby decreasing arteriolar resistance and increasing venous capacity, as vasoconstriction by angiotensin is curbed. Calcium channel blockers exert their effect by blocking the voltage gated calcium channels in cardiac muscles and blood vessels. This leads to a decrease in intracellular calcium levels. Various drug combinations can be prescribed by the physician based on the stage of hypertension and patient's response to drugs³.

COMPLEMENTARY AND ALTERNATIVE THERAPY

There are many different types of complementary and alternative treatments believed to be effective against high blood pressure. Scientific evidence indicates that a diet that containing low saturated fat and salt and high levels of carbohydrates can be helpful in reducing blood pressure. It has been scientifically proved that men and women of all age groups who have a physically active lifestyle, have lower blood pressure or better control over the blood pressure levels. Ancient relaxation methods such as yoga, qigong and tai chi are effective in regulating blood pressure levels. Changes in the diet and lifestyle are a must for improved life. The following lifestyle changes will help treat high blood pressure such as reducing body weight, staying physically active, quitting smoking or drinking and eating more nutritious and dietary supplements⁵.

PREVENTIVE CARE FOR HYPERTENSION

Studies suggest that the following actions can help prevent high blood pressure:

- Maintaining a proper weight – According to several large-scale, population-based studies, being overweight is one of the strongest indicators of high blood pressure. Hence, staying at a healthy weight is one of the most effective things to prevent hypertension.
- Reducing salt intake – The current recommended amount of sodium for healthy people is no more than 2,400mg per day, and less is better.
- Getting more exercise – Several studies suggest that sedentary people may be at higher risk for developing hypertension. According to some studies, men who lead physically active lives can lower their risk of developing hypertension by 35 - 70 %. Regular exercise also helps to our weight in check.
- Limiting alcohol - Studies suggest that people who have three or more alcoholic drinks per day increase their risk for developing hypertension.

The goal in treating high blood pressure is to reduce the risk of serious complications, including heart disease and stroke, by getting blood pressure under control. Ideally that means reducing blood pressure to 120/80mmHg. However, even a partial lowering of blood pressure brings benefits. Often, the early stages of hypertension i.e. when blood pressure elevation is mild, lifestyle changes alone can be recommended for lowering the BP values⁵.

CONCLUSION

Epidemiological studies to assess the prevalence of Hypertension are urgently needed in developing countries like India to bring these populations into preventive care and reduce the mortality risk associated with

hypertension and associated disorders. Studies are needed in rural areas to have a base line data about the prevalence of hypertension and its association with the risk factors. Also identification of subjects with pre-hypertension around 35 years of age and using high risk strategy of prevention of hypertension among them is important in the prevention of hypertension in rural societies to prevent the emerging pandemic of hypertension.

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NUTRACEUTICAL, PHARMACEUTICAL AND INDUSTRIAL VALUE OF COFFEE PLUM : *FLACOURTIA JANGOMAS* (LOUR.) RAEUSCH

V. N. Pandey and Neeharika Dubey*

Flacourtia jangomas (Lour.) Raeusch is an indigenous traditional fruit crop of India. The biofunctional parts of the plant have multifarious utilization. Many biofunctional biomolecules and alkaloids are the secondary power of the fruit. The special emphasis on the plant for sustainable utilization, extensive cultivation and conservation has been given for nutraceutical, industrial and pharmaceutical use. The proper agro-techniques will provide health, economy, environment and food security to the country.

Edible wild plants are exploited as sources of food in many nations because they provide an adequate level of nutrition to the inhabitants. Recent studies showed that these plant resources play a significant role in nutrition, pharmaceuticals, food security and income generation. In this modern era, they can promote good health and help to reduce the risk of disease. Thus they are very important and on this basis the term "Nutraceutical" was coined by Stephen De Felice.

The word "Nutraceutical" consists of two words "Nutrition" and "Pharmaceutical". According to Stephen De Felice, nutraceutical can be defined as "A food (or a part of food) that provide medical or health benefits including the prevention and/or treatment of a

disease. Nutraceutical a portmanteau of "nutrition" and "pharmaceutical" refers to extracts of food claimed to have a medicinal effect on human health. The use of nutraceuticals as an attempt to accomplish desirable, therapeutic outcomes with reduced side-effects as compared with other therapeutic agent has met with great monetary success. The preference for the discovery and production of nutraceuticals over pharmaceuticals is well seen in pharmaceutical, industrial and biotechnological companies. However, with all of the aforementioned positive points nutraceuticals still need support of an extensive scientific study to prove "Their effect with reduce side-effect"⁸. Examples of nutraceuticals includes fortified dairy products (eg. milk) and citrus fruits (eg. orange juice).

Technically a fruit is the ripened ovary. Fruits are undoubtedly man's oldest food and must have always been a source of pleasure

* Experimental Botany and Nutraceutical Laboratory, Department of Botany, DDU Gorakhpur University, Gorakhpur-273009 (UP) E.mail:

for him because of their flavour and taste. In pre-agricultural days, humans lived on wild game, fruits and succulent herbage.

Cultivation of fruits is a highly profitable enterprise and are classed as "protective foods" absolutely essential for the maintenance of health. Dietitians recommend the consumption of at least 5-7g of fruits in our daily diet in addition to cereals, pulses, milk and vegetables. Vegetables and fruits contain water and are low in proteins and fats and are important sources of both digestible and indigestible carbohydrates. In general, fruits are good source of minerals and vitamins, particularly A and C. Apart from the constituents mentioned above, fruits contain organic acids (chiefly malic, citric and tartaric acids) ethereal substances, pigments, tannins and the most important is antioxidants¹. Antioxidant is a substance that opposes oxidation or inhibits reactions promoted by oxygen or peroxides. Many of these substances being used as preservatives in various products as in fats, oils, food products and soaps for retarding the development of rancidity in gasoline and other petroleum products for retarding gum formation and other undesirable change and in rubber for retarding ageing. Antioxidants are a type of complex compounds found in our diet that act as a protective shield for our body against certain disastrous enemies (diseases) such as arterial and cardiac diseases, arthritis, cataracts and also premature ageing along with several chronic diseases^{6, 2, 5}.

Plants are susceptible to damage caused by active oxygen and thus develop numerous antioxidants. Different compounds such as vitamins, phytochemicals, carotenoids, flavonoids, phenols and minerals, function as antioxidants. Different phytochemicals are being extracted from different plants and are used as nutraceuticals. Many research works

has been done on different fruits related to estimation of phytochemicals, antioxidants and their implications in treatment of different diseases^{9, 10}.

FLACOURTIA JANGOMAS (LOUR) RAEUSCH

F. jangomas (Lour.) Raeusch commonly known as Coffee plum, belongs to family Flacourtiaceae is very important fruit crop of Gorakhpur region and indigenous to North-Eastern Terai region of U.P., Assam, Bihar Maharashtra, Bengal and Orissa and some parts of South India (Fig. 1).

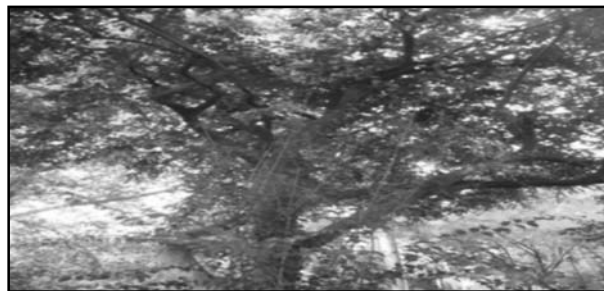


Fig. 1 : Tree of *F. jangomas*

F. jangomas is a small deciduous tree of 6-14m height. Old tree trunk and branches are without thorn whereas woody thorns are present when young. Bark is light brown to copper red or pinkish buff, flaking into thin lamels, smooth and lenticelled. Young branches are white dotted by numerous sub orbicular lenticels, puberulous or mostly glabrous. Its fruits are edible with pleasant tart flavor. The flesh is firm, brownish green and fairly juicy. It is stewed as dessert, made into juice, syrup, jam, marmalade and pickles and also used in chutneys.

DESCRIPTION OF THE TREE

Petiole 6.0-8.0 mm long, leaves alternate, deciduous, pale pink when young, spirally

arranged, oval-lanceolate, long point toothed, very thin, both surfaces glossy, blade elliptic, serrate, 7.0 cm-11.0 cm x 3.5cm-4.0cm, pappery and show 3-6 pairs of secondary nerves (Fig. 2 and 3).



Fig. 2 : Leaves of *F. jangomas*



Fig. 3 : Twig showing woody thorns

Inflorescence axillary racemes 1.0-2.0cm long, subcorymbose, glabrous, few flowered, the male 1.5 -3.0cm and the female 1.0-1.5cm long. The flowers are white to greenish and comprise 4 or 5 ovate triangular, flowers bear fragrance of honey before or with the young foliage. Pedicels very slender, 0.5-1.0(-1.5) cm. Flowers dioecious, in shortly branched glabrous racemes; male flowers solitary or in clusters; female flowers are solitary.

The no. of sepals are 4(-5). They are ovate, obtuse, greenish, pubescent on both sides, 2mm. Disk fleshy, entire or slightly lobed, white or yellow (Fig. 4 and 5). Sepals are

puberulous outside. The androecium consists of numerous anthers, which are ovate to sub orbicular¹⁴.



Fig. 4 : Staminate flowers of *F. jangomas*



Fig. 5 : Pistillate flowers of *F. jangomas*

In female flowers sepals are orbicular; stamens 3.0-5.0mm long. Ovary is 4-6 celled, with two ovules per locule. Ovary first flask shaped, soon subglobose, with 4-6 styles connate into a distinct, 1mm high column, not or slightly free at their apices, each bearing a dilate, bilobed, recurved stigma.

Fruit is an ellipsoid berry. They are round or slightly oval, subglobose, 3/4 to 1 inch (2.0-2.5cm) long, dark maroon to nearly black; the flesh greenish to white or amber, varying from acid to sweet, and containing 7 to 12 flat, hard, pale-yellow seeds (Fig.6 and 7).¹³

The term "Agro-techniques" is used in scientific techniques to increase the quality and quantity of a crop. Different types of

agro-techniques have been used for different crops as per requirements.



Fig. 6 : Fruits of *F. jangomas*



Fig. 7 : Seeds of *F. jangomas*

For *F. jangomas*, simple agro-techniques like inarching and budding are used and this type of agriculture will help the farmers to improve their crop productivity, quality and economic status. *F. jangomas* is propagated through seeds. The seeds are slow to germinate; therefore propagation is usually by inarching or budding onto self-seedlings. It is cultured under full sun and rich well drained soil. This is a multipurpose useful plant, so its cultivation should be encouraged. This species should be included in various tree plantation programs^{13,12}.

F. jangomas is an important biofunctional plant of this region which contains many biofunctional molecules viz; phenolic glucoside ester, flacourtin, steroid and beta-carotene.

ETHNOPHARMACOLOGY

Medicinal Properties : The leaves and young shoots, which taste like rhubarb are astringent and stomachic. The fruits are used to overcome biliousness, nausea and diarrhea. The leaf decoction is taken to halt diarrhea. Powdered dried leaves are employed to relieve bronchitis and cough. The leaves and bark are applied on bleeding gums and aching teeth, and the bark infusion is gargled to alleviate hoarseness. Pulverised roots are poultice on sores and skin eruptions and held in the mouth to soothe toothache. Dried leaves are used for bronchitis. The ripe fruits have high fiber content together with good protein content, low fat and higher amount of monosaturated fatty acids as compared to polysaturated fatty acids. It contains significant amount of beta carotene followed by lutein and zeaxanthin, retinol and phyloquinone (vit.k) which are important in the regulation of hemoglobin and fibrinogen in human body.¹¹ Besides these, ascorbic acid (vit.c) and niacin are also present in significant amounts. Ripe fruits contain good amount of potassium which has a definite role in regulation of blood pressure followed by phosphorus and magnesium having their role in controlling osteoporosis. The fruits are eaten in Burma to promote digestion. In Malaysia a decoction of leaves is used as a drink to treat diarrhea, to promote digestion and the juice squeezed from the roots is used to treat herpes infection. In Cambodia, Laos, and Vietnam, a decoction of the leaves is used as a drink to abort, or the fruits are eaten for the same purpose. A paste of roots is applied to sores, ulcers, and to soothe an inflamed throat.

Bark contains a phenolic glucoside ester, flacourtin. The heartwood contains the steroid,

ramontoside, beta-sitosterol and its beta-D-glucopyranoside. Fruits are given in jaundice and enlarged spleen.

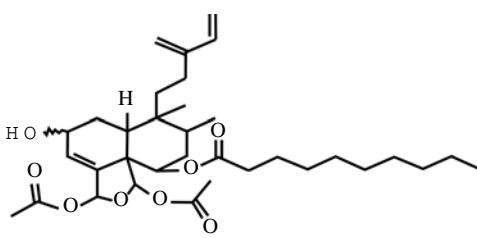
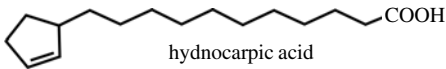
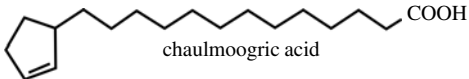
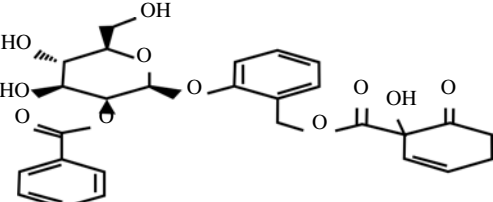
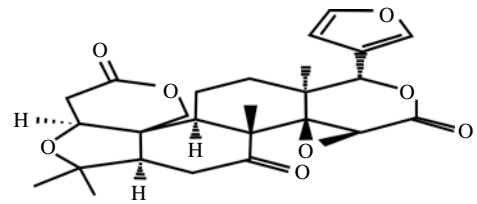
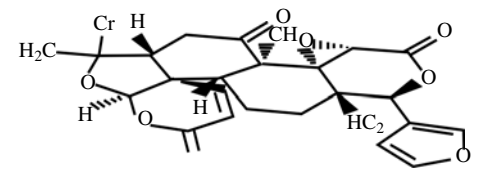
BIOACTIVE NATURAL PRODUCTS OF *FLACOURTIA JANGOMAS*

The bioactive natural products found in *F.jangomas* are Corymbulosine, Hydnocarpic

acid, Chaulmoogric acid, Tremulacin, Limonin and Jangomolide (limonoid) (Table-1).

Bioprospection : Fruits have a pleasant tart flavour. The flesh is firm brownish green and fairly juicy. Sometimes the fits may be astringent. For eating out of hand, the fruit is rolled between the hands to reduce astringency

Table-1: Bioactive molecules, Chemical structure and their Properties.

Bioactive Products	Chemical Structure	Properties
Corymbulosine		Natural Product with Antitumor Activity
Hydnocarpic acid	 hydnocarpic acid	Curative action in treatment of Leprosy
Chaulmoogric acid	 chaulmoogric acid	Curative action in treatment of Leprosy
Tremulacin		Anti-inflammatory action
Limonin		Neuroprotective effects and antiviral properties.
Jangomolide (limonoid)		Antibilious and effective in liver infections.

and is better liked than that of other species. When slightly under ripe, it is used to make jellies. The acidic young shoots are eaten in Indonesia. It contains moisture 78.28%; protein : 6.16%;fat : 0.8%;sugar: 9.85%; ash : 2%; carbohydrates : 11.78% and crude fibre : 9.6%. The wood is red or scarlet, is closed grained, hard, brittle, durable and polishes well. It is used for agricultural implements or for block

useful plant so special emphasis should be given for its sustainable utilization, cultivation and research work.

ACKNOWLEDGEMENTS :

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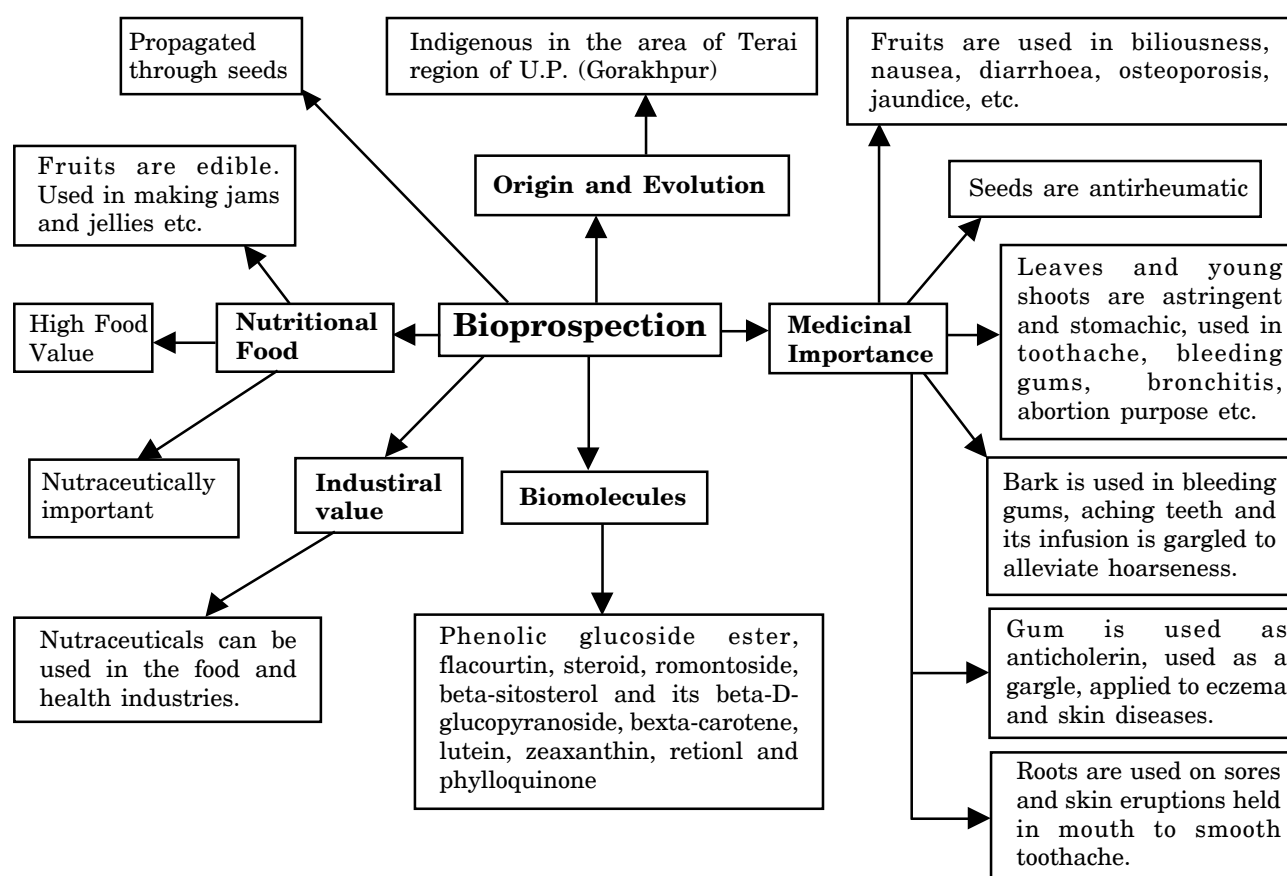


Fig. 8 : Polyvalent Utilization and Bioprospection of Flacourtia jangomas.

sheaves⁷. Bioprospection of *F. jangomas* as nutritional food, medicinal, industrial, biofunctional biomolecules and other importance has been given (Fig.8).

Thus *F.jangomas* is a very important and

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REMOTE SENSING AND ITS APPLICATIONS IN DISASTER MANAGEMENT

Roopa V.

Impact of natural disasters on life and property and ability to predict them would be one of the main contribution of remote sensing technology. Involving remote sensing with GIS and web technology makes it an extremely powerful tool to identify indicators of potential disasters. Information sharing through Internet reduces data acquisition time and thus providing efficient way to carry out real time disaster predictions (floods, forest fire, tsunami and hurricane etc.). Changing land use and assessment of its impact on the system in general within reasonable time frame and with greater degree of accuracy becomes possible with new technology.

INTRODUCTION

Remote Sensing is a revolutionary tool that can be used for obtaining information about an object by observing it from a distance and without coming into actual contact with it. In fact, when we see an object and understand what it is, our eye is sensing that object remotely. This is a broad definition, but we generally use this term for observing our earth's surface from space using satellites or from the air using aircraft which have been modified suitably.

Remote sensing is useful to many variety of applications in the areas of high relevance to every country in the world. The civilian application areas include Agriculture, Forestry, Oceans, the study of Biodiversity, monitoring urban growth, mapping of waste lands,

Disaster management and managing water Resources. These studies are of very important, especially to the developing countries.

Space platforms or Satellite systems comprise of (i) Space segments (ii) Sensor systems & (iii) Ground segments.

The Space segment consists of the satellite which is placed in the orbit and in which a sensor system is mounted on it, which in turn acts as the instrument that observes and transmits information to the earth receiving stations. In some cases provision exists in the form of a tape recorder which records the observed information, and transmits it to the earth receiving station located at a different place other than the place which is being observed. The process of observing and transmitting the information to the earth receiving station is a continuous process.

Sensors are instruments which sense the objects on the surface of the earth and records them. Camera is also a form of sensor, which

* Department of Electronics, Sree Siddaganga College of Arts, Science and Commerce for Women, Tumkur, Karnataka, India. Email : roopanaveen20@gmail.com

records the object it looks at and the light reflected reacts with the sensitized coating on the film which, when processed, reveals the object.

Satellite mounted sensors sense the various objects in the form of digital format of the energy reflected. The data obtained in digital form can be converted to picture format by electro-optical conversion. Thus, we get a picture or image of each scene covering on the earth's surface. Different satellite systems may have different types of sensors, depending upon the design and specific needs¹.

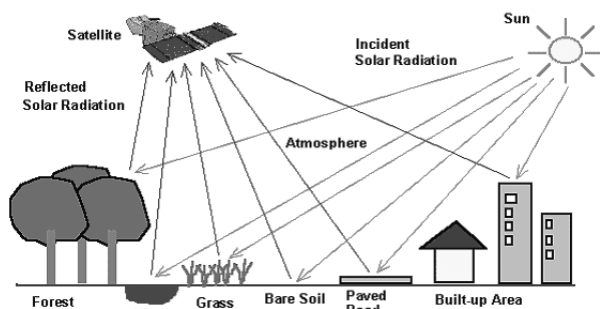


Fig 1. Remote Sensing Process

Remote sensing technology uses the visible, infrared and microwave regions of the solar radiation to collect information about the various objects on the earth's surface. The electromagnetic spectrum has a visible region, which we use to view an object with our eyes. The sun's energy, when it falls on the earth, gets reflected that we generally use in remote sensing.

ADVANTAGES OF SATELLITE REMOTE SENSING

- A large or wide area can be covered by a single image/Photo. Different Satellites with different sensor systems may cover different extent of areas.
- We can get the data of any area repeatedly at regular intervals of time, enabling monitoring of changes.

- Coverage of inaccessible or difficult terrain like mountains, thick forests etc. are imaged.
- Since data is obtained in digital form & in different channels, computer processing and analysis becomes possible.
- Economic in cost and time.

DISASTER MANAGEMENT

The impact of natural disasters can be reduced through a proper disaster management, including disaster prevention, disaster preparedness (forecasts, warning, prediction), rapid and adequate disaster relief. Reduction of natural disasters can be successful only when adequate knowledge is obtained about the expected frequency and magnitude of hazardous events. Some types of disasters, like, floods or earthquakes may originate very rapidly and may affect larger areas. The use of synoptic earth observation methods has proven to be especially suitable in the field of disaster management. In a number of countries, where warning systems and building codes are more advanced, remote sensing of the earth has been found successful to predict the occurrence of disastrous phenomena and to warn the people on time.

(a) Earthquakes

Remote sensing techniques can give additional information available through seismic techniques. Generally, the faults associated with earthquakes can be identified on good resolution satellite imagery. For this purpose land use and geological maps can give vital pointers towards potential earthquake zones. Satellite sensors that are active in the visible and near infrared spectral band would be useful. Though IRS, NOAA (www.usgs.gov),

SPOT (www.SPOTimage.fr), LANDSAT (www.nasa.gov) and IKONOS (www.spaceimaging.com) all of them collect the required data, LANDSAT imageries are more popular because of the long historical data archives of the satellite and its cost effectiveness. Conventionally, aerial remote sensing (airborne radar) would be thought as more effective to delineate unconsolidated deposits sitting on fault zones, upon which most of the destruction occurs, and to identify areas where an earthquake can trigger landslides but now with 1m resolution satellite imageries professionals are very hopeful to apply more and more of remote sensing techniques.

(b) Volcanic Eruptions

Volcano monitoring is important simply because an unexpected awakening can save thousands of lives over a wide area. Remote sensing techniques can play an important role by providing the vital information with only limited fieldwork, which saves effort and money. Thermal infrared (TIR) imagery can capture the volcanic heat provided the spatial resolution is high enough⁷. Also, PAN stereo-pair imagery, due to its 3-D capabilities, of moderate resolution would serve the purpose of finding out the evidence of hazardous activities. An IR pattern of geothermal heat in the vicinity of a volcano is an indication of thermal activity, which many inactive volcanoes display. Changes in thermal patterns can be obtained for a volcano only through periodic IR imageries of very high resolution, like that of IKONOS, taken under similar conditions of data acquisition. The temperature and gas emission changes, however, can be monitored, through a geostationary satellite, at ideal locations identified on the thermal imagery⁵.

(c) Tsunamis

Tsunamis are water waves or seismic sea waves caused by large-scale sudden movement of the sea floor (due to earthquakes; landslides; volcanic eruptions or man-made explosions). With increasing population and development along most coastlines, there is a corresponding increase in tsunami disaster risk in recent years. Tsunamis differ from other earthquake hazards in that they can cause serious damage thousands of kilometers from the causative faults. Once they are generated, they are nearly imperceptible in mid ocean, where their surface height is less than a meter. They travel at incredible speeds, as much as 900 km/hr, and the distance between wave crests can be as much as 500 km. As the waves approach shallow water, a tsunami's speed decreases and the energy is transformed into wave height, sometimes reaching as high as 25 m, but the interval of time between successive waves remains unchanged, usually between 20 and 40 minutes. When tsunamis near the coastline, the sea recedes, often to levels much lower than low tide, and then rises as a giant wave. Satellite or aerial photography, especially when combined with a good GIS database of an area, can provide critical information for emergency managers, including damage to structures, transportation and communication links, and other "life-line" infrastructure components.

(d) Hurricanes

These large-scale low-pressure systems occur throughout the world over zones referred to as "tropical cyclone basins". The determination of past hurricane paths for the region can be derived from remotely sensed data from the U.S. National Oceanographic and Atmospheric Administration (NOAA)

satellite sensors designed and operated for meteorological purposes. The Tropical Analysis and Forecast Branch of the Tropical Prediction Center (TPC) provides year-round products involving marine forecasts, aviation forecasts and warnings (SIGMETs), and surface analyses. The unit also provides satellite interpretation and satellite rainfall estimates for the international community. The Technical Support Branch provides support for satellite data processing. One of the key lessons NASA learned during Hurricane Andrew was that it is critical to select appropriate data and put it together to make informed decisions. Due to the lengthy process required to gather the data, it was suggested that communities not wait until a disaster happens to do so. Imagery is an important aspect of a community's database. The next generation of satellites such as Earth watch's Early Birds and Astrovision will significantly enhance the remote sensing capabilities. At present, for plotting new data, the best sensor is the AVHRR with its 2,940 km swath, twice-a-day coverage and appropriate resolution. The red band is useful for defining day time clouds and vegetation, while the TIR band is useful for both day time and night time cloud observations.

(e) Floods

According to the Federal Emergency Management Agency (FEMA) of the USA, floods are the second most common and widespread of all natural disasters. Within the USA an average of more than 225 people are killed and more than \$3.5 billion in property is damaged by heavy rain and flooding each year^{6,11}. Scientists and researchers have been investing valuable hours and funds in finding out more accurate and faster methodologies to predict and estimate flood

depth and extent. Satellite imagery can be very effective for flood management in the following way:

- Detailed mapping that is required for the production of hazard assessment maps and for input to various types of hydrological models;
- Developing a larger scale view of the general flood situation within a river catchment or coastal belt with the aim of identifying areas at greatest risk and in the need of immediate assistance; and
- Monitoring land use/cover changes over the years to quantify prominent changes in land use/cover in general and extent of impervious area in particular⁸⁻¹⁰.

Floods are result of excess runoff, which could increase or decrease depending on various factors, such as, intensity of rainfall, snow melt, soil type, soil moisture conditions and land use and land cover. Runoff from rural and urban areas is generally a response of excess water after the processes of infiltration. Obviously, urban regions will have more of impervious land where infiltration cannot occur. On the other hand, rural drainage area will have some water absorbed in the soil till it reaches saturation level sending the rest to contribute to direct runoff. Soil erosion, too, is greatly controlled by vegetation. Hence, land use classes, as determined by remote sensing, have an implicit hydrological significance in terms of water yield, peak flows and soil erosion. Continuing deforestation leads to more sediment yield downstream causing damages in flood plain agricultural fields. Since, sudden increase in river flows might also cause floods, the stakeholders here are not only the watershed management agencies

and people living in the region but also insurance agencies who provide insurance against flood damages²⁻⁴.

CONCLUSION

Natural disasters cause damage to life and property all over the world in various forms. The pressure on the earth's resources caused by increased population has resulted in increased vulnerability of human and their infrastructure to the natural hazards, which have always existed. The result is a dynamic equilibrium between these forces in which scientific and technological development plays a major role. Recurring occurrences of earthquakes, floods, landslides and forest fires need to be studied using today's advanced technology to find effective preventive measures. Space technology can help the disaster mitigation process through better future scenario predictions; detection of disaster prone areas; location of protection measures and safe alternate routes etc. Post-disaster satellite data acquisition helps in disaster recovery; damage claim process and fast compensation settlement.

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GNOTOBIOTIC ANIMALS : A POTENT TOOL FOR LIFE SCIENCE RESEARCH

S. Parthiban, S. Malmarugan, J. Johnson Rajeswar and V. Kumar

Gnotobiotics is the scientific study of animals or other organisms that are raised in germ free environments or ones that contain only specifically known germs. The gnotobiotic laboratory animal is potentially a very valuable tool for investigating any suspected interaction between the host and its associated microflora or between different components of that flora. However, like many other good ideas, the production of gnotobiotics is simple in concept but complicated in execution. In the early stages the greatest obstacles to the general use of germ free animals were the expense and the restricted amount of space that could be maintained free from contaminants. Nowadays, with modern isolators and facilities it is easier to produce gnotobiotic animals at relatively modest price.

INTRODUCTION

Gnotobiotic animals (or) gnotobiotic are an animal stock or strain in which only certain known strains of bacteria and other microorganisms are present. Technically, the term also includes germ-free animals, as the status of their microbial communities is also known⁴. Gnotobiotic animals are derived by aseptic hysterotomy or hysterectomy, embryo transfer or sterile hatching of eggs and are continuously maintained using aseptic technique where the microbial status of the animal is fully defined; includes both germ free and defined flora animals. Animals reared in a gnotobiotic colony are devoid of normal flora, has poorly developed immune systems,

lower cardiac output, thin intestinal walls, low antibody titers low metabolism rate and high susceptibility to infectious pathogens³. Lower amounts of serum gamma-globulins have been observed in germ-free animals of several species, and the quantity increases on association with microorganisms. Nuttall and Thierfelder are considered pioneers of gnotobiotics and germ free research. Germ free mice have adapted anatomically and physiologically to life without microbes.

DERIVATION OF GNOTOBIOTIC ANIMALS

The production of germ-free animals or birds depends upon the fact that embryos developing inside an egg or the mammalian uterus are microbiologically sterile, provided that they come from healthy parent stock. The uterus is removed and passed into the isolator

* Department of Veterinary Microbiology, and Department of Veterinary Pathology, VC & RI, Tirunelveli and TANUVAS. Email: parthis17@gmail.com.

through germicidal dip tank. Once inside the isolator, the uterus is opened and young ones are removed, cleaned, and then placed with foster germ free females. Hysterectomy does not eliminate pathogens that may contaminate fetus after uterine implantation or that is vertically transmitted. Vertical transmission of pathogens can be avoided by using embryo transfer².

Birds are relatively easy to be produced germ-free. Germfree chicks, turkeys, and Japanese quail can be obtained by passing surface-sterilized eggs through a germicidal trap into a sterile isolator, where they are allowed to hatch. The fertilized eggs must be obtained from flocks free from microorganisms that invade the egg in the oviduct.

Rats and mice have been bred germ-free through many generations; other species have been bred but are not yet available commercially. The guinea-pig is well-developed at birth and readily takes solid food within a day or two, but the operator must work fast during delivery into the isolator as the fetuses do not survive more than few minutes after removal from the mother.

ISOLATOR TECHNOLOGY IN GNOTOBIOTICS

Isolators are enclosures used to create the sterile environment. They must be made of material with an impervious physical barrier; main components are the chamber, air supply, air inlet and outlet, transfer port, and gloves; they come as rigid, semi-rigid, and flexible film isolators made of plastic or stainless steel. All manipulation of animals and supplies occurs within the chamber via the use of gloves and sleeves that are attached to the isolator walls. The glove is the most vulnerable part of the isolator in terms of contamination

potential. The transfer port is the enclosure that provides a transition between the isolator chamber and room environment; used for loading and removing items from the chamber it is the physical barrier to prevent contamination of the chamber. Isolators have HEPA filtration on air entry and exhaust. Positive pressure is used to prevent introduction of airborne contaminants through any punctures and is maintained when rearing germfree or gnotobiotic animals. If biohazardous agents are used in the incubator, negative pressure should be used. Air exchange rates are usually higher than the animal room some are 30 or more air exchanges per hour inside the chamber. Test the chamber for leakage using the gas leak detection test. The long term success of any gnotobiotic operation depends on the sterilization of the isolator chamber and the equipment/supplies that enter it⁶.

CARE AND MAINTENANCE OF GNOTOBIOTIC ANIMALS

Mammals must be aseptically derived by hysterectomy or hysterotomy as late as possible before term. Inside the isolator the young are hand-fed on a sterilized liquid diet similar in composition to the mother's milk. If the animals are successfully brought to sexual maturity natural breeding can continue in the germ-free environment and other strains or even other species may be fostered on to lactating females. Rats and mice have been bred germ-free through many generations; other species have bred but are not yet available commercially. Among the larger animals the difficulties of sterile delivery increase with their size. Beagle dogs have been satisfactorily reared and used for physiological experiments. Germ-free pigs have been produced for many years, although the problems of handling and

caging limit their usefulness beyond the first few weeks of life. Lambs, calves and goats have all been maintained germ-free throughout the life.

TERMINOLOGIES RELATED TO GNOTOBIOLOGY

Germfree (axenic) animal is free of all foreign life forms (e.g., bacteria, viruses, etc.) apart from it thought to be hypothetical state because indigenous or heretofore uncharacterized viruses may be integrated into host genome.

Defined flora animals are maintained in isolated environment and are intentionally associated with one or more known life forms, usually microorganisms.

Specific Pathogen Free (SPF) are animals free from specific pathogens but otherwise have an undefined flora.

Restricted flora – gnotobionte associated with altered Schaedler flora from isolator but is then moved into a maximum barrier room where it can become colonized with additional organisms (but remains free of adventitial pathogens); higher level of SPF.

Conventional animal – animal reared in a room with an unknown microflora and unknown disease status.

IMPORTANCE OF GNOTOBIOTIC ANIMAL

The gnotobiotic principles used in the production of infection free laboratory animals evolved from the efforts to rear and study animals in the absence of microbes or in

association with one or more pure cultures of microbes³. The gnotobiotic animal is potentially a very valuable tool for investigating any suspected interaction between the host and its associated microflora or between different components of that flora. The study of nutrition and metabolism is one to which the gnotobionte has made a significant contribution¹. Germfree animals are used in research involving various fields like toxicology, pollution control, autoimmune disorders, drug metabolism, genetic expression and vaccine tests⁵.

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BIOLOGICAL WEAPONS AND DETECTION SYSTEMS IN HUMAN POPULATION

S. Parthiban*, P. Pothiappan, M. Ranjithkumar, M. S. Murugan,
S. Malmarugan, J. Johnson Rajeswar and V. Kumar

This article gives an insight to the bioweapons and possible measures to be taken to strengthen the war against Biological Warfare agents. Biological weapons are a threat to the health and well-being of human's. Biological weapons should not only be considered a national security issue, but also public health priority. This paper will clarify the definitions associated with biological weapons and classification of Bio-weapons based on their effects. Adequate environmental detection and monitoring, improved vaccines and prophylactic drugs are all pathways toward defending against the biological attack.

INTRODUCTION

Biological agents are living organisms capable of infecting and causing both sickness and death in people, animals and plants. There are seven types of biological agents: parasites, fungi and yeasts, bacteria, rickettsia and chlamydia, viruses, prions, and toxins. Of these biological agents only bacteria, viruses and toxins are considered when referring to agents that can be used in a biological attack. While toxins are included in the list of biological agents, they are not living organisms, but small proteins produced by bacteria that can poison a person, animal or plant. Bacteria, viruses and toxins can be spread through the contamination of food, water or fomites; via vectors such as insects; or as aerosols suspended in wet or dry formulations^{1, 4}.

There are four classifications for how biological agents can be used to harm or kill a person, animal or plant. Biological Warfare (BW) is the military use of biological agents, where targets of agents are predominately soldiers, governments, or resources that might hinder a nation's ability to attack and/or defend itself. Bioterrorism (BT) is the threat or use of biological agents that, like most forms of terrorism, is intended to make political, religious or personal statements to governments and populations through attacks primarily aimed at civilians or resources that affect the civilian economy⁷. With few exceptions, bioterrorism is non-state sponsored. Biocrime (BC) is the threat or use of biological agents for individual objectives such as revenge or financial gain. The fourth classification is Bioaccident (BA), defined as the unintentional release of an agent from a laboratory or other facility. Biocrimes and Bioaccidents comprise events that typically have small effects on populations.

* Department of Veterinary Microbiology, Veterinary College and Research Institute, Tirunelveli, Email : parthis17@gmail.com

With the realization that the threat of bioterrorism was increasing, the Centers for Disease Control and Prevention (CDC) has developed a strategic plan for the response to biological and chemical terrorism. The plan of the CDC outlines 3 categories of biological agents that could or have been used by terrorist groups. The categories are grouped by priority for preparation as follows⁵ :

Category A : This group consists of the highest priority of agents. These agents pose a risk to national security because they can only be disseminated or transmitted person to person, causes high mortality with potential for major public health impact, might cause public panic and social disruption and require special action for public health preparedness. The category A agents are variola major (smallpox), *Bacillus anthracis* (anthrax), *Yersinia pestis* (plague), *Francisella tularensis* (tularemia), arena viruses (Lassa fever and Argentine hemorrhagic fever and related viruses), filoviruses (Ebola hemorrhagic fever and Marburg hemorrhagic fever) and *Clostridium botulinum* toxin (botulism).

Category B : This group consists of the second highest priority of agents because they are moderately easy to disseminate, causes moderate morbidity and low mortality rates and require specific enhancements of diagnostic capacity and surveillance activities. The category B agents are *Coxiella burnetti* (Q fever), *Brucella* spp (brucellosis), *Burkholderia mallei* (glanders), alphaviruses (Venezuelan/eastern/western encephalitides), ricin toxin from *Ricinus communis* (castor beans), epsilon toxin of *C. perfringens*, and *Staphylococcus enterotoxin B*. A subset of Category B agents includes pathogens that are food or waterborne and include *Salmonella* spp, *Shigella dysenteriae*, *Escherichia coli* O157:H7, *Vibrio cholerae*, and *Cryptosporidium parvum*³.

Category C : The category C agents are those that include emerging pathogens that could be engineered for mass dissemination in the future because of availability, ease of production, dissemination and potential for high morbidity and mortality and major health impact. The category C agents are Nipah virus, Hantaviruses, tickborne hemorrhagic fever viruses, tickborne encephalitis viruses, yellow fever and multidrug-resistant tuberculosis.

DETECTING BIOLOGICAL WARFARE AGENTS

A satisfactory battlefield biological defense requires a sensitive environmental monitoring system to be employed, one that can detect the presence of toxic or infectious biological materials in the environment in a manner similar to chemical agent detectors². A distinction must be made here between detection of biological agents in the environment (detection, monitoring, or standoff detection) and medical diagnostics (detection of biological agents, components of biological agents, or antibodies to biological agents in tissue samples such as blood or other body fluids). Environmental biological detectors must be reliable and sensitive to be useful, and also must be able to determine when a previously contaminated area is safe. Medical diagnostics depend on fieldable laboratory testing.

ENVIRONMENTAL DETECTION AND MONITORING

Once a biowarfare agent has been dispersed, detection of the aerosol prior to its arrival over the target, in time for personnel to don their protective equipment, is the best way to minimize or prevent casualties. Evolving detector systems are an area of intense interest with the highest priority within the research and development community. A Biological

Integrated Detection System (BIDS) will be vehicle mounted and will test environmental air samples, by concentrating appropriate aerosol particle sizes in the air samples, then subjecting the sample to analytical- and antibody-based detection for selected agents. The Tactical Biological Standoff Detection System will employ ultraviolet laser and laser induced fluorescence to detect biological aerosol clouds at a standoff distance of up to 5 km. This system will be available for fixed-site applications or inserted into various transport platforms such as fixed-wing or rotary aircraft, tactical vehicles, or unmanned aerial vehicles. The other standoff detection system now in the research and development phase is the Strategic Biological Standoff Detection System, which will provide a long range/large area aerosol detection, tracking, and mapping capability⁶. This system has the potential to detect aerosol clouds out to ranges of 100 km. The information will be used to provide early warning, enhance contamination avoidance efforts, and cue tactical-level (i.e., unit-level) detection assets.

The principal difficulty in detecting biological agent aerosols stems from differentiating the artificially generated biological warfare cloud from the background of organic matter normally present in the atmosphere. Therefore, medical protection (vaccines and other prophylactic measures), intelligence, medical surveillance and medical diagnostics, and physical protection during times of high threat must be relied on as primary defenses in the absence of currently fielded environmental biological detectors⁸.

EPIDEMIOLOGICAL SURVEILLANCE

An epidemiological surveillance system that closely monitors unusual illnesses or outbreaks

of disease is also extremely important. It is difficult for command medical advisors to know if a disease outbreak is consistent with a biowarfare attack unless background rates of disease for an area of operations are known. Surveillance programs must be specifically tailored to both the mission and the geographical area where the mission is based, and they must be focused toward specific, diagnosable disease entities. Generic surveillance systems that lump disease and injury into broad categories such as "respiratory" or "dermatological" are nearly useless as epidemiological indicators of a biological warfare attack. Early and rapid analysis of specific epidemiological surveillance data may be the first clue, however, that such an attack has occurred. In addition to specific clinical clues that suggest illness from biological threat agents (eg, a widened mediastinum in the terminal phases of inhalational anthrax),

MEDICAL DIAGNOSTICS

Medical diagnostics are also extremely important. A field medical laboratory capable of identifying live agents or toxins quickly and accurately in medical samples is an absolute necessity if the use of biological weapons by the enemy is a Possibility. Viral agents and toxins present the most difficult diagnostic problems for current diagnostic tests, which are based on Polymerase Chain Reaction (PCR), radioimmunoassays, or Enzyme-Linked Immuno Sorbent Assays (ELISAs). Laboratory capabilities must be tailored carefully to intelligence information on enemy biological warfare capabilities and also to information on specific endemic diseases that are likely to occur in the theater of operations. Both ELISA-based testing and specific testing for minute amounts of specific genetic material of biological agents in medical samples using PCR techniques are feasible for deployment

and use in a field setting. Both epidemiological surveillance and field laboratory capabilities are receiving a great deal of attention in the control of biological warfare⁷.

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BIOHYDROGEN PRODUCTION FROM ALGAE : AN OVERVIEW

Chiranjib Banerjee, Pratyosh Shukla, Ramesh Chandra and Rajib Bandopadhyay*

Few microalgae are able to produce hydrogen using light and water under anaerobic condition. Two enzymes *viz.* nitrogenase and hydrogenase are responsible for the production of hydrogen in lower plant system. In this article both direct biophotolysis (green algae) and indirect biophotolysis (blue green algae) for the production of hydrogen are briefly described. The photoproduction of hydrogen from algae will have a positive impact on environment and is a key to green fuel technology.

INTRODUCTION

Hydrogen is the lightest gas and abundant in form of hydrocarbon and water. Hydrogen can be produced by different methods like chemical reaction and electrolysis. The electrolysis of water and thermo catalytic reformation of hydrogen rich compounds require high input of energy from non-renewable source of energy, so biological hydrogen production receives much attention now a days. Biological hydrogen production can be summarized as following methods.

- (1) Direct biophotolysis (by green algae)
- (2) Indirect biophotolysis (by blue green algae/cyanobacteria)
- (3) Photofermentation (purple non-sulfur bacteria), and
- (4) Dark fermentation (anaerobic bacteria).

First hydrogen production from green algae (*Scenedesmus obliquus*) was reported by Hans Gaffron and Jack Rubin under anaerobic conditions¹. As in photosynthesis oxygen is produced during photolysis of water and oxygen, is a potent inhibitor of hydrogenase,

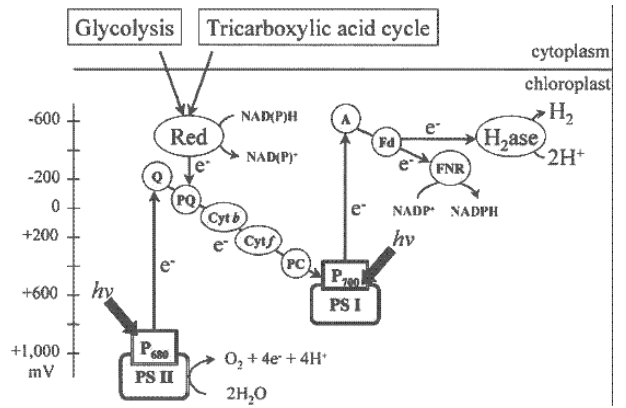
* Department of Biotechnology, Birla Institute of Technology, Mesra, Ranchi-835215, India, E-mail:rajib_bandopadhyay@bitmesra.ac.in

so two stage biophotolysis is developed by Melis² where oxygen and hydrogen is separately produced in *Chlamydomonas reinhardtii* cells. In two stage photosynthesis, *C. reinhardtii* cells were first grown in normal medium where water oxidation, oxygen evolution and biomass accumulation occur and in the next stage the cells of *C. reinhardtii* were transferred to sulphur deprived medium and anoxygenic condition is introduced in the system which act as a metabolic switch for the production of hydrogen³. Major hydrogen producing algae are listed in Table 1^{1,4,5}.

Table-1: Major Hydrogen Producing Algae

Name of the algae	Maximum rate of hydrogen production(ml/l.h)	Reference
Green algae		
<i>Scenedesmus obliquus</i>	3.6 a	1,4
<i>Chlamydomonas reinhardtii</i>	4.5 a	4
<i>Chlamydomonas moewusii</i>	10.0 a	4
Blue green algae		
<i>Oscillatoria sp</i> Miami BG7	90	5

a- ml/ μ g Chl a.l



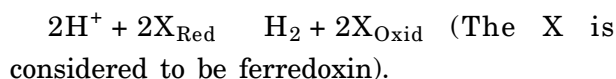
MECHANISM OF PHOTOBIOLOGICAL HYDROGEN PRODUCTION

Algae can produce hydrogen by the following mechanism :

- (i) **Direct Biophotolysis**—By Green algae (Chlorophyceae)
- (ii) **Indirect Biophotolysis**—By Blue Green algae (BGA) or cyanobacteria (Cyanophyceae). In this text we will describe it as BGA.
- (iii) **Direct Biophotolysis** - Light energy is absorbed by photosystem-II generate electron from biophotolysis of water.



The pigments (chlorophyll, carotenoids, phycobilisome) capture photons (packets of energy) and this energy excite an electron which either return to ground state or if electron acceptor is present the excited electron can move to acceptor resulting in formation of positive charge on acceptor and referred as photoinduced charge separation. Now this electron can reduce other species to store light energy in chemical forms. Electron then transferred to ferredoxin using light energy absorbed by PSI. Under aerobic photosynthetic conditions, reduced Fd is responsible for the conversion of NADP^+ to NADPH catalyzed by the ferredoxin-NADP-oxidoreductase enzyme (FNR). NADPH is used as a reductant in the dark reactions that fix CO_2 and store sunlight energy in the form of carbohydrates and starch. Hydrogen is produced by hydrogenase by catalysing the following reaction,



Under anaerobic condition the stored starch is oxidised *via* glycolysis and tricarboxylic acid cycle. The reductant produced (NADH) provide to the photosynthetic electron transfer chain at the plastoquinone pool chain which will be used up for producing hydrogen (Fig. 1).

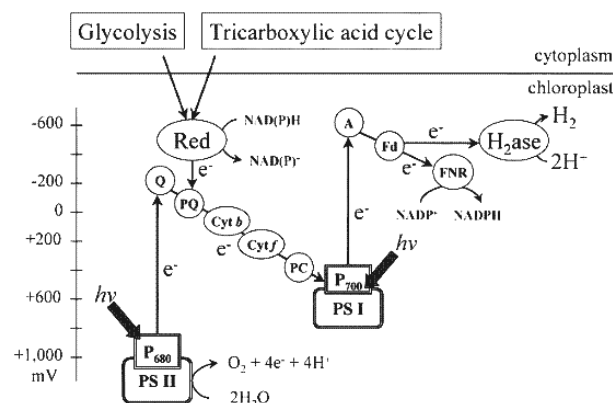


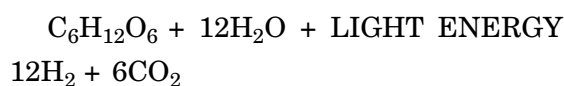
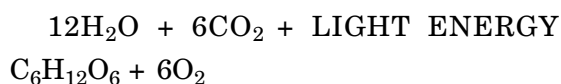
Fig. 1. Schematic drawing of Hydrogen production in green algae: Electron will be produced from photolysis of water under aerobic but under anaerobic condition the electron will come from oxidation of stored starch. Electron will transported to ferredoxin via PSI and then to hydrogenase. (Adapted and slightly modified from Melis and Happe, 2003)

In laboratory condition anaerobic condition is obtained by flushing the medium with argon to remove dissolved oxygen and sulphur counterparts which is replaced with chloride counterparts i.e. the medium is sulphur deprived. Under this condition the hydrogenase gene expression is triggered. Mitochondrial respiration scavenges all oxygen (O_2) generated by residual photosynthesis as oxygen is a potent inhibitor of hydrogenase. Long term hydrogen production can be obtained by transferring the algae (*Chlamydomonas reinhardtii*) cells into sulphur deprived medium (anaerobic) which should be placed near the cool fluorescent light. Under deprived condition

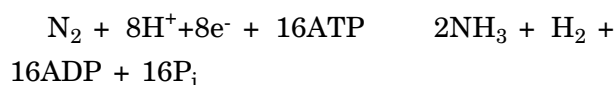
→

e^- (electron) comes from degradation of protein and starch which is produced during the first phase (photosynthetic). Depletion of sulphur blocks the synthesis of D1 poly peptide chain which contains much sulphur containing amino acid leading to declining in photosynthetic activity⁶.

(ii) **Indirect Biphotosynthesis** - BGA can synthesize and evolve hydrogen through the following reaction.



BGA is a large and diverse group of photoautotrophic microorganism. It contains chlorophyll a, carotenoids and phycobiliprotein BGA possess nitrogenase (catalyse the production of hydrogen as a byproduct of nitrogen fixation), uptake hydrogenase (catalyse the oxidation of hydrogen synthesized by nitrogenase) and bi-directional hydrogenase which has the ability to both oxidise and synthesize hydrogen⁷. Temporal separation of hydrogen evolution and photosynthesis is natural process because nitrogenase is also inhibited by O_2 . The separation is achieved by the formation of specialized cell called heterocyst. In heterocyst nitrogen fixations occur and hydrogen is produced as by product while photosynthesis is occurring in vegetative cells^{7,8,9}.



The above reactions occur in heterocyst to fix nitrogen to ammonia and production of

hydrogen as a byproduct. Nitrogenases require ATP and high partial pressure to produce hydrogen⁷.

CONCLUSION

As fossil fuel is a limiting source of energy so hydrogen can be used which is clean, renewable and eco-friendly. Current state of art for the production of hydrogen is either steam reformation methane or by electrolysis of water. The single cell organism (*Chlamydomonas reinhardtii*) became a model organism for hydrogen production. However, more research and development is required in the area of metabolic engineering, optimization of photobioreactor culture condition, genetic engineering of algae to enhance hydrogen production for its commercial viability.

ACKNOWLEDGEMENT

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TUBULIN TARGETING AGENTS : AN INDISPENSABLE CLASS FOR CANCER TREATMENT

Vijay K. Patel, Avineesh Singh, Deepak K. Jain, Harish Rajak*.

Cancer is a global disease and its incidences are growing fastest in low and middle income countries like India. Microtubules have long been identified as an attractive and promising target for development of anticancer drugs. Microtubules, a vital cell component are involved in a wide number of cellular functions such as division, motility, shape maintenance and intracellular transport. Interruption with microtubule assembly, either by inhibition of tubulin polymerization or by blocking microtubule disassembly, leads to death of cancerous cells. The scientific endeavor of last two decades in the field of anticancer research indicates that tubulin-interactive agents would play a noteworthy role in the treatment of cancer.

INTRODUCTION

Cancer is a disease characterized by unregulated proliferation of cells. It is a growing public problem whose estimated worldwide incidences are 10.9 million new cancer diagnoses, 6.7 million deaths from cancer, and 24.6 million individuals alive with cancer (within 5 years of diagnosis). Over the coming decades, it is predicted that cancer incidence rates will grow significantly in line with the increasing global elderly population; therefore, a need exists for new cancer therapeutic agents with improved efficacy that are well tolerated.^{1,2}

Tubulin protein is a highly imperative and feasible goal for anticancer drug discovery. Hundreds of naturally occurring, semi

synthetic and synthetic antitubulin agents have been reported till now³⁻⁵. Microtubules are composed of two globular protein subunits, α and β -tubulin. These two subunits combine to form an α , β -hetero-dimer which then assembles in a filamentous tube-shaped structure. The tubulin hetero-dimers arrange themselves in a head to tail manner with the α -subunit of one dimer coming in contact with the β -subunit of the other (Fig. 1). This arrangement results in the formation of long protein fibres called protofilaments. These protofilaments form the backbone of the hollow, cylindrical microtubule which is about 25 nanometers in diameter and varies from 200 nanometers to 25 micrometers in length. About 12-13 protofilaments arrange themselves in parallel to form a C-shaped protein sheet, which then locks around to give a pipe-like structure called the microtubule. The head to

* ¹ Institute of Pharmaceutical Sciences, Guru Ghasidas Central University, Bilaspur-495009, (C.G.) India E-mail : harishdops@yahoo.co.in

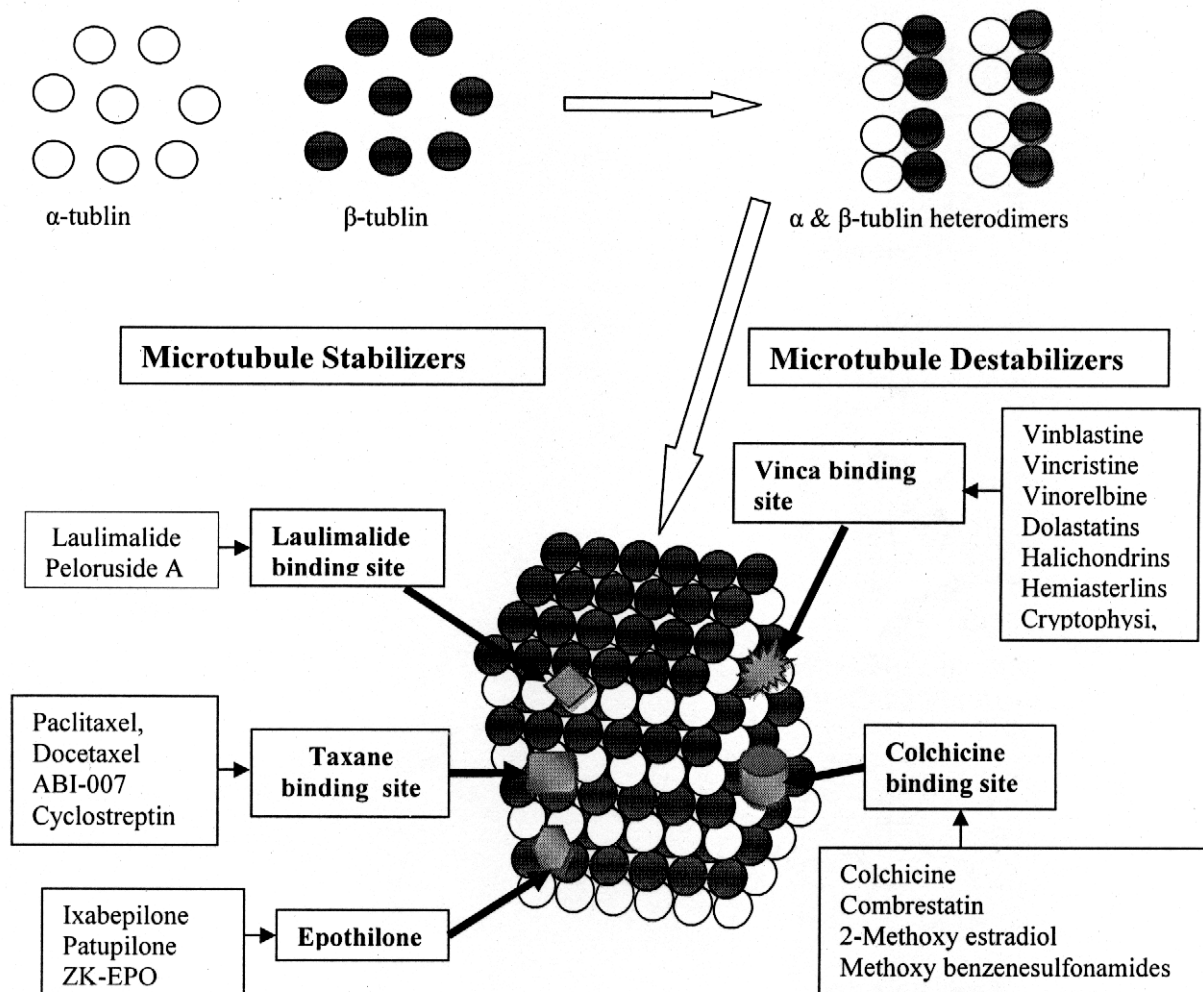


Fig. 1 : Structure of tubulin binding site with examples

tail arrangement of the hetero dimers gives polarity to the resulting microtubule, which has an α -subunit at one end and a β -subunit at the other end. The α -tubulin end has negative (-) charges while the β -tubulin end has positive (+) charges¹⁻⁶.

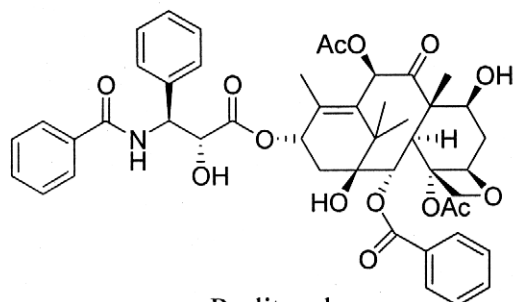
FUNCTION

Microtubules are involved in a wide number of cellular functions such as division, motility, shape maintenance and intracellular transport. Interruption with microtubule assembly, either by inhibition of tubulin polymerization or by blocking microtubule disassembly, leads to an

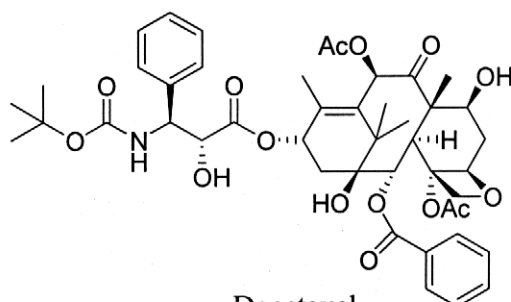
increase in the number of cells in Metaphase arrest¹⁻⁴.

MECHANISM OF TUBULIN INHIBITOR

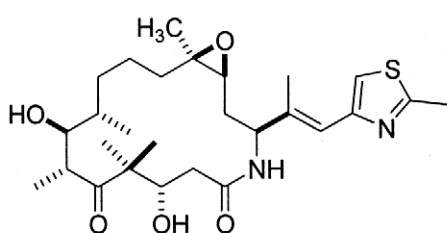
Tubulin inhibitors proceed by interfering with the dynamics of the microtubule that is growing (Microtubule Stabilizers) and shortening (Microtubule Destabilizers). On the basis of mechanism of action tubulin inhibitors are divided in two class, first class operates by inhibiting the depolymerization of polymerized tubulin and increases the microtubule polymer mass in the cells are called Microtubule Stabilizers second class of inhibitors operates



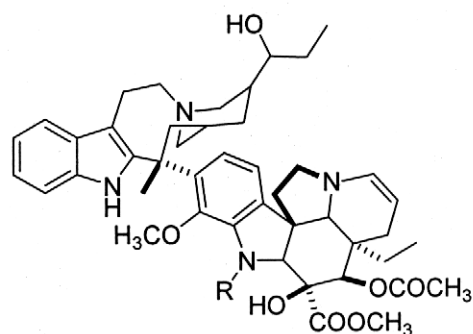
Paclitaxel



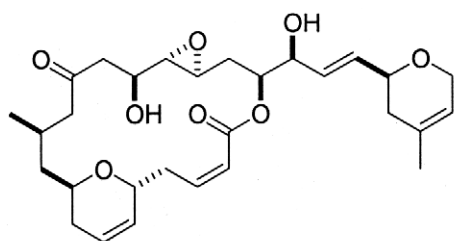
Docetaxel



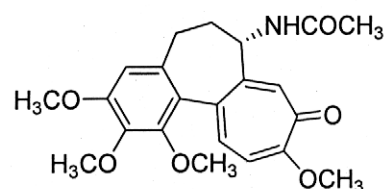
Ixabepilone

R= -CH₃ Vincristin

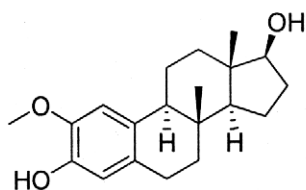
R= -CHO Vinblastine



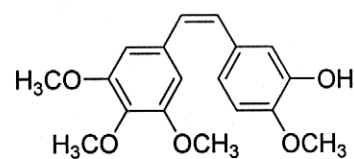
Laulimalide



Colchicine



2-Methoxyestradiol



Combretastatin A-4 (CA-4)

Fig. 2 : Structure of important tubulin binding drugs

by inhibiting polymerization of tubulin to are called Microtubule Destabilizers. Structure of tubulin binding site with examples shown in Fig. 2.

Class I. Microtubule Stabilizers

- Laulimalide binding site:** Laulimalide, Peloruside A etc.
- Paclitaxel site ligands:** Paclitaxel, Docetaxel, ABI-007, Cyclostreptin etc.

- (c) **Epothilone** : Ixabepilone, Patupilone, ZK-EPO etc.

Class II. Microtubule Destabilizers

- (a) **Colchicine binding site**: colchicine, combrestatin, 2-methoxy estradiol, methoxy benzenesulfonamides (E7010) etc.
- (b) **Vinca binding site**: vinblastine, vincristine, vinorelbine, vinfluine, dolastatins, halichondrins, hemiasterlins, cryptophysi, etc.

IMPORTANT TUBULIN BINDING DRUGS

The Taxanes : During the past two decades, mitotic inhibitors have been comprehensively explored through numerous experimental and clinical trials which have resulted in better treatment of breast, ovarian, lung, prostate, pancreas, gastric and head and neck cancers. The taxane class of anticancer agents effectively prevents growth and division of cancer cells. The taxanes group mainly comprises of Paclitaxel (Taxol) and Docetaxel (Taxotere) as well as taxanes homologs, which are derived from natural sources. Taxol is obtained originally from *Taxus brevifolia*, while Docetaxel is a semisynthetic analogue of the later. Key therapeutic indications of Praclitaxel include AIDS-related Kaposi's sarcoma, breast cancer, non-small cell lung cancer and ovarian cancer. On the other hand, major therapeutic indications of Docetaxel includes breast cancer, gastric cancer, head and neck cancer, hormone refractory prostate cancer. During course of time, poor oral bioavailability, solubility and numerous side effects were emerged as limitations of taxane therapy, thus necessitating the requirement for the development of novel

similar antimetotics agents. Taxanes also known to possess a radiosensitizing effect i.e., taxanes are administered before application of radiations leading to enhancement of sensitivity of radiation therapy to the tumors.

Epothilones : The epothilones are a class of microtubule stabilizing compounds with extreme cytotoxicity and similar mode of action to Taxol. Epothilone B is more active than Taxol (*in vitro*). It was first isolated from the common soil bacteria *Sorangium cellulosum* as early as 1987 by Höfle and Reichenbach. The epothilones are active against Taxol resistant cancer cell lines. One epothilone derivative, the semisynthetic analogue ixabepilone has been permitted for clinical use in the United States, in addition, several other epothilone derivatives (Epothilone B, Dehydellone and Sagopilone) are in advanced clinical trials.

Laulimalide : is a marine natural product and was isolated in 1999 from the marine sponge *Cacospongia mycofijiensis*. It stabilizes microtubules in a similar manner to paclitaxel, but it bind to the Laulimalide binding site on tubulin. It is a highly potent antimetotic agent, which inhibits proliferation of a range of human cancer cell lines, at nanomolar concentrations. It also kills cells resistant to epothilones and paclitaxel, so it is an interesting lead compound. In recent past, number of analogues have been synthesized, but it has not yet entered in clinical trials.

The Vinca Alkaloids : Vincristine and vinblastine, the first natural products used for anticancer properties were isolated from the *Vinca rosea* Linn. (periwinkle) of the family Apocynaceae. The major therapeutic

applications of Vincristine include treatment of acute leukemia, pediatric solid tumors and other lymphomas. On the other hand, vinblastine is mainly employed for treatment of Hodgkin's lymphoma, metastatic testicular tumors (with bleomycin and cisplatin) and advanced breast cancer.^{7, 8}

Vinorelbine is a semi-synthetic analogue of vinblastine. It exhibited promising activity against cancer specially, breast cancer and is in clinical trial for the treatment of several types of neoplasm.

Vinflunine has displayed superior antitumor activity to vinorelbine and vinblastine. It is a novel fluorinated vinca alkaloid, currently in Phase II clinical trials for treatment of urothelial tract cancer and advanced transitional cell bladder.

Colchicine : is an active component of the meadow saffron or autumn crocus *Colchicum autumnale*. It inhibits the formation of the microtubules required for chromosome transport during metaphase by forming a 1:1 complex with tubulin, which binds to the end of the forming microtubule and inhibits further polymerization. Its therapeutic applications in the treatment of gout, familial Mediterranean fever and certain liver disorders are directly related to its tubulin binding activity. Its analogs have been established for anticancer activity with some success.

2-Methoxyestradiol : is a novel antineoplastic and antiangiogenic drug in phase I and II clinical trials for the treatment of multiple myeloma, glioblastoma multiforme, prostate, and breast cancer. It binds to tubulin at colchicine site, inhibiting microtubule assembly.

It also selectively targets endothelial cells of the developing tumor vasculature without affecting preexisting blood vessels and shows lesser side effects.

Combretastatin A-4 (CA-4) is a low molecular weight cytotoxic agent isolated from the bark of the South African tree *Combretum caffrum* and strongly inhibits of tubulin polymerization by binding to the colchicine site of tubulin microtubule. A number of CA-4 analogues such as CA-4P, AVE8062 (ombrabulin), EPC2407 (Crolibulin), OXi4503, ABT-751 (E7010), T138067, BNC-105P, etc are in different stages of clinical trial.^{9, 10}

Conclusion: Tubulin is the biochemical target for several clinically used anticancer drugs. Antimitotic agents inhibit the normal microtubule polymerization or depolymerization process, leading to mitotic arrest of eukaryotic cells. Thus microtubule tubulin targeting agents is a well established approach to anticancer therapy with some limitations i.e., resistance and toxicity. Future challenges in the application of microtubule-targeted agents include increasing the understanding of their basic mechanisms, improving their clinical effectiveness, discovery of new small molecule as tubulin targeting agents. These agents hold great promise as inhibitors of angiogenesis with potential critical applications in cancer and other diseases associated with aberrant vascularization.

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KNOW THY INSTITUTIONS

SOLAR ENERGY CENTRE, GURGAON

The Solar Energy Centre (SEC), established in 1982, is a dedicated unit of the Ministry of New and Renewable Energy, Government of India for development of solar energy technologies and its related science and engineering. To achieve its objective, the Centre has been working on various aspects of solar resource utilization and technology development in collaboration with other research institutions, implementing agencies and industry. Over the years, the Centre has developed a variety of technical facilities for technology evaluation and validation, testing and standardization, performance reliability, monitoring and data analysis apart from training.

CAMPUS

The campus of the Centre for its R&D activities is located at the 19th milestone on the Gurgaon-Faridabad road which is about 25 km south of main office of the Ministry. The surrounding area is predominantly agricultural and beautiful green or yellow fields can be seen around the Campus depending upon the season. The main approach to the Campus passes through the Arawalis, which are considered to be the oldest mountain range in India. Covering an area of about 81 hectares, the campus receives abundant sunshine for experimenting with the energy from the sun. The buildings of the Centre have been constructed using solar passive techniques to

achieve energy efficiency and environmental friendliness.

ACTIVITIES

The Solar Energy Centre (SEC) serves as an effective interface between the Government and institutions, industry & user organizations for development, promotion and widespread utilization of solar energy in the country. The functions of the Centre are as follows :

Research and development

- Cooperation with institutions and industry Technology evaluation, testing and standardization.
- Evaluation of Technical, Environmental, and Economic performance.
- National Referral Test Facility Developmental Testing
- Coordination with Regional Test Centers (RTCs) and Standards Organizations.

Human resource development

- Visitors Programme
- Training, workshops, symposia and seminars.

Advisory and consultancy services

- International cooperation
- Plantation of *Jatropha curcas* for production of Bio-diesel

ACHIEVEMENTS

The Centre has been playing a crucial role in development and promotion of solar energy technologies. The Centre has been the technical focal point for the National Solar Energy Programme. The facilities created at the Centre to enable it to perform its role are the most advanced and unique in India and south Asian region. The Centre is recognised today as a leading institution for :

1. Solar Resource Assessment
2. Technology Assessment
3. Solar Buildings
4. System Designing
5. Evaluation of Emerging Technologies
6. Testing and Standardization of solar devices.
7. Bio-fuel Plantation

Apart from development of infrastructural and R&D facilities, the Centre has also many other significant achievements as given below, to his credit.

- Technical assistance to industry for development for solar energy products.
- Development of National Standards for solar thermal devices.
- Establishments of testing protocol for solar thermal and solar PV devices for attaining uniformity in the testing carried out by various authorized agencies within the country.
- Preparation of a number of technical reports/papers on important solar energy topics, such as solar thermal power generation, solar refrigeration, solar desalination, biofuel and other technologies.
- Establishment of a number of technology demonstration projects which includes a 46 KW solar PV power project at the Centre.
- Establishment of state-of-the-art facilities for solar energy research and testing under assistance from UNDP, USAID and GTZ.
- Establishment of a solar evaporative cooling system for a part of the technical blocks of the Solar Energy Centre.
- Reviving 50 KWe Solar Thermal Power Plant by indigenizing some critical

components like Heat Collection Elements. Plant is in use as R&D, Demonstration & Educational facility.

- 26,000 & 500 saplings of *Jatropha curcas* and *Pongamia pinnata* have been planted respectively under the biofuel the biofuel programme during 2005-06.
- Prepared a bio-diversity report including both indigenous and exotic flora of SEC.
- Prepared presentation material i.e. posters giving technical details from cultivation of *Jatropha curcas* production of biodiesel.

NEW INITIATIVES

Details of the major Solar Thermal Projects / PV Systems & components recently undertaken at Solar Energy Centre (SEC)

● National Solar Thermal Power Testing, Research and Simulation Facility

The facility envisages a grid connected Solar Thermal Power Plant of 1 MW capacity. This will also include a test set up that enables companies and research institutions to test the performance of different solar concentrators, coatings and materials, components and system for a Solar Thermal Power Plant. The project is being implemented by IIT Mumbai and a consortium partners consisting of Tata Power, Tata Consulting Engineers, Larsen & Toubro, Clique, KIE Solatherm.

● Concentrated Solar Thermal Energy Technology based on Parabolic Dish collectors

The project is a cooperative effort between Megawatt Solutions Pvt. Ltd. and SEC under MNRE's initiative to promote research, development and demonstration of indigenously developed renewable energy

systems and technologies under a cost-sharing basis. It involves demonstration and evaluation of 4 interconnected dish concentrators each of 90m² aperture area providing heated thermic fluids upto 400°C.

● Solar Thermal Stirling Engine

The project has been taken up in collaboration with ONGC Energy Centre (OEC). Three units of engines of 3 kW capacity each have been installed and commissioned in the campus. The objective of the project is to carryout long term performance evaluation under Indian conditions. The engines have been connected to the local grid and the electricity produced during the sunshine hours is being utilized in the Technical Block. The rated output of the facility is 9 kW (peak power) at solar insolation of 850 W/m² at 20°C ambient temperature.

● Development of a Modular Central Receiver Concentrated Solar Power Plant for Decentralized Power Generation

SunBorne Energy with support from MNRE will be setting up a 1 MW_{Th} CSP Central Tower pilot facility in partnership with SEC. The main objective is to develop the optimized designs of the heliostat field, volumetric air receiver and thermal storage, the three major components of a Concentrated Solar Power (CSP) Central Receiver plant and also to develop the local sources for all the key components of the plant with a focus on lowering costs.

● High Efficiency Solar Thermal Air-conditioning Systems - a collaborative project of Thermax Limited and solar Energy Centre

The project (100 KW cooling capacity) is being implemented by M/s Thermax Limited at Solar Energy Centre with an objective to integrate solar collectors, vapor absorption machine (VAM) and appropriate thermal storage system

to achieve consistence performance of the system with coefficient of performance (COP) (1 : 1.7)

● **Cold Storage with Solar - Biomass Hybrid System**

It is an APP project in partnership with TERI, Thermax Limited, SEC and CSIRO Australia with an objective to develop cold storage particularly in rural areas utilizing exhaust heat of biomass gasifier engine/solar schffler dish.

Solar cell characterization laboratory

● Solar Cell Characterization laboratory has a class AAA solar simulator based Solar Cell Tester of M/s ORIEL, USA make to study solar cell performance under standard Test Conditions (STC) or other user selected conditions. The conituous type solar simulator, in which illumination is continuous in time, is certified to IEC 60904-9:2007

Edition, JIS C 8912 and ASTM E 927-05 standard

At present, Solar cell testing facility at SEC is capable of testing solar cells (Only mono/multi crystalline Silicon Solar Cells with /having extended ribbons) up to 6 inch X 6 inch area as per IEC 60904-1:2006 /IS 12762 (Part 1):2010 standards.

CONTACT :

Mailing Address : Solar Energy Centre, MNRE, B-14, CGO Complex Lodhi Road, New Delhi -110003, Telefax : 0091-11-24360331

Campus: Solar Energy Centre, 19th Milestone, Institutional Area, Gurgaon-Faridabad Road, Gwalpahari, Gurgaon Telefax No. : 0091-124-2579207 Email: sec@nic.in

CONFERENCES / MEETINGS / SYMPOSIA / SEMINARS

National Conference on Harmony with nature in context of environmental issues and challenges of the 21st century” (HARMONY-2014)K 28th to 30th November, 2014.

Topics :

- Air, Water, Soil and Noise Pollution and control strategies
- Biodiversity - Conservation and Sustainable Development
- Environmental Impact Assessment
- Environmental Biotechnology and Microbiology, Bioremediation
- Toxicology, Environmental health and Medicinal plants
- Environmental Chemistry
- Environmental Geology and Green Technology
- Seri, Lac, Api and Pisciculture in Present era
- Aquatic resource Management
- Eco friendly Mining and reclamation, Groundwater Management
- Remote sensing & Gis in environmental management
- Ecotorism and Environmental management
- Industries and Environment
- Radioactivity and Environment
- Natural Disasters : Management issues and strategies
- Environmental Policies, Laws and Legislations
- Environmental ethics

Submission of registration form and abstract 15-09-2014

Contact : **Prof. Nidhi Rai**, Department of Environmental Science, Faculty of Earth Science, M.L. Sukhadia University, Udaipur (Rajasthan) - 313 001, e-mail: enquiry.harmony2014@gmail.com.

International Conference on Processing of Lean Grade and Urban Ores (IC-LGO 2015), January 20-22, 2015, NML, Jamshedpur

Topics :**Processing of lean grade ores, fines and slimes**

- Characterization & Beneficiation.
- Agglomeration/Pelletisation.
- Metal extraction processes (Pyro-/Hydro-/Electro-/Bio-/Hybrid).

Processing of urban ores

- Collection, Recycling & Management of E-waste.
- Industrial & Municipal Waste (solid/liquid) recycling.

Energy and Environmental issues

- Sustainable alternative green energy resources.
- Utilization of Solid Waste *viz.* Slag, Fly Ash, Red Mud, Anode Slime Jarosite, Flue Dust, etc.
- Environmental pollution and remediation
- Life cycle assessment of processes.

Contact : Dr. Manis Kumar Jha, Chairman, IC-LGO 2015 & Assistant Director/Senior Scientist Metal Extraction & Forming Division, CSIR-National Metallurgical Laboratory, Jamshedpur-831 007, India, E-mail : mkjha@nmlindia.org, Ph. 91-657-2345302 (O), 91-9430185563 (M)

3rd International Conference on Computer, Communication, Control and Information Technology (C3IT-2015), 7th to 8th February 2015, Academy of Technology, Hooghly, West Bengal, India**Topics :****Computer :**

Artificial Intelligence, Soft computing, Computer Graphics, Data Warehousing & Mining, Distributed Computing, System Security, Virtual Reality, Cloud Computing, Service Oriented Architecture, VLSI and embedded Systems, Cryptography.

Communication :

Information Theory, Coding Theory, Mobile, Wireless and Broadband Communications, Optical Communications, RF and Microwave Communications, Antennas and Propagation, Satellite Communications, Green Communications.

Control :

Linear & Nonlinear Control, Process Control & Instrumentation, Drives & Controls, Intelligent Control, Industrial Automation, Controls in Aerospace, Robotics, Sliding Mode Control and related topics.

Information Technology :

Next Generation Networks, Ad hoc and Sensor Networks, Multimedia, Geographical Information Systems (GIS), Vehicular Networks, Information Security, Networks and Services Management, Performance Analysis, Image, Video and Signal Processing, Knowledge management, Game and Software Engineering.

Submission last date : 31st August 2014.

Contact : Convener, Academy of Technology, Aedconagar, Hooghly—712121, West Bengal, India +91 9432926197, Mob : +919143229105, Mob : +91 9830312660, Conference E-mail : conference@aot.edu.in, Website : <http://c3it2015.aot.edu.in/>

S & T ACROSS THE WORLD**NEW METHOD COULD DETECT ALIEN LIFE, SCIENTISTS CLAIM**

Scientists say they have developed a powerful new model to detect life on planets outside of our solar system, more accurately than ever before.

The new model focuses on methane, the simplest organic molecule, widely acknowledged to be a sign of potential life.

Researchers from University College London in the U.K. and the University of New South Wales in Australia developed a new method to detect the molecule at temperatures above that of Earth, up to 1220 degrees Celsius, something not possible before.

To find out what remote planets orbiting other stars are made of, astronomers analyze the way in which their atmospheres absorb starlight of different colors. They then compare that to a model, or "spectrum," to identify different molecules.

"Current models of methane are incomplete, leading to a severe underestimation of methane levels on planets," said Jonathan Tennyson, a physicist at University College London. "We anticipate our new model will have a big impact on the future study of planets and 'cool' stars external to our solar system, potentially helping scientists identify signs of extraterrestrial life."

"The comprehensive spectrum we have created has only been possible with the astonishing power of modern supercomputers which are needed for the billions of lines required for the modeling," added the study's lead author, Sergei Yurchenko, also of the university.

"We limited the temperature threshold," he added, "to fit the capacity available, so more research could be done to expand the model to higher temperatures still. Our calculations required about three million CPU (central processing unit) hours alone," he said.

"We are thrilled to have used this technology to significantly advance beyond previous models available for researchers studying potential life on astronomical objects, and we are eager to see what our new spectrum helps them discover."

The model has been tested and verified by reproducing the way methane in failed stars, called brown dwarfs, absorbs light, the researchers added. The study is published in the journal *Proceedings of the National Academy of Sciences*, January 10, 2014.

ANXIOUS CHILDREN FOUND TO HAVE BIGGER "FEAR CENTERS" IN THE BRAIN

Children with high anxiety tend to have a larger "fear center" in the brain, with more connections to other parts of the brain, according to a study.

The report, in the current issue of the journal *Biological Psychiatry* 2014; 75 (11): 892, says anxiety problems may stem in part from changes in its development of that center, called the amygdala.

Researchers at the Stanford University School of Medicine recruited 76 children, seven to nine years of age. The parents completed assessments designed to measure the anxiety levels of the children, and the children then underwent scans of brain structure and function, through magnetic resonance or MRI imaging.

The researchers found that the more anxious children had, besides a larger "fear center," increased connectivity between the amygdala and other brain regions responsible for attention, emotion perception, and regulation. They also developed an equation that they said reliably predicted the anxiety level from the MRI measurements.

The most affected region was the basolateral portion of the amygdala, they said, implicated in fear learning and the processing of emotion-related information.

"It is a bit surprising that alterations to the structure and connectivity of the amygdala were so significant in children with higher levels of anxiety, given both the young age of the children and the fact that their anxiety levels were too low to be observed clinically," said Shaozheng Qin, one of the authors.

John Krystal, editor of the journal, added that future studies need to focus on whether the brain structure is a risk factor, or itself a consequence, of "increased childhood anxiety." This line of research "will provide important new insights into the neurodevelopmental origins of anxiety in humans," Qin said.

INTACT PTEROSAUR EGGS REPORTED FOUND WITH PARENTS

Researchers are reporting the finding of the first three-dimensionally preserved eggs of pterosaurs, flying reptiles with wingspans up to half the length of a tennis court.

The eggs, found in China, turned up among at least dozens of pterosaur fossils, representing a new species called *Hamipterus tianshanensis*, scientists reported.

The animals lived together in colonies, according to the researchers, who presented their work in the journal *Current Biology* on June 5, 2014.

"Five eggs are three-dimensionally preserved, and some are really complete," said Xiaolin Wang of the Chinese Academy of Sciences, who was involved with the research. It was most exciting to find many male and female pterosaurs and their eggs preserved together, he added.

The pterosaur fossil record has generally been poor, with little information about their populations, the researchers say. Only four isolated and flattened pterosaur eggs were known to science before now.

The resting place of the pterosaurs now described was uncovered in 2005 in the Turpan-Hami Basin, south of the Tian Shan Mountains in Xinjiang, northwestern China. The fossil-rich area is thought to possibly harbor

thousands of bones. Wang said sediments in the area suggest that the pterosaurs died in a large storm about 120 million years ago in the Early Cretaceous period.

The researchers examined the largely intact pterosaur egg specimens to find that they were pliable, with a thin eggshell outside and a soft, thick membrane inside, similar to the eggs of some modern-day snakes. The researchers' observations of 40 male and female individuals suggested differences between the sexes in the size, shape, and robustness of their head crests.

The combination of many pterosaurs and eggs strongly indicates the presence of a nesting site nearby and indicates that this species developed gregarious behavior, the researchers said. *Hamipterus* most likely buried their eggs in sand along the shore of an ancient lake to prevent them from drying out, they added. While the new fossils are thought to shed light on their reproductive strategy, development, and behavior, there's still much left to learn about them.

"Sites like the one reported here provide further evidence regarding the behavior and biology of this amazing group of flying reptiles that has no parallel in modern time," the researchers wrote.

MYSTERIOUS DANCE OF DWARFS MAY FORCE A COSMIC RETHINK

A finding that many small galaxies don't "swarm" around larger ones like bees but rather circle them in disc-shaped orbits is creating a new conundrum for scientists. Last year "we announced our startling discovery that half of the dwarf galaxies surrounding the Andromeda Galaxy are orbiting it in an immense plane," said physicist Geraint Lewis from the University of Sydney in Australia. "This plane is more than a million light years in diameter, but is very thin, with a width of only 300,000 light years."

Now, astronomers are extending the finding to other galaxies.

The universe contains billions of galaxies. Some, such as the Milky Way, are immense, containing hundreds of billions of stars. Most galaxies, however, are dwarfs, much smaller and with only a few billion stars. For decades astronomers have used computer models to predict how these dwarf galaxies should orbit large galaxies. They had always found that they should be scattered randomly.

“Our Andromeda discovery did not agree with expectations, and we felt compelled to explore if it was true of other galaxies throughout the universe,” said Lewis. Using the Sloan Digital Sky Survey, a resource of color images and 3-D maps covering more than a third of the sky, the researchers dissected the properties of thousands of nearby galaxies.

“We were surprised to find that a large proportion of pairs of satellite galaxies have oppositely directed velocities if they are situated on opposite sides of their giant galaxy hosts,” said Neil Iбата of the Lycée International in Strasbourg, France, lead author of a new study on the findings, published July 20 in the journal *Nature*.

“Everywhere we looked we saw this strangely coherent coordinated motion of dwarf galaxies. From this we can extrapolate that these circular planes of dancing dwarfs are universal, seen in about 50 percent of galaxies,” said Lewis. “This is a big problem that contradicts our standard cosmological models. It challenges our understanding of how the universe works including the nature of dark matter,” an unseen material that is detected through its gravity.

The researchers believe the answer may be hidden in some currently unknown physical process that governs how gas flows in the universe. Some experts have made more radical suggestions, including bending and twisting the laws of gravity and motion. “Throwing out seemingly established laws of physics is unpalatable,” said Professor Lewis, “but if our observations of nature are pointing us in this

direction, we have to keep an open mind. That’s what science is all about.”

(Courtesy of the University of Sydney and World Science staff)

CONSCIOUSNESS RESEARCH NOT DEAD, SCIENTISTS INSIST

Why does a relentless stream of experiences normally fill your mind? Maybe that’s just one of those mysteries that will always elude us. Yet, research suggests consciousness lies well within the realm of scientific inquiry, as impossible as that may currently seem. Although scientists have yet to agree on an objective measure to index consciousness, progress has been made on the question in several labs around the world.

“The debate about the neural basis of consciousness rages because there is no widely accepted theory about what happens in the brain to make consciousness possible,” said Ken Paller, and director of the Cognitive Neuroscience Program at Northwestern University in Evanston, Ill.

Some brain scientists claim “consciousness is never going to be understood” and so research should focus on other areas, Paller said. “On the other hand, many neuroscientists are actively engaged in probing the neural basis of consciousness, and, in many ways, this is less of a taboo area of research than it used to be.” He added: “scientists and others acknowledge that damage to the brain can lead to systematic changes in consciousness. Yet, we don’t know exactly what differentiates brain activity associated with conscious experience from brain activity that is instead associated with mental activity that remains unconscious.”

In a new article, Paller and Satoru Suzuki, also a psychologist at Northwestern, discuss what they call flawed assumptions about consciousness to suggest that a wide range of scientific perspectives can offer useful clues.

“It’s normal to think that if you attentively inspect something you must be aware of it and that analyzing it to a high level would

necessitate consciousness,” Suzuki noted. But experiments don’t always back this up. “Likewise, it feels like we can freely decide at a precise moment, when actually the process of deciding begins earlier,” through brain processing that doesn’t enter awareness, he said.

The authors write that unconscious processing can influence our conscious decisions in ways we never suspect. If these and other similar assumptions are incorrect, the researchers say, then mistaken reasoning might be behind arguments for taking the science of consciousness off the table.

Experimental evidence has supported some theories about consciousness that appeal to specific types of communication among brain cells, which can be described in biological terms or more abstractly in computational terms, the researchers said. They added that further theoretical advances can be expected if specific measures of neural activity can be brought to bear on these ideas.

Paller and Suzuki both conduct research that touches on consciousness. Suzuki studies perception, and Paller studies memory. They said it was important for them to write the article to counter the view that it is hopeless to ever make progress through scientific research on this topic. They outlined recent advances that provide reason to be optimistic about future scientific inquiries into consciousness and about the benefits that this knowledge could bring for society. “For example, continuing research on the brain basis of consciousness could inform our concerns about human rights, help us explain and treat diseases that impinge on consciousness, and help us perpetuate environments and technologies that optimally contribute to the well being of individuals and of our society,” the authors wrote.

The paper, “The Source of Consciousness,” has been published online in the journal *Trends in Cognitive Sciences*.

(Courtesy of North-Western University and World Science staff)

MYSTERIOUS BURSTS OF RADIO WAVES IDENTIFIED FAR OUTSIDE GALAXY

Mysterious split-second pulses of radio waves are coming from deep in outer space, and nobody knows what causes them, according to astronomers.

Researchers led by Laura Spitler from the Max Planck Institute for Radio Astronomy in Bonn, Germany say they have found the first so-called “fast radio burst” in the sky’s northern hemisphere, using the Arecibo radio telescope in Puerto Rico.

The mystery is reminiscent of that of gamma-ray bursts, discovered in the 1960s and now thought to come from giant stars collapsing to form black holes. The new phenomenon, in the form of radio rather than gamma-rays—a different form of light—remains an enigma.

The flashes last only a few thousandths of a second. Scientists using the Parkes Observatory in Australia had recorded such events before, but the lack of similar findings by other telescopes led to speculation that the Australian instrument might have been picking up signals from sources nearby Earth.

The finding at Arecibo is the first detection using a different telescope: the burst came from the direction of the constellation Auriga in the Northern sky, according to the scientists, who detail their findings July 10 in the online issue of *The Astrophysical Journal*.

“There are only seven bursts every minute somewhere in the sky on average, so you have to be pretty lucky to have your telescope pointed in the right place at the right time,” said Spitler, the paper’s lead author. “The

characteristics of the burst seen by the Arecibo telescope, as well as how often we expect to catch one, are consistent with the characteristics of the previously observed bursts from Parkes.”

“The radio waves show every sign of having come from far outside our galaxy – a really exciting prospect,” added Victoria Kaspi of the McGill University in Montreal and principal investigator for the pulsar-survey project that detected the burst.

Possible causes, scientists said, include a range of exotic astrophysical objects, such as evaporating black holes, mergers of neutron stars, or flares from magnetars—a type of neutron star with extremely powerful magnetic fields.

The pulse was detected on Nov. 2, 2012, at Arecibo, with the world's largest and most sensitive single-dish radio telescope.

The result confirms previous estimates that the bursts occur roughly 10,000 times a day over the whole sky, said the astronomers, who inferred the huge number by calculating how much sky was observed, and for how long, to make the few detections so far reported.

The bursts appear to be coming from beyond the Milky Way galaxy based on measurements of an effect known as plasma dispersion. Pulses that travel through the cosmos are distinguished from man-made interference by the effect of electrons in space, which cause longer radio waves to travel more slowly.

(Courtesy of the Max Plank Institute for Radio Astronomy and World Science staff)

NEWFOUND GENE COULD PLAY ROLE IN AGING FROM BIRTH

It's something of an eternal question: Can we slow or even reverse aging? Although genetic manipulations can alter some cellular processes, not so much is known about the mechanisms of the aging process in living things.

Now scientists have found in animal models that one gene plays a surprising role in aging that can be detected early on in development. They say the discovery could point toward the possibility of one day using therapeutics, even some commonly used ones, to manipulate the aging process itself.

This “developmental gene, known as Spns1, may mediate the aging process,” said Shuji Kishi, a professor at the from the Florida campus of The Scripps Research Institute who led the study, published by the journal *PLoS Genetics*. “Even a partial loss of Spns1 function can speed aging.”

Using various genetic approaches to disturb Spns1 during the embryonic and/or larval stages of zebrafish—which have emerged as useful for studying diseases associated with development and aging—the scientists said they produced some models with a shortened life span, others that lived long lives.

While most studies of “senescence”—decreases in a cell's power of division and growth—have focused on later stages of life, the new study explores early stages. “Mutations to Spns1 both disturbs developmental senescence and badly affects the long-term bio-chronological aging process,” Kishi said.

The study found that Spns1, along with a pair of “tumor suppressor genes,” called beclin 1 and p53, can influence senescence through two different mechanisms: the Spns1 defect was enhanced by Beclin 1 but suppressed by ‘basal’ p53. Spns1 also was found to hinder autophagy, a process whereby cells remove unwanted or destructive proteins and balance energy needs during various life stages.

Building on their insights from the study, Kishi and his colleagues noted in the future therapeutics might be able influence aging through Spns1. He said a commonly used antacid, Prilosec, has been shown to temporarily suppress autophagic abnormality and senescence seen in the Spns1 deficiency.

(Courtesy of the Scripps Research Institute and World Science staff)