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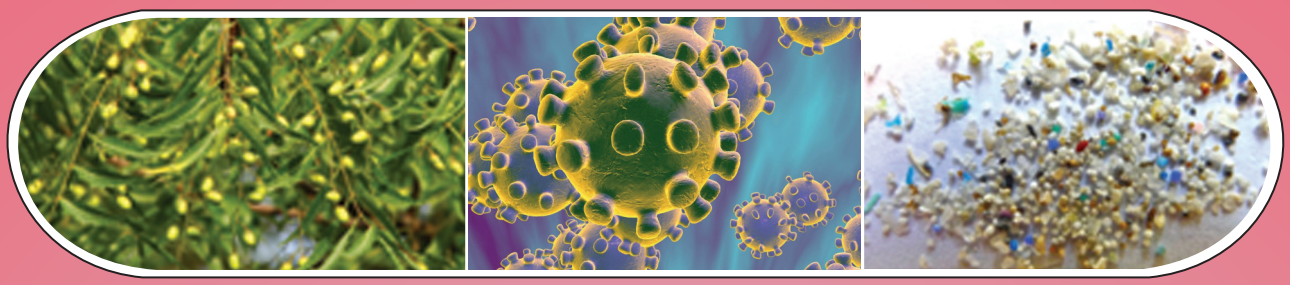

# एवरीमैन्स साइन्स
# EVERYMAN'S SCIENCE

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# CONTENTS

## EDITORIAL

# COVID-19—WAY FORWARD

For the last few months, the global pandemic of Covid 19 caused by SARS CoV-2 has emerged as an immense burden on health and economic system worldwide affecting several countries. India is already the nation with third highest number of Covid 19 cases. Nationwide lockdown for around three months with safety measures like social distancing, hand washing and wearing of masks have failed to achieve the desired reduction in disease transmission and a decrease in case load. Also in a densely populated country like India waiting for development of herd immunity for seventy percent people to get the infection will result in millions being infected and death toll in lakhs. The high number of cases being reported everyday have already resulted in acute crisis of inpatient beds in the hospitals and also shortage of doctors and other staffs for provision of patient care. In the current scenario the only hope to come out of the situation back to a normal life is development of a vaccine against Covid-19.

Vaccines are the most important tool in public health and in prevention of diseases. From small pox to polio, vaccines have helped in elimination and eradication of several diseases worldwide. However there are diseases like influenza and swine flu where the virus frequently undergoes mutation thus making it difficult to develop a single effective vaccine. To combat with this problem, flu vaccines are usually to be given every year to protect against these diseases. SarsCoV2 also undergoes frequent mutation thus imposing a challenge to the scientists in curbing the disease and the pandemic.

All over the world, medical researchers and scientists are working relentlessly in the search of an effective vaccine for the disease. Many of the vaccine trials found encouraging results in the early stage. Similarly, in India among the other agencies, ICMR along with Bharat Biotech have started trial for development of an indigenous vaccine Covaxin against SarsCoV2. Drug firm ZydusCadilla have also started human trials of a vaccine ZyCoV-D against Covid 19. But there is a long path ahead. Clinical trial for development of vaccine involves various phases which may take quite a few months.

Human trials are always preceded by animal trials where the experimental vaccine is injected to animals. In this stage we primarily check the toxicity profile of the vaccine and whether it can induce antibody response. For example if the experimental animal dies or the vaccine do not produce any antibodies we cannot proceed for human trial. Next comes Phase 1 trial where safety and pharma kinetics and dynamics the proposed vaccine has to be established. Phase 1 trial is done on a small number of volunteers. They are observed for any adverse effects following the administration of the vaccine as well. If Phase 1 is successful we can proceed to Phase 2. In this phase, the vaccine is administered to a greater number of people where safety as well as immune response is measured which can correlate with protection ( phase II B). After the success of this phase, Phase 3 trial is started with still larger number of volunteers. This phase may last up to several months where safety,

efficacy and effectiveness are measured in the volunteers across different age groups. If we get promising results then only the vaccine can be used in the general population. Even after marketing of the vaccine, there is another phase or Phase 4. This phase is for monitoring the long term safety, effectiveness or any other benefits and adverse events.

Thus despite the present crisis, increasing the demand for a vaccine urgently on an emergency basis, the development of a vaccine cannot compromise on its safety, efficacy and adverse effects. Till date, vaccine trial by the researchers of Oxford University have established the safety of vaccine as well as its potential to induce both cell mediated and humoral immunity in Phase 1 and Phase 2 trials. Phase 3 of clinical trial is still ongoing in countries like South Africa, Brazil and UK for further evaluation.

Thus before getting convincing results in all the above mentioned aspects, launching of any vaccine will only lead to an ethical dilemma. While the whole world is waiting for a vaccine, the researchers should not rush but be careful regarding all the potential effects of the vaccine. Till then safety measures like avoiding crowded places, hand hygiene and using protective gears are the only keys to bring a reduction in transmission of disease.

***Dr. Suman Kanungo***
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***Nothing in life has to be feared; it is only to be understood. Now is the time to understand more, so that we may fear less.***

***—Madam Curie***

# SEVERE ACUTE RESPIRATORY SYNDROME CORONAVIRUS (SARS-CoV) : METHODS OF DIAGNOSIS AND TREATMENT

**Shivanshi Bhargava and Aditi Singh***

**The available methods of diagnosis and treatment of the illness that is mainly caused by SARS-coronavirus have been highlighted here. The paper also attempts to better understand nature of the virus and the disease caused by it along with discussing its symptoms, transmission and prevention. New progresses made in the development of diagnostic and treatment methodologies, their efficacy and safety are also described.**

## INTRODUCTION

SARS or Severe Acute Respiratory Syndrome is an illness associated with the respiratory functions that is mainly caused by a virus known as SARS-coronavirus or abbreviated as SARS-CoV. The first emergence of this virus and its associated disease was seen in China in the year 2003 when the strain now known as SARS-CoV-1 led to a global outbreak of this disease. In December 2019, a novel virus of the family of coronavirus now labelled as SARS-CoV-2 led to a second outbreak of the disease which was given the name "COVID-19" by WHO in February 2020 which eventually turned into a global pandemic. Naturally, extensive research is underway to rapidly devise techniques for the accurate diagnosis and treatment of the disease. Some of these studies are discussed ahead.

### Corona Virus

Coronaviruses are positive-sense single-stranded RNA viruses (abbreviated as (+)ssRNA virus) which appear crown-like due to the spike of glycoproteins present on the envelope. Coronaviridae is a family of viruses with the subfamily Orthocoronavirinae which classifies the coronaviruses into 4 genera which are alphaCoV, betaCoV, deltaCoV and gammaCoV. The SARS-CoV viruses are a part of the betaCoV group. SARS-CoV-2 has a round ball-like or elliptical appearance and often times shows a pleomorphic form with a diameter of about 60-140nm. It shows sensitivity to heat and even ultraviolet radiations and can be successfully inactivated by solvents such as ethanol (75% or more), peroxyacetic acid and chlorine disinfectants. Studies conducted in China found a strain of the virus similar to SARS-CoV-2 in bats and thus suspect the evolution of the virus before having crossed the species barrier to infect human beings[1].

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### Pathogenesis

The lipid bilayer of SARS-CoV viral envelope consists of spike (S) and envelope (E) proteins[4]. The spike proteins play a significant role in allowing the binding of virus to cell surface receptors of the host to facilitate the entry of the virus. The virus may enter the cells either by pH-dependent endocytosis or by fusion with the cell membrane. The fusion mainly seems to occur by the interaction of S proteins of the viral envelope with ACE2 (angiotensin-converting enzyme 2) receptor which

is considered the major receptor found in the target host cells[6, 7, 9]. After gaining entry, the host cell ribosomes translate the viral genome producing mainly 16 non-structural proteins including the major enzymes such as RNA helicase as well as RNA-dependent RNA polymerase (abbreviated as RdRp) which ultimately facilitate the viral genetic material to be transcribed and the virus to replicate itself.

The virus recognition triggers an innate immune response activating various signalling pathways leading to production of transcription factors, inflammatory cytokines and chemokines and stimulation of interferon response factors (IRF3 and IRF7). The IRFs promote production of IFN-α and IFN-β which are type I interferons mainly responsible for innate immune response against viruses. The SARS-CoV infection seems to suppress this type I IFN activity to allow rapid viral replication leading to disease development.

## Symptoms, Transmission and Prevention

The coronaviruses can cause illnesses in humans which range from common cold and flu-like symptoms to more sever conditions like SARS or MERS. The commonly observed symptoms of COVID-19 which has SARS-CoV-2 as the main causative agent include dry cough, tiredness and fever and in severe cases patients may experience pains and aches, sore throat, diarrhoea and nasal congestion. Symptoms usually appear as mild and most people may be able to fully overcome the disease without the requirement of hospital care. However, some people may become seriously ill and experience breathing difficulties. People with underlying medical problems and older people are at an elevated risk of becoming seriously ill due to this virus and thus increasing the chances of fatality.

The virus is transmitted from human-to-human through nasal droplets entering from the mouth or nose. Just like in the case of other respiratory pathogens such as the flu, this virus is transmitted from infected patients by sneezing and coughing. The infected droplets may even settle down on objects and surfaces and may be spread by direct contact with the person or with these surfaces if followed by touching of nose, mouth or eyes. The estimated incubation time for this disease generally falls between the range of 3-7 days however it may even take up to 14 days for the symptoms to appear. Evidently since the main route of transmission of this disease appears to be direct human contact, self-isolation and distancing are currently the best and most effective ways of prevention of the disease. In addition to this, maintaining personal hygiene by frequent washing of hands with general soap and water may be effective preventive measures.

## Diagnosis

Diagnostic tests for SARS-CoV have been under rapid development since the first outbreak of the virus and the procedure had to be speeded up in view of the latest pandemic. In spite of the rapid advances to develop accurate diagnostics for the virus, the currently available tools are, for the most part, only partially successful in meeting the relevant clinical needs. The real time RT-PCR-based tests done in labs have been the major cornerstone of the COVID-19 diagnostics. However, multiple novel methods are also under development and evaluation. Three major techniques have been discussed ahead.

## RT-PCR (Reverse Transcriptase Polymerase Chain Reaction)

RT-PCR is a laboratory method that combines the traditional amplification process of DNA using PCR and the process of reverse transcription of RNA to complimentary DNA or cDNA. It is mainly utilized for measurement of amount of a target RNA in sample which is done by observing the

amplification reaction with the help of fluorescence, a technique known as real time PCR or qPCR (abbreviation for quantitative PCR).

**Principle**

In this technique, the template RNA is firstly converted to cDNA by the capability and activity of the infamous retroviral enzyme reverse transcriptase. This cDNA then acts as template for amplification using PCR. It can be done in a one or two step process. The two-step process requires the amplification and reverse transcription reactions to be done in separate tubes. The one-step process, on the other hand, involves performing the entire procedure in a single tube or environment. Although the former procedure is relatively more accurate and specific and allows the cDNA to be stored for further reactions, it is more time-consuming requiring higher level of expertise and ensues the enhanced chance of failure due to repeated sample handling. The latter method reduces the chance of contamination, is faster and easier to perform. However, in this method the RNA template is more susceptible to degradation and this approach is not recommended for repeated assays on same sample. Nevertheless, due to convenience and rapidity the one step approach is more popular for rapid detection techniques.

**Procedure**

The components mainly required for RT-PCR include: Primers, reverse transcriptase enzyme carrying RNase activity (or RNase H enzyme can be also be used separately), DNA polymerase, ligase, dNTPs and suitable buffer PCR enhancers and RNase inhibitors. The first step for RT-PCR is the preparation of sample. Sample for the purpose of coronavirus detection is collected by obtaining throat or nasal swab of a patient. RNA is then extracted from this collected sample. The next step is the selection of primers. Primers in case of RT-PCR can be of 3 types : Random, Oligo(dT) or Sequence-Specific. Random primers are mostly used for templates with large secondary structures. They, however, are incapable of attaching or binding to the RNA poly-A tail and thus are not preferred for large RNA templates. The oligo(dT) primers on the contrary, possess the ability of binding to this RNA poly-A tail and are critical if low amount of RNA sample is used. The sequence-specific primers are capable of specifically synthesising cDNA of interest from RNA template and are largely used in one-step RT-PCR. These primers are complimentary to specifically the sequence that is of our interest.

Following the primer selection and binding, the steps proceed in the same way as a normal PCR with annealing and strand synthesis or polymerisation with the exception that the denaturation step is omitted. The cDNA is synthesized with the activity of reverse transcriptase enzyme which is often used in combination with RNase H. The nicks and gaps in the newly synthesized DNA are finally filled by DNA polymerase and ligase enzymes.

**Application and Effectiveness in Diagnosis of SARS-CoV**

The RT-PCR kit developed by the CDC uses primer probe for 2 regions of the nucleocapsid gene (N1 and N2) of the virus and also for RNase P gene of humans to confirm successful RNA extraction. This differs from the kit recommended by WHO which uses probe sets that target the RdRp (RNA dependent RNA polymerase) and envelope genes of the virus. Both these assay kits have good specificity and considerably high sensitivity of analysis for SARS CoV-2 combined with very minimal or no significant amount of cross-reactivity with any of the other coronavirus strains currently circulating. Both these kits also utilize the criterion for positivity with a cycle threshold that is less than 40[3].

Even with the above advantages of specificity and sensitivity, this method cannot be completely ruled as reliable due to the employment of differing preparation methods and sample collection, lack of reliably established reference standards and insufficient knowledge of viral dynamics during the course of infection[3]. Consequently, authorities recommend the documentation of SARS CoV-2 clearance only after a minimum of 2 negative samples are collected within an interval of 24 hours or more.

## Antibody Based or Serological Test

A major drawback of the RT-PCR technique is that it takes a long time for the results to be obtained. This drawback is attempted to be overcome by using serological test (also known as antibody tests)[6, 7]. It is an indirect technique of testing which is not intended to target the virus itself but the antibodies against it. Various kinds of antibodies such as IgM and IgG may appear and transform throughout the course of infection. These can be detected by mainly two formats of serological assays which include : Immunofluorescence assay (abbreviated as IFA) and Enzyme-linked immunosorbent assay (better known as ELISA).

The ELISA-based test detects a mix of antibodies (mainly IgM and IgG types) in patient serum and most often yield positive results at approximately 21 days following the beginning of disease. The IFA-based assay uses infected cells that are fixed on a slide. The target antibodies bind to the antigens of the virus and are detected by using immunofluorescent - labelled 2 antibodies with the help of an immunofluorescence microscope. This test yields positive result at around the $10^{th}$ day after onset.

A positive antibody test suggests a previous encounter with the virus. These tests have an advantage of being relatively sample independent as well as being faster with the capability to yield results within a few hours as opposed to other detection techniques. However, an antibody response to an infection may take from days to weeks to appear, therefore, the utility of the serological tests is only limited to the detection of an infection which occurred days before the test and is ineffective for a patient with a recent exposure to the infection. Also, the chance of cross-reactivity with other strains of the coronavirus is a potential difficulty.

## Other approaches : Future prospects

The competition to develop new and better diagnostic techniques for coronavirus is at its peak. Consequently, scientists around the world are looking at novel approaches to find a solution. One such approach is the use of gene-editing tool CRISPR which utilizes variants of Cas9 such as Cas13 and Cas12a that are capable of cleaving reporter RNA sequence on being activated by a guide RNA specific for SARS-CoV-2. These can be used to tag the target sequences using fluorescent probes and offer the advantage of rapidity. In addition to CRISPR, scientists are also making efforts to combine the rapidity of serological tests and the accuracy offered by RT-PCR by developing kits that use an enzyme with the capability to amplify viral RNA at one temperature in contrast to Taq polymerase. These tests if successfully developed and approved may yield results as quickly as 5-10 minutes. Radiographic methods such as a chest CT scan also offer some success in the diagnosis of the disease although it is not completely reliable. All these diagnostic methods are still in their cradle and need further research.

## TREATMENT

Similar to most other viral illness', no specialized antiviral solution or vaccine currently exists for COVID-19. The treatment under application is solely symptomatic and focussed mostly on managing

respiratory failures, septic shocks, preventing complications, treating any existing illness and patient care. Some of the treatments under use and further research are discussed ahead.

## Ventilation

In cases of severe respiratory failure, the recommended action is the use of supportive ventilation which may be invasive or non-invasive.

## NIPPV (Non-invasive positive pressure ventilation)

It is a type of support system for ventilation which is administered using a tight-fitting nasal or face mask simultaneously along with positive or bi-level positive pressure in affected people at risk of failure of the respiratory machinery. It has been reported in certain studies that this treatment is capable of reducing the duration of ICU admission, intubation rate and 2-month mortality in a number of patients of respiratory difficulties. It is evidently a safe and useful treatment alternative for SARS patients experiencing respiratory failure under the condition that it is administered with necessary precautions, proper PPE and in a proper environment (preferably patient isolation to prevent its spread).

## Invasive mechanical ventilation

If the condition of the patient deteriorates further or doesn't improve even after 1 to 2 days of non-invasive ventilation, mechanical ventilation or endotracheal intubation may have to employed. During administration the plateau pressure is generally kept below 30 cm $H_2O$ due to the possibility of barotrauma in SARS patients. This is used as a last resort for more severe patients[1].

## Convalescent Plasma Treatment

Convalescent Plasma is a treatment strategy that involves the use of antibodies present in the plasma of patients who have already recovered from an infection to treat patients currently battling the illness. This method has previously been used against other viral infections such as Ebola and is now being studied for its effectiveness against SARS[8]. In this technique, a cell separator device which utilises the plasma exchange mode of operation is employed to perform apharesis for extraction of convalescent plasma. The scientific community currently has limited experience with this treatment. However, in a few non-randomized studies conducted with patients showing progressive illness following pulse methylprednisolone and ribavirin treatment, this strategy showed reduced mortality and hospital stay. Further studies show a quicker discharge rate of patients who were administered this treatment before the completion of 14 days of illness[2, 11]. Nevertheless, the effectiveness of this technique for treatment of SARS still requires intensive study and clinical trials but the method does offer a promising alternative.

## Antiviral Agents

Due to wide antiviral spectrum, ribavirin was selected for empirical use with the idea to give coverage for corticosteroid therapy which was widely used against SARS[10]. However, ribavirin has been fairly criticized due to the fact that it lacks *in vitro* activity against SARS-coronavirus. Additionally, ribavirin needs to be administered in very large concentrations for the transient inhibition of the virus and such levels are clinically hard to achieve. Thus, ribavirin is still a controversial option for treatment showing significant toxicity and low efficacy. However, further studies combined the protease inhibitor lopinavir (LPV) with ribavirin(r) and managed to achieve synergistic inhibitory concentration in lab test against SARS-CoV. This LPV/r combination showed fewer adverse clinical

outcomes such as ARDS or death in patients, milder disease course, reduction in combined dose of pulse methylprednisolone and decreased viral load[5]. Such findings indicate that a combination of lopinavir and ribavirin offers a potentially promising antiviral agent against SARS-CoV. Other nucleoside analogues such as favipiravir and galidesivir are also currently under intensive study.

### Corticosteroids

Corticosteroids are currently in use for the management of the ongoing pandemic. Methylprednisolone in pulse doses has been used in SARS patients especially if their condition worsens in 2 weeks, however their efficacy is still debatable. The employment of corticosteroids in SARS for a prolonged period and in high doses has been seen to be associated with side effects including hypertension, hyperglycemia, etc. Even with the associated risks it is still somewhat useful for more serious patients in appropriate doses.

### Immunoglobulins

Another treatment mainly used as last resorts is IVIG (intravenous immunoglobulin) or pentaglobin infusion. Pentaglobin is basically a preparation of IgM-enriched immunoglobulin while a non-specific hyperimmune globulin is an IVIG[5]. Some studies suggest that the former is probably a safe and effective method if there is corticosteroid resistance. The use of IVIG is however potentially associated with the possibility of venous thrombosis.

### Novel Approaches for Treatment

It is common knowledge that viral infections are capable of triggering interferon production by the natural immune response. The combination of various interferons such as IFN-β and IFN-γ have shown inhibition of SARS-CoV replication in animal cells and in some cases when used with antiviral agents like ribavirin also in human cells. In addition to interferons, 80R, a monoclonal antibody with high affinity, has shown powerful activity of neutralization both *in-vivo* and *in-vitro* against the S1 protein possessed by the virus and is believed to be potentially assistive for SARS treatment[5]. Several natural treatments such as traditional Chinese medicine are also currently under investigation along with several other potentially effective treatments including possibly a vaccine.

## CONCLUSION

It is clear that the research on SARS-coronavirus has picked up lightning speed following the two major outbreaks which have threatened the well-being and mortality of the entire human population. Although a lot of studies have been performed to better understand the nature of the virus and the disease and to develop effective methods of diagnosis and treatment, only limited success has been achieved so far. Most of the techniques currently in use haven't achieved definitive confirmation for their efficacy, accuracy and safety. Nevertheless, a variety of novel ideas and studies are in progress that appear to be promising for the future. Since a definitive treatment technique hasn't been discovered yet social distancing seems to be the most effective way to prevent further transmission of the disease during the pandemic. However, as rapid advancement of science and technology is taking place it seems likely that a better weapon against the virus might soon be found, maybe even a vaccine to ensure good health and safety of mankind against the deadly virus.

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# CYTOKINES & CYTOKINE STORM : POPULAR TERMS EMERGING IN COVID-19

**Santanu Chakrabarti**

**The term "cytokine storm" is gaining popularity day by day in the scientific communities as well as in popular media as severe Covid-19 patients are experiencing a fatal hyper-cytokine response associated with multi-organ failure. In general, the incidences of release of excessive pro-inflammatory cytokines are well documented but the correlation of this event with patho-mechanisms or therapeutics is still elusive. Ferrara, et al. used the term for the first time in relation to graft-versus-host disease, where they elucidated the effector role for interleukin-1[1]. Following that, scientists applied it in the context of different infectious diseases like Streptococuus, Influenza, Variola, severe acute respiratory syndrome coronavirus (SARS-CoV) and in avian H5N1 influenza virus infection[2]. The contribution of cytokine storm in viral infections especially in influenza and other respiratory viruses has been well reviewed in recent years[8-12]. In this review the concept of a cytokine storm and its biological consequences especially in the pathology of infectious diseases and therapies had been defined.**

## I. What are cytokines

Cytokines are secreted by cells for the purpose of intercellular signaling and communication. These diverse groups of small proteins have autocrine, paracrine, and endocrine activitites. They can elicit a variety of responses, depending upon the cytokine and the target cell once they are bound to their specific receptors. The can control cell proliferation and differentiation, regulation of angiogenesis and immune and inflammatory responses[3]. Because of this diversity of structure and function, the classification and naming of cytokines is still debatable. A series of overlapping networks constitute the cytokine response with a degree of redundancy and with alternate pathways.

**Table 1 : Classification of Cytokines.**

| Sl No. | Type | Actions |
|---|---|---|
| 1 | **Interleukins** | Leukocytes growth and differentiation of; including pro-inflammatory functions |
| 2 | **Interferons** | Innate immunity, activation of antiviral properties, anti-proliferative effects |
| 3 | **Tumor Necrosis Factors** | Cytotoxic T lymphocytes activation, Pro-inflammatory |
| 4 | **Colony-stimulating factors** | Hematopoietic progenitor cell proliferation and differentiation |
| 5 | **Chemokines** | Chemotaxis, leukocyte recruitment; pro-inflammatory |

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The cytokines can be broadly classified in to five groups.

**i) Interleukins**

These are regulators of immune cells, help in their differentiation and activation. Though they were originally thought to be produced by leukocytes for functioning in intercellular communication, now known to be produced by a many different cell types. They can perform either pro- or anti-inflammatory functions.

**Table 2 : List of few important interleukins (ILs) with sources, targets and functions.**

| Type | Source | Targets | Function |
|---|---|---|---|
| IL-1(IL-1 α & Il-1 β) | Macrophages, macrophages like cells, endothelial and epithelial cells | T cells, fibroblasts cells, epithelial and endothelial cells | Induction of pro-inflammation, hematopoiesis |
| IL-2 | CD4+ and CD8+ T cells, DCs, NK cells, NKT cells | CD4+ and CD8+ T cells, NK and B cells | Proliferation of effector T and B cells, NK cells differentiation and proliferation, growth factor for B cells |
| IL-4 | T cells, macrophages, NK cells, mast cells, eosinophils, stromal cells | TH2 cells, basophils, eosinophils, mast cells, NKT cells, γ/δ T cells | Induction of TH2 response, IgE class switch, class II MHC expression on B cells, survival factor for B and T cells, role in tissue adhesion and inflammation |
| IL-6 | Endothelial cells, fibroblasts, monocytes/macrophages | Hepatocytes, leukocytes, T cells, B cells, hemopoietic cells | synthesis of acute phase proteins in liver; leukocytes trafficking & activation; T cells differentiation & activation, B cells differentiation, production of IgG, IgM, IgA hematopoiesis |
| IL-8 | Monocytes, macrophages, neutrophils, lymphocytes, endothelial cells, epithelial cells, fibroblasts, keratinocytes | Neutrophils, NK cells, T cells, basophils, eosinophils, endothelial cells | Chemoattractant for neutrophils, NK cells, T cells, basophils, eosinophils; angiogenesis |
| IL-10 | T cells, B cells, monocytes, macrophages, DCs | Macrophages, monocytes, T cells, B cells, NK cells, mast cells, DC and granulocytes | Immune suppression |
| IL-12 | Monocytes, macrophages, neutrophils, microglia, DCs, B cells | T cells (Th1 cells), NK cells | Induce TH1-cell response and cytotoxicity |

**Table 2 : List of few important interleukins (ILs) with sources, targets and functions *(Contd.)*.**

| Type | Source | Targets | Function |
|---|---|---|---|
| IL-17A & -17B | TH17 cells, CD8+T cells, NK cells, NKT cells, γδ T cells, neutrophils & neuronal cells, chondrocytes | Epithelial/endothelial cells, fibroblasts, osteoblasts, monocytes, macrophages & monocytes, endothelial cells, myofibroblasts | Induction of proinflammatory cytokines, chemokines and recruitment of neutrophils & chondrogenesis and osteogenesis |
| IL-17C & -17D | immune cells under certain conditions & resting B and T cells | Monocytes, endothelial cells, myofibroblasts & monocytes, endothelial cells, myofibroblasts | Induction of proinflammatory cytokines, chemokines, & induction of proinflammatory cytokines, chemokines, |
| IL-17E | TH17 cells, CD8+ T cells, NK cells, NKT cells, γδ T cells, neutrophils | Epithelial/endothelial cells, fibroblasts, osteoblasts, monocytes, macrophages | Induction of proinflammatory cytokines, chemokines,; recruitment of neutrophils |
| IL-37 | Monocytes, tonsil plasma cells, breast carcinoma cells | Intracellular mechanism manner and DC | Suppression of proinflammatory cytokines and inhibition of DC activation |

**ii) Interferons (IFN)**

This family of cytokines play a central role in innate immunity to viruses and other microbial pathogens. Till date many distinct IFN genes and proteins, divided among three classes have been detected in animals and humans.

**Table 3 : List of three classes of interferons (IFNs) with sources and functions.**

| Classes | Type | Sub Type | Source | Functions |
|---|---|---|---|---|
| **IFN Type-1** | IFN-α | 13 subtypes that are called IFNA1, IFNA2, IFNA4, IFNA5, IFNA6, IFNA7, IFNA8, IFNA10, IFNA13, IFNA14, IFNA16, IFNA17, IFNA21 | The IFN-α proteins are produced by leukocytes. These genes are found together in a cluster on chromosome 9 | They are mainly involved in innate immune response against viral infection. |
| | IFN-β | Two types of IFN-β have been described, IFN-β1 (IFNB1) and IFN-β3 | The IFN-β proteins are produced in large quantities by fibroblasts | They have antiviral activity that is involved mainly in innate immune response IFN-β1 is used as a treatment for multiple sclerosis |

**Table 3 : List of three classes of interferons (IFNs) with sources and functions *(Contd.)*.**

| Classes | Type | Sub Type | Source | Functions |
|---|---|---|---|---|
| | IFN-κ | | This protein is expressed in keratinocytes and the gene is found on chromosome 9, adjacent to the type I interferon cluster. | Role in host defences against viral infections |
| | IFN-ω | IFN-ω, although having only one functional form described to date (IFNW1), has several pseudogenes: IFNWP2, IFNWP4, IFNWP5, IFNWP9, IFNWP15, IFNWP18, and IFNWP19 in humans | Many non-primate placental mammals express multiple IFN-ω subtypes. | Role in host defences against viral infections |
| **IFN Type -2** | IFN-γ | A sole member makes up the type II interferons (IFNs) that is called IFN-γ (gamma) | It is produced in activated T-cells and natural killer cells | Involved in the regulation of the immune and inflammatory responses; in humans IFN-γ released by Th1 cells recruits leukocytes to a site of infection, resulting in increased inflammation. It also stimulates macrophages to kill bacteria that have been engulfed. IFN-γ released by Th1 cells is also important in regulating the Th2 response. As IFN-γ is vitally implicated in the regulation of immune response, its production can lead to autoimmune disorders. |
| **IFN Type -3** | IFN-λ | Group consists of three IFN-λ (lambda) molecules called IFN-λ1, IFN-λ2 and IFN-λ3 (also called IL29, IL28A and IL28B respectively) | Interleukin-29 (IL-29) is a protein that in humans is encoded by the IL29 gene that resides on chromosome 19 | IL-29 plays an important role in host defenses against microbes and its gene is highly upregulated in cells infected with viruses classification of IL_28 & 29 as Interferons is due to their ability to induce an antiviral state |

**iii) Tumor Necrosis Factor (TNF)**

The best known pro-inflammatory cytokines, playing pivotal role in the cytokine storm is TNFs. The name "tumor necrosis factor" was first used in 1975 for a cytotoxic serum factor capable of inducing tumor regression in mice[4]. In acute viral diseases, including influenza, dengue, and Ebola infections TNF plays a central role.

Its primary receptor, TNFR1, expressed by all cell types, proves wide pleiotropic effects of this cytokine. A number of chronic inflammatory and autoimmune diseases exhibit a lot of TNF production.

**iv) Colony-Stimulating Factors (CSFs)**

Colony-Stimulating Factors, also associated with inflammation, stimulate hematopoietic progenitor cell proliferation and differentiation. It is a constituent of pro-inflammatory cytokine network that includes IL-1 and Tumor Necrosis Factor (TNF). It increases the number of macrophages at inflammation site and amplifies the reaction.

Closely linked on the same chromosome in mammals (Chromosome 5 in humans and Chromosome11 in mice), Granulocyte-Macrophage Colonly Stimulating Factor (GM-CSF), exhibit a number of biological similarities with IL3 and IL5. Some non-hematopoietic cells like fibroblasts, endothelial cells, and smooth muscle cells are capable of producing many kinds of CSFs.

Differentiated by modes of action there are four distinct types of CSFs.

**Table 4 : Types of Colony-stimulating factors (CSFs) with functions.**

| Type | Name | Functions |
|---|---|---|
| 1 | GM-CSF or CSF2 | Stimulates the proliferation of granulocytes, macrophages, eosinophils, megakaryocytes, the progenitor cells of platelets |
| 2 | M-CSF or CSF1 | Stimulates macrophage colony formation |
| 3 | G-CSF or CSF3 | Causes granulocyte colony formation and granulocyte-macrophage colonies |
| 4 | Multi-CSF (IL-3) | Stimulates colony formation for a broad spectrum of blood cells |

**v) Chemokines**

The largest family of cytokines is the chemokines. They are classified into four types (CXC, CC, C, and $CX_3C$), depending upon the spacing of their first two cysteine residues[5]. Chemokines function as chemo-attractants to control the migration of immune system cells thereby stimulates innate and adaptive immunity.

Chemokines are considered to be pro-inflammatory that results in the recruitment of immune system cells (neutrophils, macrophages, and lymphocytes) to the site of infection in response to infection.

**Table 5 : List of some important chemokines with sources and functions.**

| Chemokine | Sourcess | Functions |
|---|---|---|
| CXCL8 (IL-8) | Alveolar Macrophage | Recruitment of Neutrophils |
| CXCL9, CXCL10, CXCL11 | Bronchial epithelial cells | Recruitment of immune cells |
| CXCL13 | Dendritic cells, lymph nodes | Recruitment of B cells |
| CCL2(MCP-1) | Monocytes and Alveolar Macrophage | Recruitment of macrophages and other immune cells |
| CCL3(MIP-1A), CCL4(MIP-1B), CCL5 (RANTES) | Alveolar Macrophage | Recruitment of macrophages and other immune cells |
| CCL19, CCL21 | Stromal cells of the lymph nodes | Recruitment of IFN- $\gamma$ + T cells |

## II. Cytokine storm and Four Cardinal Signs of Inflammation

Cytokine storm usually begins at a local site and spreads systemically causing inflammation. Four cardinal signs of inflammation are called Rubor (redness), tumor (swelling or edema), calor (heat), dolor (pain). Localized infection increases blood flow and extravasation causing rise in local temperature, generation of pain and may affect local organ function. Severe inflammation may result in persistent organ malfunction which may be restored by repair mechanisms.

Many studies measured cytokines in peripheral blood ignoring the immune microenvironments in tissues. Influenza viruses damage the epithelial cells of respiratory system, SARS-CoV infects pneumocytes in the alveolar walls. Interstitial inflammation, diffuse alveolar damage, and necrotizing bronchitis/bronchiolitis are general histopathological findings of lung in COVID-19 disease caused by the SARS-CoV-2 virus.

In human, acute lung injury (ALI) is a common consequence of a cytokine storm in the lung alveolar environment which is characterized by an acute mononuclear/ polymorphonuclear inflammatory response followed by a chronic fibro-proliferative phase marked by progressive collagen deposition in the lung leading to acute respiratory distress syndrome (ARDS), as seen with SARS-CoV and influenza virus infections. IL-1β is a key cytokine driving proinflammatory activity in bronchoalveolar lavage fluid of patients with lung injury. The cytokine is evident in severe lung infections, and these local inflammations enter into the systemic circulation, causing systemic sepsis. In addition to lung infections, the cytokine storm is also observed in severe infections in the gastrointestinal tract, urinary tract, central nervous system, skin, joint spaces, and other sites.

## III. Expression of cytokine genes in creating cytokine storm

Several genomic evidences indicate highly pathogenic influenza viruses aberrantly regulate cytokine and chemokine transcriptional responses, leading to a cytokine storm. De Jong, et al.[6] showed fatal outcome of human influenza A (H5N1) is associated with high viral load and hypercytokinemia where ,elevated levels of MCP-1 (known as CCL2), IFN-γ-inducible IP-10 (CXCL10), MIG protein (CXCL9), and IL-8 were observed. Strong upregulation of IL-6, IL-8 cytokine and CCL2, CCL5 chemokine gene expression in the lungs of infected animals was observed[7].

TNF is one of the most prominent cytokines upregulated during H5N1 infection. It is highly

**Table 6 : Plasma cytokine profiles over time in severe sepsis.**

| Phases of Response | Cytokine Profiles |
|---|---|
| The acute-response (early minutes to hours) | cytokines TNF and IL-1β and the chemotactic cytokines IL-8 and MCP-1 |
| Following hours | more sustained increase in IL-6 |
| Later stages | The anti-inflammatory cytokine IL-10 appears to control the acute systemic inflammatory response |
| 3 to 4 days after the onset of severe sepsis and cytokine storm | Patients with persistent downregulation of HLA-DR (a marker of immunosuppression) on monocytes have a high mortality rate |

expressed across infection models, including primary human respiratory epithelial cells[8] and human monocyte-derived macrophages[9], compared with during seasonal H1N1 influenza virus and swine-origin H1N1 influenza virus (SOIV) infection.

overproduction of early response pro-inflammatory cytokines TNF, IL-6, and IL-1β results in what has been described as a cytokine storm. High cytokine concentrations may lead to an increased risk of vascular hyperpermeability, multiorgan failure, and eventual death.

**Table 7 : Dysfunctions due to cytokine storm.**

| Endothelial level | Inflammatory Responses | Pulmonary Fibrosis |
|---|---|---|
| i) Altered endothelial function and barriers;<br>ii) increased permeability | i) Peripheral Cytokine circulation;<br>ii) Hypotension;<br>iii) Leukocytosis;<br>iv) Sepsis | i) Recruitment of fibrocytes;<br>ii) T cell immunopathological features |

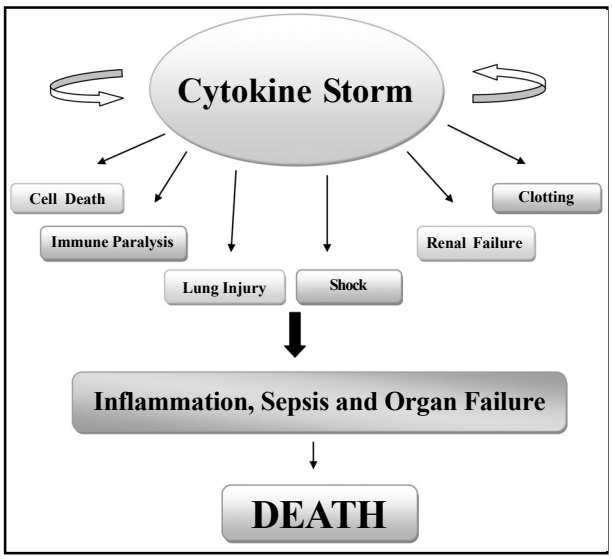


**Figure : The pathway of death due to Cytokine Storm as observed in Covid-19 infection.**

## IV. Principal Mediators of Cytokine storm

Cytokines such as TNF, IFN- α/β, IFN-γ, IL-1 α/β, IL-6, CCL-2 are the chief mediators of this cytokine storm. These factors produce different expression in inflammatory responses leading to several dysfunctions.

## V. Cytokine Storm in Covid-19

The pathophysiology of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) shows the

Many cytokines take part in the "cytokine storm" in COVID-19 patients, including IL-6, IL-1, IL-2, IL-10, TNF-α and IFN-γ; however, a crucial role seems to be played by IL-6, whose increased levels in the serum have been correlated with respiratory failure, ARDS, and adverse clinical outcomes.

IL-6 has significant pro-inflammatory properties, and it functions through two main signaling pathways: *cis* or *trans*. In *cis* signaling, IL-6 forms a complex with the membrane-bound IL-6 receptor (mIL-6R) and gp130 which then activates downstream the Janus kinases (JAKs) and signal transducer and activator of transcription 3 (STAT3). The activation of this signal cascade leads to pleiotropic effects on the acquired immune system (B and T cells) as well as the innate immune system (neutrophils, macrophages, and natural killer cells) which can contribute to cytokine release syndrome (CRS). In *trans* signaling, high circulating IL-6 concentrations bind to the soluble form of IL-6 receptor (sIL-6R) and form a complex with a gp130 dimer on most somatic cell types. The resultant IL-6–sIL-6R–JAK-STAT3 signaling is then activated in cells that do not express mIL-6R, such as endothelial cells. This severely aggravates the

"cytokine storm" through secretion of vascular endothelial growth factor (VEGF), monocyte chemoattractant protein–1 (MCP-1), IL-8, and additional IL-6, as well as reduced E-cadherin expression on endothelial cells. Secretion of VEGF and reduction of E-cadherin expression contribute to vascular permeability and leakage which participate in the pathophysiology of hypotension and pulmonary dysfunction in ARDS[10].

## VI. Therapies to Prevent Cytokine Storm

Immunomodulatory drugs that diminish inflammation during infection may have therapeutic benefits. COX inhibitors may inhibit cellular infiltration, sphingosine analogs have shown potential for controlling the cytokine storm caused by influenza virus[11] as it suppresses immune cell recruitment through downregulation of cytokine and chemokine production by respiratory endothelial cells. Anti-TNF agents and some antagonists may reduce production of IL-1α, IL-6, and TNF cytokines, CXCL8 and CCL5 chemokines. In a recent study in Britain, use of the steroid dexamethasone appears to reduce inflammation caused by the immune system, protecting the tissues[12]. In the study they showed, dexamethasone can reduce mortality of the patients on ventilators by one-third, and deaths of patients on oxygen by one-fifth.

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# MICROPLASTIC POLLUTION : THREAT TO INDIAN RIVER SYSTEM

**Dhruba Jyoti Sarkar, Soma Das Sarkar, R. K. Manna and Basanta Kumar Das***

**Recently, there has been global concern on the distribution and effect of plastic debris including microplastics (MPs) in the natural ecosystems. They have been exhaustively assessed in the marine aquatic ecosystems as "Contaminant of Emerging Concern" (CEC) besides other chemical pollutants. MPs are reported to possess threat to the aquatic biodiversity with various exposure routes to the food chain and ultimately to the human health. Though the MPs abundance has been extensively studied in the marine ecosystem, very few studies are done in the inland waters especially in Indian Rivers. Their abundance study in the Indian freshwater ecosystems *viz.* rivers, lakes, etc. is of paramount importance in the present day context to establish their fate and for mitigation of their human health hazard potentiality.**

## INTRODUCTION

Plastic materials have become part and parcel of our life. Unlike electronic gadgets, we cannot imagine a day without plastic. And thus, we started enjoying the 'age of plastic'. These durable, pliable, light and relatively inert synthetic polymers have come into existence in early 20$^{th}$ century. But these magic materials do not decompose naturally and thus affecting world habitat including the isolated ecosystem. The best example is the Great Pacific Garbage Patch of plastic (600 sq. km.) located in North Pacific Ocean. Recently, there has been great interest on the distribution and effect of plastic particles including microplastics (MPs) in the natural ecosystems. Microplastics are synthetic polymers in the size range 100 µm - 5mm and are one of the significant emerging contaminants. They are directly/ indirectly introduced into the environment through anthropogenic activities (primary microplastics) or derived from bigger plastic particles through environmental and microbial degradation process (secondary microplastics) (Figure 1). They are ubiquitous in nature in various mophotypes like fragments, fibres, pellets, films, beads, foams, etc. especially in marine and inland aquatic ecosystems. Due to their very small size, shape and high abundance, microplastics are accessed by the aquatic biota of multiple trophic levels. Thus, plastic debris including microplastics not only alters the conducive environment but also cause harm to biological diversity. It was found that less dense and floating microplastics are mostly accessed by lower aquatic organisms (phytoplankton and zooplankton) whereas, benthic invertebrates (amphipods, polychaete worms, mollusks and echinoderms) show more tendency towards dense microplastics. The higher vertebrates such as fishes, birds and mammals also reported to engulf significant amount of microplastics through the process of prey-predation relationship in aquatic environment. The mechanism of toxic impact of microplastics is widely studied in assessment of organism health including fishes with neurotoxic disorders, reduction in growth and reproduction competency, oxidative stress and genotoxicity. Due to these potential ecological threat caused by

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microplastics, recently several studies have been made in various aquatic ecosystems of many countries including China, India, Portugal, Germany, Mexico, etc.

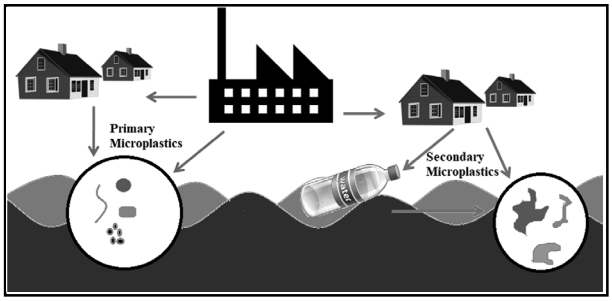


**Figure 1 : Influx of microplastics in aquatic ecosystem: intentional industrial manufacturing (Primary microplastics) and through anthropogenic processes (Secondary microplastics).**

## AQUATIC ECOTOXICITY OF MICRO-PLASTICS

MPs are omnipresent in nature and remain scattered in the water column based upon its shape and density which further accessed by the aquatic biota of multiple trophic strata[1]. Less dense and floating MPs are mostly found in lower organisms (phytoplankon, zooplankton) whereas, benthic invertebrates (amphipods, polychaete worms, mollusks and echinoderms) show higher tendency towards dense MPs. Concurrently, fibre and fragments (600-1000 µm) are mostly detected in field animals. The higher vertebrates such as fishes, birds and mammals also engulf MPs through the process of prey-predation relationship in aquatic environment. Hence, the mechanism of MPs toxicity has become more relevant in assessing organism's health (Table 1). Fishes with neurotoxic disorders (96 h; 1-5 ìm; 0.184 mg L)[1], freshwater crustacean amphipod *Hyalella azteca* with decreased growth and reproduction competency (240 h and 1008 h; 10-27 ìm; 0-108 particles L)[1-2], marine mussel *Mytilus galloprovincialis* with oxidative stress and genotoxicity when exposed to PE MPs (168 h; <100 ìm; 20,000 mg L)[1-3] are few examples of toxic implications of MPs. MPs are also found to alter morphological appendages and haemolymp proteome in blue mussel (*Mytilus edulis*) in reef habitat[4]. Recently, presence of MPs (polystyrene polymers) is also evidenced in soft tissues of green mussel, *Perna viridis* harvested from fishing harbour of Southeast coast of India. The author has highlighted

**Table 1 : Biological effect of microplastics against aquatic organism.**

| Damage type | Organism |
|---|---|
| Impaired metabolism and cellular stress response | Polychaetes, Echinoderms, Bivalves, Fish |
| Tissue damage | Fish |
| Tissue transfer | Crustaceans, Mussels, Fish |
| Obstructed respiration | Polychaetes, Crustaceans, Bivalves |
| Hindered feeding potentiality | Polychaetes, Crustaceans, Bivalves, Fish |
| Retarded physiological development and reproductive competency | Crustaceans, Echinoderms, Bivalves, Fish |
| Decreased growth rates | Crustaceans, Bivalves |
| Behavioural abnormalitis | Fish |
| Increased mortality | Crustaceans, Bivalves, Fish |

that the filter feeding coastal bivalves are at highest risk due to bioaccumulation of MPs generated from anthropogenic activities[5]. Meanwhile several authors have also raised the environmental concerns regarding macro-sized debris and MPs.

## MICROPLASTICS POLLUTION IN AQUATIC ECOSYSTEM

A worldwide estimate on the occurrence of plastic litter, including MP, dumped into the marine water shown that the river is the one of main source of plastic pollution carrying more than 2 million tonnes of MP per year[6]. Moreover, it was reported that reverine transport of plastic debris accounts for 80% of the release from land to the marine environment[7]. Since, there is extensive report on the bad effect of plastic debris on the habitat properties of the ecosystem including harm to the biological diversity[1], it is very much essential to understand the behavior of the plastic debris in river ecosystem. Moreover, as the small plastic debris were reported to have trophic transfer potential, the reduction of plastic debris size has enormous effect on the ecological health due to its harmful effect on biosystem by bioaccumulation through ingestion process by different organism of aquatic food chain[8]. It is reported that less dense and floating MPs are mostly associated with lower organisms (phytoplankon and zooplankton) whereas, benthic invertebrates (amphipods, polychaete worms, molluscs and echinoderms) shows more tendency towards dense MPs. The higher vertebrates such as fishes also engulf MPs through the process of prey-predation relationship in aquatic environment. In addition, microplastics are also reported to have potential to accumulate hydrophobic organic pollutants like POPs, PAHs, PCBs and to have other chemical mixture in their polymer structure, like flame retardants, additives and plastisizer[9]. In this regard, it is very much essential to estimate spatial distribution of different plastic fragments in the natural streams to alert and avoid plastic pollution in the environment.

MPs occurrence was estimated in rivers *viz.* Rhine River (228-3760 items/kg), Beijiang River (178 to 544 items/kg) sediments, Thames River (185-660 items/kg, 2 times) etc.[10-12]. The most common type of plastic debris (mesoplastic) found in the river sediments was PE, PP and PET. These plastic chemical types were reported extensively as dominant plastic debris in the rivers of Asia and South East Asia. The most important morphotypes of the plastic particles was found to be fibers (polyesters) and sheet or film. Recently, microplastics pollution highlighting fibers was more emphasized as compared other morphotypes like film and beads. These fibers in the Ganga sediment might have been coming from garment washing through effluents from municipal sewages. Asian river contributes 86% of the total global plastic input[6]. A recent report by United Nations Environment Program on "Single-use plastics: A Roadmap for Sustainability" underscore the annual environmental damage to the global marine ecosystem at $13 billion. According to a predictive model,[6] it has been highlighted that Yangtze river catchment of China holds highest annual (0.33 million tonnes) plastic debris followed by Ganges of Indian Subcontinnent (0.12 nillion tonnes per year). In addition authors have also opined that August is the peak period for plastic inputs in river Ganga with 44500 tonnes per month whereas, the river dischrages <150 tonnes per month during December to March.

## MICROPLASTICS POLLUTION IN INDIAN RIVERS

Though there are many reports on the characterization of microplastics in various riverine ecosystems, none is available on the mighty river

Ganga which is the sociocultural backbone and integral part of Indian subcontinent. Originating from Gangotri, the Ganga flows through number of industrial cities and effluent points, mainly in the lower stretch, to reach the Bay of Bengal, the north east coast of Indian subcontinent. The river harbours more than 650 million people through her basin and designated as the most heavily populated basin in the world. On her course, river Ganga carries inland debris pervasive of wastage from rayon industries, paint industries, dairy and milk manufacturing units which received enter river through city sewage ingress. Hence, the zone thought to be receives plenty of inland wastes/litters including particles of microplastics. Therefore, ICAR-CIFRI attempted to measure the abundance of microplastics (with various categories of size and shape) in the sediments of lower stretch of river Ganga at three locations (Buxar, Bhagalpur and Patna) of Bihar and four locations of (Nabadwip, Barrackpore, Godakhali and Frasergunj) of West Bengal[13].

The study by ICAR-CIFRI revealed that microplastics were abundant in sediments of river Ganga at all the selected seven sites with different size, number and morphological diversity (Figure 2).

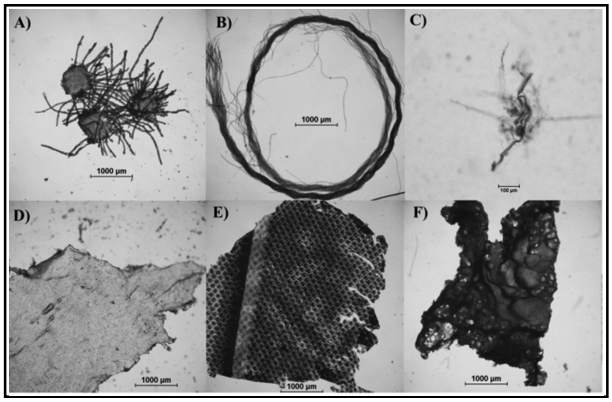


**Figure 2 : Microscopic image of different microplastics extracted from the seven location of Ganga; Fibers (A, B and C), Film (D and E) and Foam (F)[13].**

The abundance of microplastic in the sediment samples found to be ranged from 11.48 to 63.79 ng/g (Mean ± SE ~37.56 ± 16.50 ng/g) (Figure 3). However, the level of microplastic abundance was found to be lower as compared to the some other rivers of the world like in the Antuã River of Portugal (2600-71400 ng/g), Beijiang River of China (178 to 544 items/kg), Thames River (185-660 items/kg), etc. Based on factors like source loading, hydrodynamic condition and geographic position, some sites at Ganga were found to be containing higher amount of microplastics as compared to other, like the abundance of microplastics was more in Buxar sediment (63.79 ng/g) as compared to Patna (39.52 ng/g). The level of plastics debris was also found more in Godakhali and Fraserganj sites due to generation of plastic waste during huge fishing activities (impaired fishing gears). ICAR-CIFRI's investigation found that the most common type of plastic debris found in the river sediments were Polyethylene, Polypropylene and Polyethylene terepthalate. The most important morphotypes of the plastic particles were found to be film and fibers. As reported in other literature the source of these fibers in Ganga sediments might be the garment washing through effluents from municipal sewages. Polypropylene and polyethylene were found to be the major chemical types of the plastic film found in the sediments. These plastic types were reported to be most widely distributed plastic ingredients globally. Residues of microplastics were also detected in ship- breaking yard of river Sabarmati in Gujarat by researchers from IIT, Gandhinagar[14]. The researchers have shown their concern for inclusion of microplastics polutants in river pollution mitigation policies.

Other than river Ganga, the institute has started working on the estimating microplastic contamination in the various water treatment plants. One study in

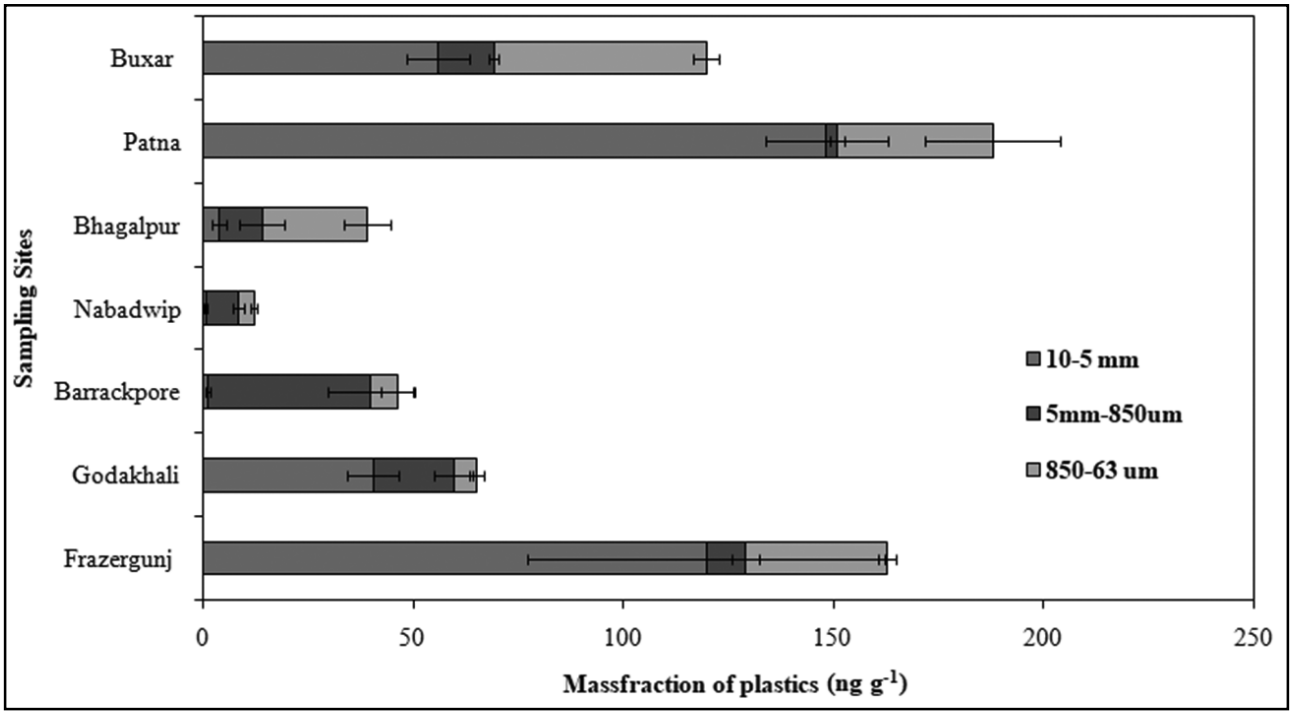


**Figure 3 : Mass fraction (ng/g) (A), number abundance (items/kg) (B) and morphotypes (C) of plastic particles in the sediments of selected sites[13].**

Indira Gandhi Water Treatment Plant, Barrackpore, it was found that plastic debris was present in the filter beds, however no microplastic particles were found in the treated water for human consumption. In the current research activities ICAR-CIFRI is planning to expand its research activities in estimating emerging contaminants including microplastic and its derivatives in the vast ecologically important aquatic bodies like East Kolkata Wetlands, extensive canal network of Sundarban and other potentially threatened wetlands and rivers of India.

## CONCERN FOR FISHERIES AND THREAT TO MANGROVE ECOSYSTEM

Plastic debrises especially microplastics fragments, fibres, beads etc. are found to damage fishes by its toxic effects. Moreover, abandoned and discarded fishing gear which is formally known as ghost fishing, also accounts for marine litter (640000 tons) in terms of nylon net which drifts a long distance and hence keep on entangling many large animals and mammals as well [15]. Seabirds, turtles also become worst victim of this marine litte problem. Researchers also have observed traces of microplastics on regular basis in the filter feeder mussel, fish flesh. Estuaries are the hotspot for MP occurrence and mangroves, being located in the estuarine zone, are no more left out (Figure 4). Study by CSIR-NIO, Goa has confirmed that tourism activities are responsible for occurrence of MP residues along coastline [16]. The researchers have also shown their interest to involve areas like, Zuari,

**Figure 4 : Plastic debris during fish catches at Godakhali (Source : ICAR-CIFRI)**

Mandovi, Chapora, Terekhol, Talpona and Galgibag rivers and in Salim Ali bird sanctuary for upcoming studies.

## OCCURRENCE OF MPS IN FISH GUT AND HUMAN HEALTH CONCERN

Researchers from CUSAT (Cochin University of Science and Technology, India) have traced microplastic fibres in the gut of red line torpedo barb, *Sahyadria chalakkudiensis* from Periyar river, South India. The authors reported that discards from eco-tourism industries and abandoned fishing net materials in upper stretches of Periyar river might be resulting into fragments of microplastics contaminations in fishes[17]. Fishes have accidentaly engulfed plastic particles along with their preferred food items. Members of the Centre for Environmental Science and Engineering, India (CESE) have reported 626 microplastics particles from the popular Indian salt. Infact, a study by IIT, Bombay have shown that edible salt of Indian market also contain traces of microplastics. Moreover, researchers from the same institute have reported quantified fractions of MPs viz. fragment (63%) and fibers (37%) in Indian table salt[18].

## MICROPLASTICS MANAGEMENT STRATEGIES

Worldwide till now there is no concrete solution to the microplastic pollution. However, Government agencies are taking measure to reduce the anthropogenic source microplastics in environment. For instance, Plastic waste (management and handling) rules of India (2011) ban use of plastic carry bags and also to reduce use of same by setting pricing mechanism and through recycling. Further, new rule "Plastic waste management, 2016" India emphasizes upon ban on plastics below 50 µm. A recent literature reports flood-driven microplastic flushing has been suggested as an effective tool for eradicating abundance of microbeads on river catchments[19]. Authors also opined that fluvial processes have the capacity to clean microplastic contaminated river channel beds rapidly and assigning a new pace to understand the global sediment system fully. In search of solution to plastic pollution, waste-to-energy (WTE) plants are incinerating municipal waste to convert to energy. In contrary, the second solution is the promoting bioplastics as potential alternative to polythene bags. These bioplastics are oxibiodegradable plastics, hydrobiodegradable plastics and biodegradable plastics. However, researchers have also indicated that use of edible starch and vegetable oil to produce biodegradable bags may be reflected into implications on food security. Another, solution is the invention of plastic eating bacteria. However, such research are always becomes critical than what is anticipated. Increasing rate of plastic waste problems can be overcome by use of conventional biodegradable material such as, reused cotton, paper, wood made from novel materials like vegetable fibers and cellulose. Although, according to FICCI (Federation of Indian Chambers of Commerce and Industry) the per capita plastic consumption is low (11 kg per year) in India as compared to America (109 kg per year)[20] the condition may create an alarming situation for the sustenance of aquatic organisms.

## CONCLUSION

Though recent international report depicts the river Ganga as second most plastic pollution causing river to the marine environment, on filed scientific studies on the occurrence and estimation of plastic pollution in the Ganga are nil except the study conducted by ICAR-CIFRI. So there is an urgent need to further explore the scenario of plastic pollution in river Ganga by the Indian scientific communities. Besides Ganga, many other important river systems exist in India with many cities and

industries on their bank. Thus the issue of plastic pollution should also be critically examined in these rivers too. Microplastics, a contaminant of emerging concern (CEC) can impair the biological system drastically especially aquatic ecosystem and have the potential to hamper the inland fisheries activities thus should be evaluated exhaustively in Indian rivers keeping in view the live hoods of millions depending on capture fisheries in the Inland river systems.

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# PLANT DISPERSAL THROUGH SILK ROUTE : A COMPENDIUM

**R.B. Mohanty[1] and T. Panda*[2]**

**The present article highlights the role of ancient Silk Road linking not only east with west but also in transmission of knowledge, ideas, cultures, religion and beliefs among the Eurasian people. Also it become instrumental in migration or dispersal of some economically important plants including cereal, pulses, fruits, vegetable, oil seeds and medicinal plants from one region and to another, those would ultimately dominate the earth and changed the food habit all over the globe. A handful of plants utilized or have manipulated the humanity as well as the prevailing situation into spreading their genes and creating an ecological niche that was better suited for their survival and productivity.**

## INTRODUCTION

All type of plants did not evolve in all places. Each plant has originated in a particular locality with specific geo-climatic conditions and gradually migrated to other places adapting different methods. Majority of crop plants, for instance, have been evolved broadly in 08 different regions of earth called the centre of origin of those species[1]. They are China, India, Central Asia, Middle East, Mediterranean region, Abyssinia (Ethiopia), Central America and South America. Plant migration or dispersal occurs by both natural and manmade means. Natural process includes various methods adapted by plants for their dispersal. But, the plant propagules normally cannot be dispersed to far away places crossing great barriers, like oceans, large mountains or deserts. In contrast, plant dispersal by human beings occurs in different periods of history for different reasons and mostly economically important plants were dispersed by them. The prominent types among them are :

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(a) Plant dispersal by man in ancient period with the expansion and migration of primitive agricultural communities.

(b) Dispersal with early trade and migration of people between different parts of the world.

(c) Plants of economic value were introduced from different parts of the world to Europe in 15$^{th}$ century, after the discovery of sea route to Asia and specifically India.

(d) In 16$^{th}$ and 17$^{th}$ centuries, there was dispersal of most tropical crops to other parts of the world with rapid development of communication network.

(e) Crops indigenous to America's were spread to other parts of tropics during 16$^{th}$ century by missionaries, colonial authorities and developers concerned with agri-business.

(f) Recent development in dispersal has been associated with expansion of agricultural research and large scale collection as well as exchange of germplasm of economically important plants by scientists and researchers of different countries.

Silk Road was one important route of early trade and commerce through which there occurred large scale man made dispersal of plants between different countries.

## ANCIENT SILK ROAD

Silk Road, also called silk route was an ancient trade route, linking China with the west, carrying goods and ideas between the two great civilizations i.e. Rome and China. Silk went westward while wools, gold and silver were carried to east through this route. Silk Road is in fact, a relatively recent term and for the majority of its long history, these ancient roads had no definite name. The German geologist and geographer Baron Ferdinand Von Richthofen named this trade and communication network as Silk Road in mid nineteenth century (1877 AD), which was accepted and acclaimed by all. Because silk was the major trade product carried on this road for long time, this name was appropriate and became popular among historians and intellectuals. This great overland trade route was originated and became functional from 2$^{nd}$ century BC to the later part of 14$^{th}$ century AD. It started from Changan (now Xian) in the east and ended at Mediterranean in the west, covering 6400kms and linking China with the Roman Empire[2]. It was actually a caravan tract which crossed through China along the Gan-Su corridor then through the Tarima basin and the highlands of the Pamir, and Tian-Shan ranges, in to the Central Asia, Afghanistan, Iran and ultimately to the eastern shores of Mediterranean Sea, from where the goods were shipped. China traded silk through this route and also exported tea, salt, sugar, porcelain and spices to the west. They imported goods like cotton, ivory, wool, gold and silver[3]. China also received Nostorian Christianity and Buddhism (from India) *via* this route. It became defunct in 1453 AD, when the Ottoman Empire boycotted trade with China. Moreover, the discovery of sea route to India and expansion of European shipping activity after 1500 AD become instrumental for the death of this once important inter-continental trade route.

This vast communication network operating for more than one and half millennia had carried something more than just merchandise and precious commodities. The constant movement and mixing of different population also brought about the transmission of knowledge, ideas, cultures, religion and beliefs and which had a profound impact on the history and civilization of Eurasian people. Travelers along the silk roads were attracted not only by the trade but also towards the intellectual and cultural aspects in the localities along the silk route. Science, Arts, Literature as well as crafts and technologies were also shared and disseminated in to societies all along the length of the routes[4]. In this way, languages, religions and cultures developed and influenced each other. The splendid cultures of China, India, Persia, Arabia, Greek and Rome were thus shared and exchanged through this ancient route. There was also exchange of genes or germplasm of plants and animals between east and west through this route crossing thousands of kilometers of expansive deserts and mountainous terrain, which has been archaeologically traced back in 3$^{rd}$ millennium BC[5]. Archaeo-botanically tracing this path that plants followed on their long eastward or westward journey across Central Asia provides a road map of the early routes and migration of the foods that ultimately reaching our dinner tables to day.

## DISPERSAL OF PLANTS THROUGH SILK ROAD

Some economically important plants particularly cereals, millets, pulses, oil seed plants, fruits, vegetables and medicinal plants having the centre of origin in one continent were carried through this

silk road to the other and domesticated in new habitat in course of time[6]. The travelers particularly the traders and shepherds, who carried plant products as material of commerce or food, provided an ideal dispersal mechanism for the crops that would ultimately dominate the planet. These mobile people spread the germplasm of the plants and animals that would fed the blossoming empires of Europe and Asia[6].

When individual plants are concerned, Arab traders introduced rice (*Oryza japonica*) in Europe[7] and had taken sugarcane (*Saccharum officinarum*) from south Asia to the Mediterranean basin. Similarly wheat (*Triticum aestivum*) was dispersed from Mediterranean region to Asia through this road[8] while Buck wheat (*Polygonum fagopyrum*) went in reverse direction. Most of the millets like, Foxtail millet (*Setaria italica* ) and Broom corn millet (*Panicum miliaceum*)[9, 10]; pulses like horse gram (*Macrotyloma uniflorum*), green gram (*Vigna radiata*), black gram ( *Vigna mungo*), rice bean, oil seed sesame (*Sesamum indicum*) and fiber yielding plant "Cotton" (*Gossypium arboretum*) have migrated from Asia, particularly south east Asia to middle east and ultimately to Mediterranean region. But germplasm of sorghum (*Sorghum vulgare*), pearl millet (*Penisetum typhoideum*) and Hyacinth bean have come from their place of origin Africa to Asian countries. When fruits and vegetable are concerned, most of the fruits like apricots (*Prunus americana*), cherries (*Prunus cerasus*), walnuts (*Juglans regia*), plums (*Prunus domestica*) and pistachios (*Pistacia vera*) being originated in east have migrated to Europe. Similarly apple (*Malus pumila*) from Kazakhstan, almonds (*Prunus dulcis*) from south Eurasia, grapes (*Vitis vinifera*) from western Asia and citrus (*Citrus sinensis*) plants from south East Asia have migrated to other regions through this inter-continental trade route. But peach (*Prunus persia*) with centre of origin China dispersed first to Persia and then to Europe[11]. Vegetables Like brinjal (*Solanum melongena*), cucumber (*Cucumis sativus*) and pumpkin (*Cucurbita pepo*) have spreaded to other regions from Indian subcontinent. Similarly *Asparagus* (*Asparagus racemosus*) from eastern India and rhubarb (*Rheum palmatum*) as well as sorrel (*Rumex* sp.) from China migrated to other parts of globe via this important highway. Hemp (*Cannabis sativa*) plant having East Asian origin also dispersed to other regions passing through this route[12]. Moreover, the black mulberry (*Morus* sp.) cultivated by Europeans as silk worm fodder is said to have come from India.

## CONCLUSION

The Silk Road has a significant impact to the prosperity of many ancient civilizations, such as Chinese, Arabic, Egyptian, Indian, Greek and Rome. As a final remark, it would suffice to say that a handful of plants on their nascent journey along this exchange route through Central Asia, have ultimately shaped the course of human history and changed cuisines all over the globe. It can also be said that, a select handful of plants utilized or have manipulated the humanity as well as the prevailing situation into spreading their genes and creating an ecological niche that was better suited for their survival and productivity while the famous Silk Road played a crucial role in their virgin trans-continental migration.

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# ON THE ONSLAUGHTS OF THE AMPHAN *VIS A VIS* THE ON-GOING PANDEMIC

**Dilip Kumar Sinha**

**Here is a presentation that aims at critiquing essentially the aftermath of the cyclone Amphan, in the wider canopy of the ongoing pandemic. That lockdown imperatives can provide different perceptions of the storm is also featured here. An account of the destroyed habitats and trees does portray a dismality but all the more worsened because of not being treated as pre-disaster sites.**

The 'lockdown' being curbed gradually and so, allowing the 'unlock' to step in, could ill afford to miss witnessing the cyclone Amphan to have its rampages in the coastal milieus of the Bay of Bengal. Amphan could make its pathways scaringly felt in the alleys and corridors of Kolkata. Amphan had the tavails stretched out to sixteen out of twenty three districts of West Bengal. A simple database of stormy happenings consists of six crores of people being acutely affected, two lakhs of people being rendered homeless. The conundrum could assume to be all the more poignant because of the pandemic COVID-19. The lockdown has already brought about a perception of the ferocity of the ongoing pandemic. Distancing off has already come up as a tenor in thought-styles, impinging often in the life styles. Coping with the wild features of the storms, in earlier times, cannot but be given a go-by.

Adding grist to the mill of the existential threat from the pandemic, the fury of the Indian Ocean can in no way be overlooked. The warmth of the Indian Ocean, with its spillover on the coastal shores of Bengal has now become irretrievably a reality. The Arabian counterpart could hardly mince worsening through the storm Nisarga. In scientific terms, the liveliness of the dipole can hardly be precluded. If offshores in the Bay of Bengal be taken as the harbinger of atmospheric disasters, how can one be unthoughtful about its counterpart in the outskirts of Pune. The Indian Science Congress Association can ill afford to be a unswayed on such scores. 'Coping with Natural Disasters An Integrated Approach' happened to be the focal theme of an ISCA Annual event 78$^{th}$ ISC session Indore, in the earlier decades of nineties. The tenor and ramifications can in no way shy away from the possible interplay with the ferocity of the virus affecting the public health, and so, the rationale of this writeup.

The data on moisture content and the prolific rain, cannot be ignored, because of the telling backlashes. Pre-disaster necessities must have been scrupulously attended to by the disaster management personnel. But that could hardly stem the anguish of the people, who keep on losing their 'hold onto', whatever be the virulence of the invading externalities. That needs to be contained in. Couldn't that be indirectly softened by the isolation through the 'lockdown'? Let us get into the details of the virus, from which immunity *per se* could become remorsely unavailable.

A ceaseless request for a pathogen in the corona virus, be that old or new, can hardly be avoided on several grounds, e.g. 'the viruses have a receptor

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binding site that finds ways to the cell that it is going to affect, which in COVID-19 is the lungs'. True, that all animals carry viruses can in no way be transmitted. A misleading idea, almost going to take roots is that there may be an environment that facilitates zoonotic distance spread through direct transmission or through a vector intermediary. The diversity of pathogens has to be reckoned with. Can there exist a risk of emergence of new pathogens? An interplay can occur because of high densities of humans and livestock. A high ecological deterioration, rather a degradation keeps on surfacing and so, runs the risk of increase of the pathogen spillover increase. The habitats labouring under risks of emergence are situated in the close vicinities of the parts of Asia, specially the Indian subcontinent, South East Asia and South China. A natural ecosystem may thus become fragile, even through the few servient stages.

One can have always a layout of the atmospheric niceties on speed, temperature, moisture, humidity etc. relating to Amphan, pouncing upon the trees that could stand the test of times. The uprooted trees of mango, jackfruit, woodapple, krishnachura, matonginy and banyan could become painfully visible on the roads, grounds, roofs etc., that do rake up the memories with several alignments. Didn't the trees provide the places of shelter, saviour and succour to people ? Who is not left forlorn while witnessing the highways or the formal streets found strewn with the *elan vital* of the trees? Presumably, Alia, Phani and Bulbul could somehow be condescending but the Amphan has staringly ripped the canopies apart. The Kolkata Municipal Corporation provides an estimate on uprooted trees. The concerns on impediments to pathways seem to have edges over the sense of gloom and sorrow, over the beloved trees. As of now, one hardly dares to speak about the migrant labour, seeking a shelter with trees having a cohesion elsewhere. The COVID-19 lockdown must have enabled a viewer, in the house, trees, trunk and the branches being tormented by whirls with a dominantly torsional ilk. There is no point of espousal of sentiments around trees. A collision with COVID-19 can hardly be brushed off, on grounds of 'social disaster' imperatives. Birds and squirrels certainly chose to be occupiers of trembling trees. The cuckoo, without being bogged down by the dictum on distance, could quieten its melodious voice. The habitats and niches stand perturbed, with a slew of alternative trajectories and without being choosy in any way. The emotive spells kept on simmering if there be a coupling, where the pandemicity is well bent on seeking zoonotic entries and the Amphin playing fiddle for ephemeral broadsides.

Somewhat painfully, the debilitating devastation could happen by the cyclone Amphan which did invade on May 20, the 2373-acre spread containing 15,000 plants belonging to 1300 species, felling thereby hundreds of trees. To a professional Botanist, a tree stands as a dead body. The Great Banyan Tree in the Botanic Gardens must have acquired a capability to withstand the brutality of the Amphan. Some of the valuable inmates there, particularly those brought from abroad some centuries ago, have fallen prey to the Amphan. The area around the Botanic Gardens happens to be a declared containment zone of COVID-19. Does it allow an intuitive exercise on the coercive flare up on the inmates of the Botanic Gardens, somewhat akin to a Netflx of COVID-19?

It would be too perfunctory if this presentation is not wound up with some lead references. The pandemic COVID-19 has the literature, domineeringly contemporary in nature. New terminologies are almost invariably in the offing. Few institutions and organizations are fairly pro-

active in bringing out whatever they are capable to lay their hands on. Yet, one finds the new book, 'The Coronavirus : What you Need to Know about the Global Pandemic', written by Rajesh Parikh, Director of Medical Research, Jaslok Hospital and Research Centre, Mumbai with two physicians Swapnell Parikh and Meherra Desai as coworkers. The work of C Brown[1] has a seminality on aspects of zoonoses and pathogens related to public health. WHO Reports on Corona virus disease 2019 keep on pouring out investigative studies on a continuing basis, since February 2020. The work of Wang, Horby, Hayden and Gao[2] needs to be referred to. The Editorial of the Current Computer-Aided Drug Design, 2020 by Subhash C Basak *et al.*[3], should be looked into. Sinha[4]'s treatise may also be perused, specially for natural-disaster scenarios in the South Asian realities.

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# BIOLOGICAL ACTIVITIES OF NEEM & NEEM COMPOUNDS

**Amit Krishna De***

**For thousands of years the beneficial properties of Neem have been recognized in the Indian tradition. In India, neem is known as "the village pharmacy" because of its healing versatility, and it has been used in Ayurvedic medicine for more than 4,000 years due to its medicinal properties. Each part of the neem tree has some medicinal property. The seeds, bark and leaves contain compounds with proven anti-septic, anti-viral, anti-pyretic, anti-inflammatory, anti-ulcer, anti-oxidant, immunomodulatory, anti-hyperglycaemic, anti-malarial, anti-bacterial, anti-mutagenic, anti-carcinogenic properties and anti-fungal uses. In this review, the traditional uses and medicinal properties of Neem have been discussed in brief.**

## INTRODUCTION

**Neem** (*Azadirachta indica* A Juss) is native to India and Burma, growing in tropical and semi-tropical regions. It is known as *Antelaea azadirachta* (L.) Adelb. or *Melia azadirachta* L.; Neem has two closely related species: *A. indica* is popularly known as Indian neem (margosa tree) or Indian lilac, and *M. azadirachta* as the Persian Lilac.The latinized name of Neem - *Azadirachta indica* - is derived from the Persian: Azad = Free, dirakht = Tree, i - Hind = of Indian Origin - which literally means: 'The Free Tree of India".

**Figure : Neem Tree.**

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The word Neem is derived from Sanskrit *Nimba* from the term '*nimbati syasthyamdadati*' which means 'bestower of good health'. It has also been known as *Ravisambha* - sun ray like effects in providing health. Neem is also called '*arista*' in Sanskrit- a word that means 'perfect, complete and imperishable' or 'reliever of sickness'.

**Table 1 : Local names of Neem in India and around the world.**

| |
|---|
| English - Margosa, Neem, Indian Lilac |
| Hindi - Neem |
| Bengali - Nim, Nimgachh |
| Konkani - Beva-rooku |
| Marathi - Kadunimb |
| Gujarati - Leemdo |
| Tamil - Vembu, Vempu |
| Punjabi - Nimb |
| Malayalam - Veppu, Aryaveppu, Aruveppu, Kaippan, Veppu, Vepa |
| Simhalee - Nimu |

Oriya - Nimo
Telegu - Vepa
Kannada - Bevinmar, Kahibevu
French - Azarirae d'lnde, Margousier
German - Indischer Zadrach
Persian - Azade Darakhte Hindi
Arabic - Azad Darkhtu Hind
Burmese - Tamabin, Kamakha
Malay - Dawoon Nambu, Baypay
Latin - Azadirachta indica A. Juss or Melia azadirachta Linn
Farsi - Azad darkht 1 hindi (Free tree of India)
Singapore - Kohumba, nimba
Indonesia - Mindi
Nigeria - Don goyaro
Spanish - Margosa
Nepal - Nim
Portuguese - Margosa, Nimbo

Source : *www.frienvis.nic.in › WriteReadData › UserFiles › file › pdfs › Neem*

Neem is originally native to Indo-Burma region being distributed throughout Southeast Asia, i.e. India, Pakistan, Bangladesh, Sri Lanka, Burma, Thailand, Malaysia and Indonesia. In addition to these countries, neem is found in some other countries over the continents. Neem now has become a global tree. Neem was introduced to Africa earlier this century. It was brought from India. Now it is planted extensively in the tropical regions of Africa, particularly in the regions along the Sahara's southern fringe. The tree is now also well established in the Middle East and South America. In recent times Neem has been introduced into Saudi Arabia, Yemen, China (Hainan Island), and Philippines. Small plantings of neem are also found in USA (South Florida and Hawaii), Brazil and Australia.

Neem (*Azadirachta indica*) tree can grow upto a height of 15-20 m, rarely to 35-40 m. It is noted for its drought resistance and normally thrives in areas with sub-arid to sub-humid conditions, with an annual rainfall between 400 and 1200 mm. It thrives best on well drained deep and sandy soils (pH 6.2-7.0) but also can be grown in many different types of soil. Generally can grow between 21-32°C but can tolerate high to very high temperatures. However, it does not tolerate temperature below 4°C as leaf shedding may start and cause death.

## TRADITIONAL USES

For thousands of years the beneficial properties of Neem have been recognized in the Indian tradition. In India, neem is known as "the village pharmacy" because of its healing versatility, and it has been used in Ayurvedic medicine for more than 4,000 years due to its medicinal properties. Each part of the neem tree has some medicinal property. All parts of the tree (seeds, leaves, flowers and bark) are used for preparing many different medical preparation and neem oil is also used for preparing cosmetics (soap, shampoo, balms and creams) The Vedas called Neem *sarva roga nivarini*, which means 'one that cures all ailments and ills'. According to Indian mythology, Neem tree is considered to be divine as a few drops of amrita fell on it while being carried to heaven. Another story tells of the time the Sun took refuge in the Neem tree to escape from the awesome powers of the demons.

Neem fruit, seeds, oil, leaves, roots and bark have been reported to be extensively used in Ayurveda, homoeopathic and unani medicine. Since last 2500 years the pesticidal and medicinal properties of extracts from the neem tree have been in practice. Sanskrit texts dating back to the sixth century BC, document the anti-microbial and prophylactic effects of neem extracts.

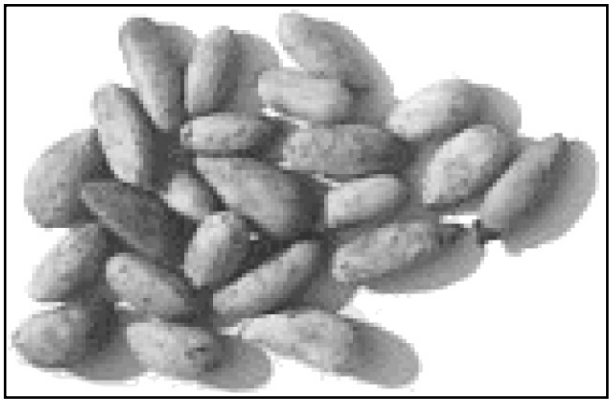

**Figure : Neem seeds (with husk).**

Most of the uses of Neem has been mentioned in ancient documents on natural treatments like '*Carak- Samhita'* and '*Susruta*-Samhita'. In the 6th Century BC Charaka recommended the consumption of neem extracts to ward off pimples, leprosy and edema. In the 5th century BC Sushruta recommended the use of neem-leaf smoke for fumigation and maintenance of general hygiene including cure of wounds. It is also used as a "krimihara", an agent effective against insects, grubs and maggots.

Indian women in particular, believe that a bath with a decoction of neem leaves can keep their skin supple and healthy and improve health and hygiene. The leaves have been used since ages for healing cuts, bruises, skin disorders and acne and also as a cosmetic to remove skin blemishes. Neem leaf powder or crushed leaves incorporated into their face packs provided emollient and anti- ageing action and controlled pimples and acne. The Bark has been used for cosmetics, health care products and medicinal preparations.

**Figure : Neem Leaves.**

Since ancient time twigs of neem bark are used as toothbrushes in India and Africa [1]. Traditional uses of Neem leaf and neem bark includes curing of earaches and headaches. In villages there is practice of using Neem leaves in paste form or neem leaves in water for bathing the chickenpox patients. Neem leaves are also consumed along with diet or made into tea to increase immunity of the body. The tea is traditionally drunk to reduce fever caused by malaria. Neem water is used to soak feet for treating various foot fungi.

Neem has been used since ages as fertilizer and pest control material. Women also use this to protect their stored grains and pulses through the year. It has also been reported to be effective against termites. Neem oil has been used as anti-lice and anti-dandruff treatment and also to prevent baldness and greying of hair. The oil after crushing the kernel of the neem fruit has been used chiefly in pest controlling preparations and also in medicinal, cosmetic and health care products. The residue after crushing the kernel called neem cake is an excellent organic fertilizer. In brief, as folk medicine different parts of Neem including bark, oil and leaf extracts had been used to control many types of diseases

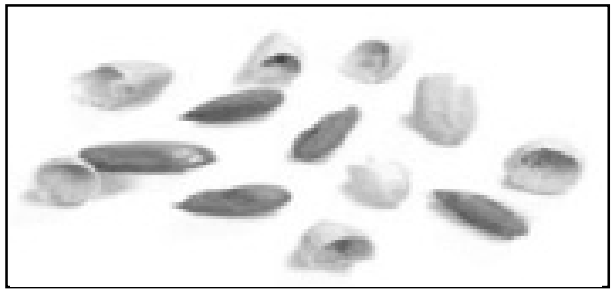

**Figure : Neem kernels and husk.**

like leprosy, constipation, intestinal helminthiasis, respiratory disorders, rheumatism, chronic syphilitic sores and indolent ulcer.

Besides its use as medicine, the tender shoots of the neem tree and leaves are eaten as a vegetable in many parts of India, Cambodia, Vietnam and other Asian countries. Even lightly cooked, the flavor is quite bitter and hence the food is not really enjoyed by all.

**Table 2 : Traditional Uses of Neem.**

| Part | Uses |
|---|---|
| Leaf | Leprosy, eye problem, epistaxis, intestinal works, anorexia, skin ulcers |
| Bark | Analgesic, fever |
| Flower | Bile suppression, intestinal worms, phlegm |
| Fruit | Piles, diabetes, wound, leprosy, intestinal worms, urinary disorder, phlegm, eye problem, diabetes, wounds, leprosy |
| Twig | Scabies, wounds, ulcers, skin diseases |
| Seed/oil | Leprosy and intestinal worms |

(Source : *https://www.infinityfoundation.com/mandala/t_es/t_es_agraw_neem.htm*)

## CHEMICAL CONSTITUENTS

To give a brief background, chemical investigations of neem were undertaken by Indian pharmaceutical chemists in 1919, whereby they isolated acidic principle in neem oil, which they named as 'margosic acid". However, real chemical research originated in 1942 with isolation of three active constituents, viz, nimbin, nimbidin and nimbinene. In 1963 several compounds were isolated and characterized. The importance of the neem tree has been recognized by US National Academy of Sciences, which published a report in 1992 entitled 'Neem – a tree for solving global problems'[2]. More than 135 compounds have been isolated from different parts of neem and several reviews have also been published on the chemistry and structural diversity of these compounds[3-6]. The compounds have been divided into two major classes: isoprenoids (like diterpenoids and triterpenoids containing protomeliacins, limonoids, azadirone and its derivatives, gedunin and its derivatives, vilasinin type of compounds and C- secomeliacins such as nimbin, salanin and azadirachtin ) and non-isoprenoids, which are proteins (amino acids) and carbohydrates (polysaccharides), sulphurous compounds, polyphenolics such as flavonoids and their glycosides, dihydrochalcone, coumarin and tannins, aliphatic compounds, etc.

Leaves mainly yield quercetin (flavonoid) and nimbosterol (β-sitosterol) as well as number of liminoids. The principal constituents of neem leaves include protein (7.1%), carbohydrates (22.9%), minerals, calcium, phosphorus, vitamin C, carotene etc. But they also contain glutamic acid, tyrosine, aspartic acid, alanine, praline, glutamine and cystine like amino acids, and several fatty acids (dodecanoic, tetradecanoic, elcosanic, etc.).

Besides, the essential oil consisting of sesquiterpene derivatives, the flowers contain nimbosterol and flavonoids like kaempferol, melicitrin etc. Flowers also yield a waxy material consisting of several fatty acids, viz., behenic (0.7%), arachidic (0.7%), stearic (8.2%), palmitic (13.6%), oleic (6.5%) and linoleic (8.0%). The trunk bark contains nimbn (0.04%), nimbinin (0.001%), nimbidin (0.4%), nimbosterol (0.03%), essential oil (0.02%), tannins (6.0%), a bitter principle margosine and 6-desacetyl nimbinene. The stem bark contains tannins (12-16%) and non-tannin (8-11%). The bark contains anti-

inflammatory polysaccharide consisting of glucose, arabinose and fructose at a molar ratio 1 : 1 : 1 with molecular weight of 8,400[7]. The bark also yields an anti-tumor polysaccharide. Besides polysaccharides, several diterpenoids, viz., nimbinone, nimbolicin, margocin, nimbidiol, nimbione, etc. have been isolated from stem bark and root bark. Besides β- sitosterol, 24-methylenelophenol and nimatone, the heartwood contains, calcium, potassium and iron salts. Neem wood contains cellulose, hemicellulose (14.00%) and lignin (14.63%), while wood oil contains β-sitosterol, cycloeucalenol and 24-methylenecyceloartenol.

The tree exudes a gum, which on hydrolysis yields, L-arabinose, L-fructose, D-galactose and D-glucoronic acid. The older tree exudes a sap containing free sugars (glucose, fructose, mannose and xylose), amino acids (alanine, aminobutyric acid, arginine, asparagines, aspartic acid, glycine, norvaline, praline, etc) and organic acids (citric, malonic, succinic and fumaric). The sap is reported to be useful in the treatment of general weakness and skin diseases.

Seed is very important both because of its high lipid content as well as the occurrence of a large number of bitter principles (azadirachtin, azadiradione, fraxinellone, nimbin, salannin, salannol, vepinin, vilasinin, etc.) in considerable quantities. Neem kernel lipids are similar to the normal glycerides from other oilseeds and contains oleic acid (50-60%), palmitic acid (13-15%), stearic acid (14-19%), linoleic acid (8-16%) and arachidic acid (1-3%). It is brownish yellow, non-drying oil with an acrid taste and unpleasant odour. The quality of the oil differs with the method of processing.

The composition of neem cake after the extraction of oil varies widely depending on the raw material used for expelling, for example, whole dried fruits, seeds or kernels. Extraction of cake with 70% alcohol followed by hexane yields a meal free from bitterness and odour, which will be satisfactory as animal feed. The neem cake is rich in most of the amino acids. It is a potential source of organic manure and contains many plant nutrients, viz., nitrogen 2-3%, phosphorus 1% and potassium 1.4%. It also contains 1.0-1.5% tannic acid, a large number of triterpenoids and has high sulphur content.

## BIOLOGICAL ACTIVITIES

The seeds, bark and leaves contain compounds with proven anti-septic, anti-viral, anti-pyretic, anti-inflammatory, anti-ulcer, anti-oxidant, immunomodulatory, anti-hyperglycaemic, anti-malarial, anti-bacterial, anti-mutagenic, anti-carcinogenic properties and anti-fungal uses[8-11]. The biological activities some of the neem compounds, pharmacological actions of the neem extracts, clinical study and plausible medicinal applications of neem along with their safety evaluation have been reviewed[12] and are given in brief below:

### i) Immunostimulant activity

The aqueous extract of neem bark and leaf also possesses anti-complement and immunostimulant activity. Neem oil has been shown to possess activity by selectively activating the cell-mediated immune mechanisms to elicit an enhanced response to subsequent mitogenic or antigenic challenge[13].

### ii) Hypoglycaemic activity

It is also effective in controlling diabetes. In fact, neem leaf is a traditional herb for treating diabetes[14] and has been specifically proven to be effective in preventing and treating the disease. Aqueous extract of neem leaves significantly decreases blood sugar

level and prevents adrenaline as well as glucose-induced hyperglycaemia.

**iii) Anti-ulcer effect**

Neem leaf and bark aqueous extracts produce highly potent antiacid secretory and anti-ulcer activity[15]. The mechanism of the anti-ulcer effect of Neem leaf aqueous extract to block gastric lesions in rat has been studied with emphasis on acid secretion, oxidative damage and apoptosis[16]. The extract dose-dependently inhibits gastric lesions induced by restraint-cold stress, indomethacin and ethanol. In stress ulcer model, it is more effective than ranitidine but less effective than omeprazole. It also dose-dependently blocks pylorus ligation and mercaptomethylimidazole-induced acid secretion. It inhibits H+-K+-ATPase activity *in vitro* in concentration-dependent manner to inhibit acid secretion. Oxidative membrane damage by hydroxyl radical (*OH) as measured by lipid peroxidation in stress ulcer is significantly blocked by leaf extract. Stress-induced apoptotic DNA fragmentation is also protected. The extract also prevents *OH-mediated mucosal DNA damage *in vitro* by scavenging the *OH. Neem leaf extract, thus, offers anti-ulcer activity by blocking acid secretion through inhibition of H+-K+-ATPase and by preventing oxidative damage and apoptosis.

**iv) Anti-oxidant activity**

The modifying effects of ethanolic extract of neem leaves was evaluated on oxidative stress induced by the potent gastric carcinogen N-methyl-N'-nitro-N-nitrosoguanidine (MNNG) in rats. Results demonstrate that neem leaf exerts its chemoprotective effects on MNNG- induced oxidative stress by decreasing lipid peroxidation and enhancing the anti-oxidant status[10]. The anti-oxidant activity of neem seed extract has been demonstrated *in vivo* during horse-grain germination. Extracts from leaf, flower and stem bark of the Siamese neem tree *(Azadirachta indica* A. Juss var. siamensis Valeton, Meliaceae) exhibited high anti-oxidant activity *in vitro*[17]. This report supports the ethnomedical use of young leaves and flowers of this plant as a vegetable bitter tonic to promote good health.

**v) Anti-fertility effect**

Anti-fertility activity of neem oil has been reported in rabbits and rats[18]. Intra-vaginal application of neem oil, prior to coitus, can prevent pregnancy. It could be a novel method of contraception. Neem oil Suppositories can be used in either vaginal or rectal application. A refined product from neem oil was studied in 10 human volunteers, where intra-vaginal application before sexual intercourse could prevent pregnancy with no adverse effect on vagina, cervix and uterus. The data suggested that intrauterine treatment is safe[13].

**vi) Anti-microbial activity**

Oil from the leaves, seed and bark possesses a wide spectrum of anti-bacterial action against Gram-negative and Gram-positive microorganisms, including *M. tuberculosis* and streptomycin resistant strains[19-20]. *In vitro*, it inhibits *Vibrio cholerae Klebsiella pneumoniae*, *M. tuberculosis* and *M. pyogenes*. Anti-microbial effects of neem extract have been demonstrated against *Streptococcus mutans* and *S. faecalis*. Quercetin is known to have both anti-bacterial and anti-fungal properties[21]. Extracts of neem leaf, neem oil seed kernels are effective against certain fungi including *Trichophyton*, *Epidermophyton*, *Microspor Trichosporon*, *Geotricum* and *Candida*. Neem oil

exhibits anti-fungal activity against *Helicobacter pylori*[22]. Aqueous leaf extract offers anti-viral activity against Vaccinia virus, Chikungemya and measles virus[23].

**vii) Anti-malarial activity**

Neem seed and leaf extracts are effective against both choroquin-resistant and sensitive strain malarial parasites[24]. Neem leaf extract has been prescribed for oral use for the treatment of malaria by Indian ayurvedic practitioners from time immemorial. Recently, a clinical trial has been carried out to see the efficacy of neem extract to control hyperlipidemia in a group of malarial patients severely infected with *P. falciparum*. The lipid level, especially cholesterol, was found to be lower during therapy when compared to non-malaria patients[25].

**viii) Anti-cancer activity**

Reports are available regarding the use of neem to treat patients suffering from various forms of cancer[26]. One patient with parotid tumour and another with epidermoid carcinoma have responded successfully when treated with neem seed oi1. Neem leaf aqueous extract effectively suppresses oral squamous cell carcinoma induced by 7, 12-dimethylbenz[a] anthracene (DMBA), as revealed by reduced incidence of neoplasm. Neem may exert its chemopreventive effect in the oral mucosa by modulation of glutathione and its metabolizing enzymes. Recently, inhibitory effects of *Azadirachta indica* on DMBA-induced skin carcinogenesis in Balb/c mice was reported[27]. Studies also indicated that an ethanolic extract of neem has been shown to cause cell death of prostate cancer cells (PC-3) by inducing apoptosis as evidenced by a dose-dependent increase in DNA fragmentation and a decrease in cell viability[28].

**ix) Insecticidal and pesticidal activities**

Azadirachtin is of interest to research scientists because of its activity as an insecticide and is considered to be of the most ecological importance. Studies have shown a wide spectrum of activity and species affected. It acts by breaking the insect's lifecycle. Research has increased in the past few years as the desire for safe pest control methods increases and it becomes apparent that this tree will be able to play a role in integrated pest management systems. It exhibits anti-feedant, insect repellent and insect sterilization properties. It is so potent that quantities as low as 1 ppm will totally repel certain insects. It interferes with ecdysone, the key insect molting hormone and prevents larvae and pupae from completing the molting process.

Insects treated with Azadirachtin during the larval and pupal stages, generally die within 3-14 days. It works on the insect's hormonal system, and does not lead to development of resistance in future generations On the other hand, chemical insecticides act on the digestive or nervous system of the insect and make it resistant in future. Azadirachtin by itself is an effective insect anti-feedant and repellent but better results can be obtained by using all 40 liminoids in their entirety. A kind of synergistic effect is obtained whereby one component strengthens and increases the working of another.

Neem extracts have been approved by the U.S. Environmental Protection Agency for use on food crops. It has been proven in various research studies that Neem is non-toxic to birds, beneficial insects or humans and protects crops from over 200 of the most costly pests[29]. Neem is effective in curing ringworm, eczema and scabies[30]. Lotion derived from neem leaf, when locally applied, can

cure these dermatological diseases. A paste prepared with neem and turmeric has been used traditionally for treatment of scabies. It is also effective in treating infestations of head lice in humans. Limonoids like nimocinolide and isonimocinolide present in neem affect fecundity in house flies (*Musca domestica*) at a dose ranging between 100 and 500 ppm. They also show mutagenic properties in mosquitoes (*Aedes aegypti*) producing intermediates[31].

Azadirachtin has proven effectiveness as a pesticide against about 200 insect species and is reported as non-toxic to humans. Nimbidin, a major crude bitter principle extracted from the oil of seed kernels of *A. indica* demonstrated several biological activities[32]. From this crude principle some tetranortriterpenes, including nimbin, nimbinin, nimbidinin, nimbolide and nimbidic acid have been isolated which has properties like Anti-inflammatory; Anti-arthritic; Anti-pyretic; Hypoglycaemic; Anti-gastric ulcer; Spermicidal; Anti-fungal; Anti-bacterial; Diuretic; Anti-malarial; Anti-tumour; Immunomodulatory, etc.

**x) Anthelmintic and Hepatoprotective activity**

Anthelmintics control gastrointestinal nematode and the development of resistant populations has required research into new alternatives. There are reports about anti-parasitic activity of neem in animals and plants[33]. Hepatoprotective activity of *Azadirachta indica* leaves were found on paracetamol induced hepatic damage in rats[34].

## NEEM TOXICITY

Neem oil, leaves and extracts are used in health and beauty care products like soaps, bath powders, shampoos, lotions and creams, toothpastes, pet care products, etc. Various studies have been reported on the safety evaluation of different parts of neem as well as its various biologically active products. Neem oil can be slightly irritating to the eyes and skin. If the oil is accidentally administered by nasal or oral to infants and children can cause toxicity include vomiting, drowsiness, generalized seizures, coma, and severe metabolic acidosis. The components of neem oil specially, Azadirachtin, Nimbidin, Nimbin can be very irritating to the skin and stomach. Nimbidin was subjected to detailed toxicity studies in mice, rats and mongrel dogs and showed no toxicity up to 2000 mg/kg orally and 1000 mg/kg intraperitoneally. Subacute toxicity studies in albino rats up to 100 mg/kg daily for 6 weeks and 10 and 20 mg/kg orally in dogs for 4 weeks did not evidence any systemic toxicity. Teratogenic studies in rats also did not reveal any toxic manifestations or foetal abnormalities[35].

## CONCLUSION

Neem is is a tree that can help solve global environmental and health concerns. Like other trees neem is a natural air purifier, exhaling out oxygen and keeping the oxygen level in the atmosphere balanced. In addition it wards off insects and has remarkable powers for controlling insects. This bio-activity of Neem based products has been extensively evaluated and proven and commercially manufactured as bio-pesticides. Neem pesticides are now increasingly used in India on crops like cotton, vegetables, fruit trees, coffee, tea, rice and spices. Moreover, neem's ability to withstand extreme heat and water pollution is well known. It also helps to improve fertility of the soil and to rehabilitate degraded wastelands. The Neem tree can also play a vital role in controlling soil erosion, salination and preventing floods. Hence, an extensive research and development work should be undertaken on neem

and its products for their better economic and therapeutic utilization.

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# ANTIMICROBIAL CHEMOTHERAPY AND DRUG RESISTANCE

Tina Mukherjee

**Antibiotic are chemotherapeutic drugs which are used to control infections caused by various microorganisms, mostly bacteria. These chemical agents have been used for centuries for the treatment of various diseases, which have been discussed briefly in this article. Unfortunately, the misuse of this category of drug gave rise to antibiotic resistance worldwide, that needs to be addressed everywhere to overcome the attack from multi drug resistant superbugs.**

## INTRODUCTION

The treatment of a disease with a chemical substance is known as chemotherapy and the chemical agent is called chemotherapeutic agents. Chemotherapy has been practiced for centuries all over the globe by most civilization but it was only the early of 20$^{th}$ century when the practice has revolutionized the medical science. The discovery of sulphonamide drug by Paul Ehrlich and Sahachiro Hata, opened a new era in antimicrobial drug discovery.

Antibiotics are the drugs mainly obtained from living organisms. It means a metabolic product of one organism is inhibitory to other microorganisms. The term antibiotic was first discovered by Vuillemin in 1889 to describe a condition where, 'One creature destroys the other in order to sustain its own'[1]. The more appropriate definition of antibiotics was used by Waksman in 1945 as chemical substances of microbial origin which in small amounts exert antimicrobial activity[1].

## ANCIENT PRACTICES OF CHEMO-THERAPY

Antibiotics were known by their activities even before they were given their names. Long back Chinese used moldy soybean curd for the treatment of boils and controlled foot infection by wearing moldy sandals. Dated back to 350-550 CE, the antibiotic tetracycline was probably used in the diet of these ancient people as very small amount of tetracycline was found in human skeletal remains from ancient Sudanese Nubia[2]. Another sample taken from the Dakhleh Oasis, Egypt where a histological study from the femoral midshafts of the late Roman period skeletons was examined and traces of tetracycline was also obtained. However, the purpose of the use of the tetracycline is not exactly known, it is only assumed to be used as preventive measures from infective diseases[3]. More primordial practices of antibiotics have been traced while we consider the ancient habit of eating earth, the favourite one being red or yellow, having a strong smell, or being greasy that might suggest a strong link to the usage of antibiotics. The colors and smell were mainly due to antibiotic-producing bacteria and concomitant antibiotic production in these soils [4]. The bacteria were mainly actinomycetes and produced actinomycin C2 and actinomycin C3, which are polypeptide antibiotics that interfere in bacterial transcriptional process[5]. Another very useful data we obtain from traditional chineese medicines, the use of qinghaosu (artemisinin), a potent anti-malarial

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drug that used by Chinese herbalists for thousands of years as a remedy for many illnesses.

It was as early as 1630 when Europeans used natural quinine from the bark of the cinchona tree for the treatment of malaria and even before that the South American Red Indians used to chew the bark of cinchona tree for treatment of malarial fever. In the year 1901, Emmerich and Low showed that when *Pseudomonas aeruginosa* was injected in rabbits, they got protection against anthrax. They called the material 'pyocyanase'which was responsible of killing of *Anthrax bacilli*, as *Pseudomonas aeruginosa* was known as *Bacillus pyocyaneus* then[1].

In 1899 Ellie Metchnikoff recommended the use of lactobacilli for the treatment of dysentery, which was a clear case of bacteria antagonism. In today's advanced medicinal world probiotics in the form of lactobacilli are highly recommended by the physicians to control gastric infections[1].

The first search of antibiotic was made by Gratia and Dath in 1924 that resulted in discovery of actinomycetin from actinomycetes . Although it was never associated with treatment of antimicrobial diseases directly, it was used to lyse bacterial culture for the production of vaccine[1].

## MODERN ERA OF ANTIBIOTICS

The modern era of chemotherapy started with the work of German physician Paul Ehrlich (1854-1915). Ehrlich (Fig. 1) took fascinating interest in dyes as dyes are the substances that can bind the bacterial cells selectively and can kill the cells with very less effects on hosts. So he named dyes as 'magic bullet'. Ehrlich was working with a dye trypan red which was selectively effective against the trypanosomes causing African sleeping sickness. He was working with a Japanese student named Sahachiro Hata and they screened the impacts of a number of arsenicals on syphilis infected rabbits and found that 'arsphenamine' was active against *Syphilis spirochete*. In 1909 this 'arsphenamine' came in the market under the trade name of 'Salvarsan' and was probably the first truly modern antimicrobial agent to be used[6] .

Gerhard Domagk in the year 1927 worked on a large number of chemicals and found that 'Prontosil Red' a leather dye protected mice against virulent streptococcus and staphylococcus infections without apparent toxicity. It was later shown that body

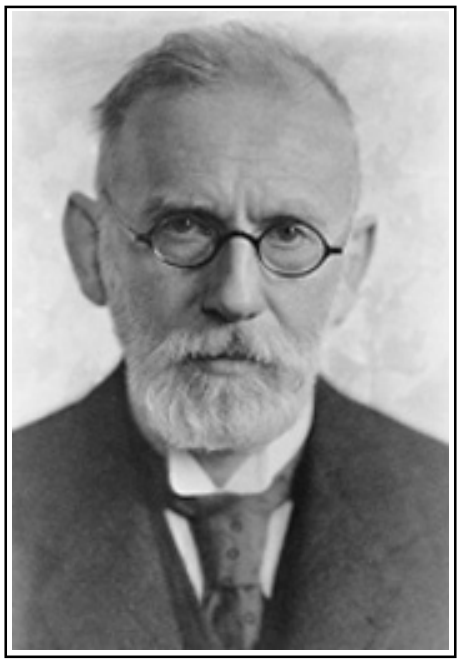

**Figure 1 : Paul Ehrlich-Father of Chemotherapy**
*(Source : https://www.britannica.com)*

metabolized this dye into active sulfanilamide, for which Domagk was awarded Nobel prize in the year 1939[7].

All of us are more or less familiar with the somewhat unexpected event on the 3rd September, 1928 when Alexander Fleming discovered penicillin. Although he was awarded the Nobel prize for this enormous achievement, many scientists got there before him. Sir John Scott Burdon-Sanderson in the

year 1870 showed that bacterial culture media covered with the growth of mould inhibited the growth of bacteria. Another notable scientist in this field was Joseph Lister (1827-1912) who worked with '*Penicillium glaucium*' and demonstrated its antibacterial effect on human tissues, Dr John Tyndall (1820-1893) also showed the same with *Penicillium notatum*. Another French medical student, Ernst Duchesne, in 1897, successfully used *Penicillium notatum* successfully, to treat induced typhoid in guinea pigs.

However, it was Fleming's perseverance and belief that made him different from all others.

For more than a decade after his preliminary finding, he tried a lot to draw attention of the chemists to help him with the problems of purification and stability of the active substance and he was ready to supply the *Penicillium* strain to anyone requesting it. He was almost about to discard the idea in 1940, until in the same year an Oxford team led by Howard Florey and Ernest Chain published a paper describing the purification and quantification of penicillin for clinical purpose[8]. Their protocol eventually led to penicillin mass production and distribution in 1945, which brought Fleming, Florey and Chain the Nobel Prize in 1945 (Figure 2).

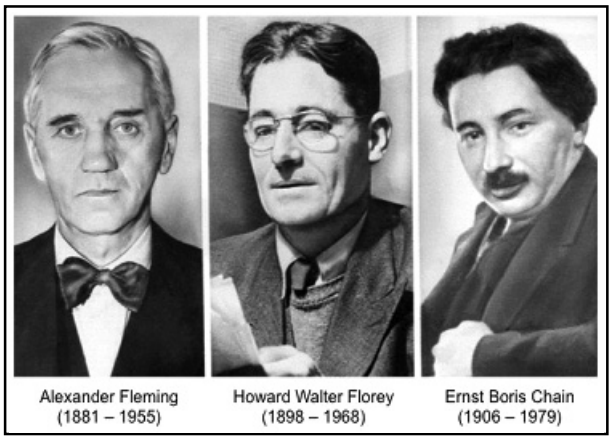


**Figure 2 : The Nobel prize in Physiology or Medicine was awarded jointly to Alexander Fleming, Ernst Chain and Howard Florey "for the discovery of penicillin and its curative effect in various infectious disease"** *(Source: https://ib.bioninja.com)*

Another notable breakthrough was the discovery of streptomycin by Selman Waksman; (July 22, 1888-August 16, 1973) a Ukrain-borne Jewish-American inventor, professor of Biochemistry and Microbiology at Rutgers University. Not only Streptomycin, but he discovered a number of antibiotics and also introduced the procedures that have led to the development of many others. In 1952, he was awarded the Nobel Prize in Physiology and Medicine for "ingenious, systematic and successful studies of the soil microbes that led to the discovery of streptomycin.", although a controversy existed when Albert Schatz, one of his Ph.D students sued him for minimizing Schatz's role in the discovery of streptomycin.

## THE GOLDEN AGE OF CHEMO-THERAPY

The next 20 years were the 'Golden Age' of antibiotic discovery. American pharmaceutical company Eli Lilly requested Christian missionaries to send them a soil sample from different exotic places they visit and accordingly, a sample sent from Borneo in 1952 showed the presence of *Streptomyces orientalis*, from which vancomycin was eventually extracted and available in the market in 1958[9].

Cephalosporins came in the 1960s and according to their spectrum of activity they came in three generations and with the emergence of third-generation antipseudomonal agent ceftazidime appearing in the late 1970s. In 1976, bacterial beta-lactamase inhibitors[10] were first identified as a byproduct of *Streptomyces clavuligerus*. From these were derived clavulanic acid, which was

combined with amoxicillin to become co-amoxiclav, and thienamycin, which became the precursor for the carbapenems. Thienamycin later came as imipenem, although very active against infections but was very short-lived.

Then came, meropenem during 1995 with a similar spectrum of activity but showed a number of adverse effects. Other beta-lactamase inhibitors, like tazobactam and sulbactam, evolved with other agents to broaden their spectrum,e.g., piperacillin was mixed with tazobactam and was used as a licensed drug in the USA in 1993 . The combination was used extensively in the UK as a cephalosporins-resistant therapy for *Clostridium difficile*.

Nalidixic acid, the quinolone drug was available for clinical use in 1967, but, it was a narrow spectrum drug used mainly to treat urinary infections. The advent of fluoroquinolones made these group of drugs broad spectrum. Then came the ciprofloxacin, was introduced in the mid-1980s, got immense popularity in anthrax treatment during the year 2000s. Many other members like tetracycline, puromycin, erythromycin etc. also come up and evolve during late 20$^{th}$ century that rich medical science a lot, however, the advent of antibiotic resistant microbes again put a big question mark on advancement of chemotherapy.

## ANTIBIOTIC RESISTANCE

In an interview with New York Times in 1945 Alexander Fleming mentioned that abuse of drugs might lead to selection of resistant bacteria. Making his assumptions true within only 10 years after penicillin got its reputation globally the antibiotic resistance among bacteria became prevalent. In many cases antibiotics could not be effective due to advent resistant bacteria. The most notorious was the species of *Staphylococcus aureus,* that started showing resistance against sulfa-drugs. Penicillin was effective initially, slowly it develops immunity against penicillin, then become resistant against penicillanase-resistant methicillin. *S. aureus* is a pathogen of a great apprehension due to its capacity to adapt to different environmental conditions and rapidity in production of antibiotic resistance ,compared to other bacterial species. This single organism is responsible for most nosocomial diseases happening all over the World. It already acquired resistance to most beta-lactam antibiotics through its acquisition of the penicillin-binding protein (PBP)2' gene; PBP2' is an enzyme involved in cell wall synthesis of bacteria that has low binding affinity for beta-lactam antibiotics.

On the other hand, vancomycin-resistant *S. aureus* (VRSA) was reported in the US which appeared to obtain the resistance genes horizontally from vancomycin-resistant enterococci (VRE). Initially, *S. pneumoniae* was susceptible to penicillin, however, penicillin-intermediate *S.pneumoniae* (PISP) strains and penicillin-resistant *S.pneumoniae* (PRSP) strains were found in the latter half of the 1960s and 1970s respectively. It could have been resulted due to very frequent use of oral cephem drugs. At the same time, macrolide resistant *S. pneumoniae* also appeared due to extensive use of this antibiotic.

Ampicillin resistant *Haemophilus influenza* evolved during 1980s, due to mutation in beta-lactam through mutations in PBP genes. Gonococci have also developed resistance against penicillins and quinolones. Multi drug resistant *Pseudomonas aeruginosa* emerged making the strains resistant against three classes of antimicrobials, i.e., carbapenems, quinolones, and aminoglycosides. Many environmental bacteria have become multidrug resistant due to continuous misuse of drugs.

Drug resistance events are mainly originated through the Resistance plasmids present in various bacterial cells that have obtained the resistance genes from various mobile genetic elements or transposons. Resistance has been generated due to continuous mutation in chromosomal genes also. Mostly the resistance factors are transmitted horizontally from one bacterium to the others, making a wide population resistant against a specific drug. There are various mechanisms which are adopted by bacterial systems to become resistant against various antibiotics- they are mainly by preventing access to the target of the antibiotic, degradation or modification of antibiotic and rapidly extruding the antibiotics with the help of efflux pump. If we consider multi drug resistant *Pseudomonas* sp., we find it has complex mechanisms of drug resistance, including reduced membrane permeability due to decreased outer membrane protein (D2 porin), that denies the access of antibiotics, overexpression of efflux pump resulting in expelling the antibiotics out, mutation of the quinolone target (DNA gyrase), production of aminoglycoside modification enzyme, and production of metallo-beta-lactamase (carbapenem-hydrolysing enzyme) altogether.

## CONCLUSION

Without chemotherapeutic drugs the medical science and treatment of infectious diseases are just not feasible. From pre historic times antibiotics were saviour of many a number of illness, but today their misuse have led us to such a unprecedented situation while pathogens instead of getting cleared off becoming more powerful in presence of them. Microorganisms grow natural resistance against antibiotics as a means of defence, however, improper use of drugs resulted in the normal human flora, in a number of cases, resistant to multiple antibiotics. Therefore proper antibiotic stewardship is needed to control the drug resistance, e.g., use of two types of drugs to control infections or use of antibiotics in such a high concentration that even if any resistant forms persist, can be killed, most rational approach should be structure based drug design. Above all, it is mandatory to have a clear awareness about the drug abuse in all levels of the society.

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# PERNIOSIS : UNBIDDEN SEASONAL FELICITATION

**Sukhvir Kaur[1] and Rajinder Kaur[2*]**

**Perniosis or chilblains, is a localised inflammatory lesion of the skin resulting from an abnormal response to cold and seen in susceptible individuals after prolonged exposure to non-freezing cold temperatures and damp conditions which results in an abnormal inflammatory reaction of small blood vessels. Treatments consist mainly of topical remedies and medications.**

## INTRODUCTION

Perniosis also known as chilblain or chill burns is incredibly usual form of sickness that is caused due to massive exposure to coolness and humidity. Chilblains', meaning cold sore-chill (cold) and blegen (swelling), was ûrst described in 1894 by Corlett[1]. Fingers, toes, nose and earlobes are the most affected areas by perniosis. It is often confused with frostbite. Swelling, itching, burning sensation, bluish color, blisters and discoloration of skin of hands, feet or different extremities are the comprehensible signs shown during chilblains. Perniosis is divided into two stages, an acute stage which is completely reversible and chronic stage in which permanent tissue changes have developed, a stage which is never completely reversible. Acute stage is short, developing within 12-24 hours after exposure to the cold and getting better after one to two weeks, but chronic stage lasts for a minimum of five months to a year and cause persistent sores that can lead to scarring. The condition usually starts in early winter and vanishes in spring, but often recurs the next winter[2]. Apart from external factors, there seems to be a personal tendency to develop lesions. Doctors can diagnose perniosis from the typical symptoms and appearance. If the diagnosis is in doubt, in rare cases, a skin biopsy may be taken.

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## ETIOLOGY

Perniosis is quite common and can occur at any age. It most commonly affects women, children and the elderly. Especially skinny patients may be at higher risk of getting chilblains. Several hours after the exposure to cold weather the blood vessels in toes and fingers get smaller by confine. The vascular mechanism underlying perniosis is to be persistent prolonged cold-induced vasoconstriction, without episodes of cold-induced vasodilation, leading to hypoxemia and a subsequent secondary inflammatory reaction[3]. There may be a genetic influence in perniosis, since several generations within a family can be affected. Other etiological factors include poor nutrition, anorexia nervosa, and systemic diseases, most typically lupus erythematosus and hematological malignancy.

## PATHOLOGY

Pathogenesis of perniosis has been attributed to a defective vasodilatory reflex and caused by a combination of arteriolar and venular constriction, the latter predominating on rewarming with exudation of fluid into the tissues. In perniosis patients, the initial vasoconstriction is prolonged, resulting in vasospasms[4]. Result of this prolonged

vasoconstriction is localized inflammation due to hypoxic damage. Severe cases may lead to ulceration, super infection, and scarring of the skin[5]. Detailed investigation should be undertaken in patients presenting with chronic lesions. Physicians should monitor perniosis patients for low haemoglobin levels and note the presence and/or onset of vascular disorders and autoimmune diseases. Cold is a requirement for the development of symptoms. Perniosis seems to be more common in environments where heating is inadequate for a few months of the year and is less common in localities characterised by harsh frigid winters where adequate home heating is the norm.

## RISK FACTORS

**Clothing that is tight or exposes skin to the cold-**Wearing tight-fitting clothing and shoes in cold, damp weather may make person more susceptible to perniosis and skin exposed to cold, damp conditions is more likely to develop perniosis.

**Environment and season-**Perniosis is less likely in colder and drier areas because the living conditions and clothing used in these areas are more protective against cold. Risk of chilblains is higher in an area with high humidity and cold, but not freezing, temperatures. They are more common from November to April.

**Poor circulation-**People with poor circulation tend to be more sensitive to changes in temperature, making them more susceptible to perniosis.

**Raynaud's disease-**People with Raynaud's disease are more susceptible to perniosis as narrowing of blood vessels is excessive which causes the blood vessels almost to shut down.

**An autoimmune disorder-**Lupus-an autoimmune connective tissue disease is the most common autoimmune disorder associated with perniosis.

**Sex-**Women are more likely to get affected by perniosis than men.

**Family history-**People with a family history of perniosis are more at risk than others.

## TREATMENT

Perniosis is a temporary condition. It will cure at their own after winters. The first line of treatment generally includes measures to keep hands and feet warm and dry, such as keeping indoor environment warm and dry, using gloves and socks, and changing damp gloves and socks when needed. Affected skin is cleaned with an antiseptic and gently bandaged to prevent infection and avoiding scratching. Though there are several lotions or creams that are available to treat chilblains. Topical steroid and calcium-channel blockers are beneficial for the treatment of chilblains[6]. Elderly patients may have a prolonged course, while younger patients improve spontaneously[7]. If the patient is diabetic or has poor circulation, healing may be impaired[8]. So diabetic patients must have regular foot checks as they may not be able to feel their feet and could have septic chilblains without realising. Vulnerable individuals who wrap up warmly, or stay away from the cold as much as possible are much less likely to develop perniosis. Laboratory tests and skin biopsies for perniosis is not necessary, unless the condition persists.

## CONCLUSION

Perniosis or chilblains are small, itchy swellings on the skin that occur as a reaction to cold temperatures. These lesions are bilateral, symmetrical and painful. They are distributed over the exposed parts of the body such as hands, feet, ears, and nose. Diagnosis of perniosis requires wariness, as history of cold exposure may not be evident. Perniosis patients should avoid common

triggers such as cold conditions. Prevention is paramount in the management of perniosis.

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# THE INDIAN SCIENCE CONGRESS ASSOCIATION

**14. Dr. Biresh Guha Street, Kolkata-700 017**

## ANNOUNCEMENT FOR AWARDS : 2020-2021

**Nomination/Application in prescribed forms are invited for following Awards :**

Asutosh Mookerjee Memorial Award
C. V. Raman Birth Centenary Award
Srinivasa Ramanujan Birth Centenary Award
S. N. Bose Birth Centenary Award
S. K. Mitra Birth Centenary Award
Birbal Sahani Birth Centenary Award
S. S. Bhatnagar Memorial Award
D. S. Kothari Memorial Award
Vikram Sarabhai Memorial Award
M. K. Singal Memorial Award
Prof. R. C. Mehrotra Memorial Life Time Achievement Award
Jawaharlal Nehru Birth Centenary Awards
B. C. Guha Memorial Lecture
G. P. Chatterjee Memorial Award
Millennium Plaques of Honour
Excellence in Science and Technology Award
Jawaharlal Nehru Prize
Professor R. C. Mehrotra Commemoration Lecture – Chemical Sciences
Prof.Sushil Kumar Mukherjee Commemoration Lecture – Agriculture and Forestry Sciences
Prof. S. S. Katiyar Endowment Lecture – Chemical Sciences / New Biology
Prof. Archana Sharma Memorial Award – Plant Sciences
Prof. G. K. Manna Memorial Award – Animal, Veterinary and Fishery Sciences
Dr. V. Puri Memorial Award – Plant Sciences
Prof. William Dixon West Memorial Award – Earth System Sciences
Professor Hira Lal Chakravarti Memorial Award – Plant Sciences
Pran Vohra Award – Agriculture and Forestry Sciences
Professor Umakant Sinha Memorial Award – New Biology
Dr. B. C. Deb Memorial Award for Soil/Physical Chemistry
Dr. B. C. Deb Memorial Award for Popularisation of Sciences
Prof. R. C. Shah Memorial Lecture – Chemical Sciences
Prof. (Mrs.) Anima Sen Memorial Lecture – Anthropological & Behavioural Sciences
Dr. (Mrs.) Gouri Ganguly Memorial Award for Young Scientist – Animal, Veterinary and Fishery Sciences
*Asutosh Mookerjee Fellowship for 2021-2022
**ISCA Fellows
***Infosys Foundation—ISCA Travel Award

*Last date 15th July, 2020, **Last date 10th September, 2020, ***Last date 15th November, 2020.Last date of Receiving of Nominations / Applicant for other ISCA Awards and Lectures of 2020-2021 is July 31, 2020. Contact : General Secretary ( Membership Affairs ), The Indian Science Congress Association, 14, Dr. Biresh Guha Street, Kolkata-700 017, Email : es.sciencecongress@nic.in For details see: http://www.sciencecongress.nic.in/awards.php

★ Last date extended to August 31, 2020 as per decision of Executive Committee due to pandamic.

# THE INDIAN SCIENCE CONGRESS ASSOCIATION

## 14. Dr. Biresh Guha Street, Kolkata-700 017

## ISCA YOUNG SCIENTIST'S AWARDS PROGRAMME : 2020-2021

To encourage Young Scientists, The Indian Science Congress Association has instituted a number of awards in different disciplines. These awards carry a sum of Rs.25,000/- besides a Certificate of Merit.

1. Applications are invited from members (Life &Annual) of the Association who have paid their subscription on or before **July 15, 2020**. The upper age limit of the candidates for the award is 32 years as reckoned on **December 31, 2020 ( born on and after January 01,1989)**.
2. Four copies of the abstract (not exceeding 100 words) along with four copies of full length paper must reach the office of the General Secretary (Membership Affairs) not later than August 16, 2020. At the top of each copy of the paper and its abstract, the name of the Section under which the paper is to be considered should be indicated. For details of Sections see http://www.sciencecongress.nic.in/html/paper/presentations.php
3. Along with the Four copies of paper, Four copies of the Application Form (to be downloaded from ISCA website (http://www.sciencecongress.nic.in/html/young_sc_programme.php) with brief bio-data of the candidate (not exceeding 2 pages), list of publications , with copies of reprints of already published papers if any and a soft copy of the duly filled application form with scanned copies of enclosures (excluding reprints), full length paper and abstract in MSWord **(not PDF)** along with bio data in the form of a CD must also be sent simultaneously along with the hard copies.
4. The Paper submitted must be a **single author paper** and the research work should have been carried out in India and this has to be certified by the Head of the Institution from where the candidate is applying.
5. The candidate should give an undertaking that the paper being submitted has not been published in any journal or presented in any other Conference / Seminar / Symposium or submitted for consideration of any award.
6. A Young Scientist can present only one paper in any one Section (and not a second paper on the same or any other topic in any other Section).
7. A person who has already received Young Scientist Award in any section once will not be eligible to apply for the above Award in the same or any other section.
8. Incomplete Applications will not be considered.
9. The papers submitted will be subjected to verification for authenticity.
10. Full length paper will be evaluated by experts and the selected Young Scientists (**maximum of six**) in each section will be invited to make oral presentation of their paper during 108th Indian Science Congress. The selected candidates will be provided admissible travelling allowances by ISCA.
11. The final selection for the Awards will be made by a duly constituted committee and the awards will be given during the Valedictory Session of 108th Indian Science Congress session to be held on January 7, 2021.
12. Applications submitted for the above award will not be returned.
13. The last date for receiving papers at ISCA Headquarters is **August 16,2020.** **(Extended to August 31, 2020)**

**All correspondences should be made to**: The General Secretary (Membership Affairs), The Indian Science Congress Association, 14, Dr. Biresh Guha Street., Kolkata-700017. Tel. Nos. (033) 2287-4530/2281-5323, FaxNo.91-33-2287-2551, Email:es.sciencecongress@nic.in,aes.sciencecongress@nic.in.,Website://http:.www.sciencecongress.nic.in

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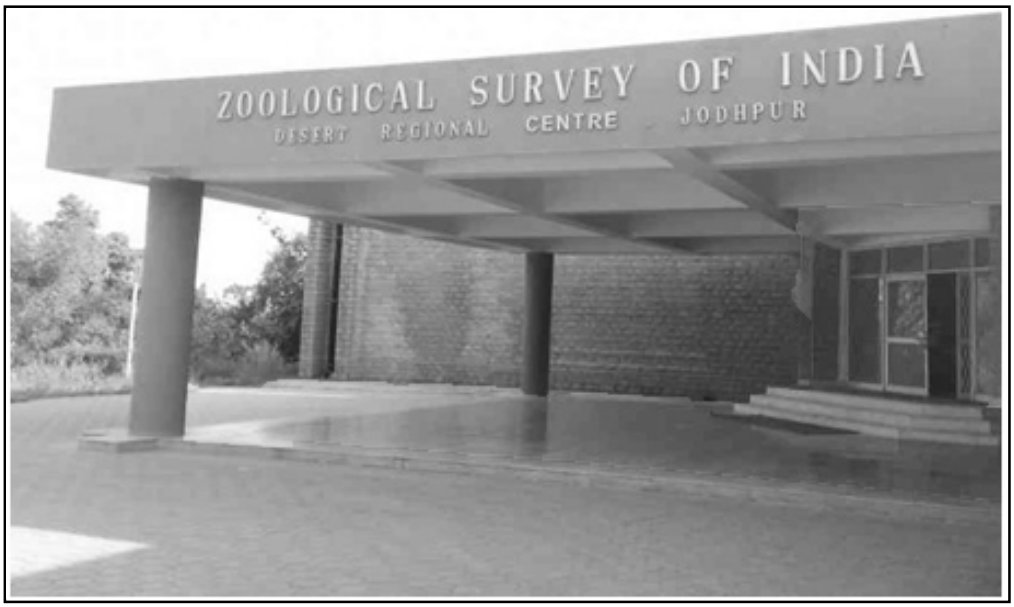


## DESERT REGIONAL CENTRE, ZOOLOGICAL SURVEY OF INDIA, JODHPUR, RAJASTHAN

The Desert Regional Centre (DRC), Zoological Survey of India, Jodhpur was established in June, 1960 as Desert and Gangetic Plains Regional Station to survey the faunal diversity of Desert Biome, Later, in 1965, it was renamed as at present. The jurisdiction of the Centre is spread over 3,42,239 $km^2$ area (33 districts) of Rajasthan and 1,81,1000 $km^2$ (25 districts) of Gujarat. The Centre is engaged in the documentation of the rich and diverse faunal resources of the two states by conducting field explorations and scientific studies.

**Major Research Programmes Undertaken by the Centre**

Termite Fauna of Gujarat and Rajasthan; Status Survey of Chinkara and Desert Cat in Rajasthan; Studies on Plant and Soil Nematodes associated with crops of economic importance in Gujarat; Fauna of Desert National Park, Rajasthan; Fauna of Pichhola Lake, Rajasthan; Assessment of Faunal Diversity of Nalsarovar Wetland, Gujarat; Faunal Exploration of Tal Chhapar Wildlife Sanctuary, Rajasthan; Fauna of Ranthambore National Park, Rajasthan; Studies on Ants (Formicidae) of Gujarat; Ants (Formicidae) of Rajasthan; Scarabaeidae Beetles of Rajasthan; Scarabaeidae Beetles of Thar Desert of Gujarat; Faunal Exploration of Sariska Tiger Reserve, Rajasthan, Qualitative and Quantitative studies of Plant and Soil Nematodes Associated with Crops of Economic importance in Rajasthan; Faunal Exploration of Kumbhalgarh Wildlife Sanctuary, Rajasthan; Faunal Survey of Important Congregative Bird Areas (Khijadiya Bird Sanctuary and Marine National Part and Sanctuary) in Gujarat; Diversity of Helminth Fauna of

Rajasthan; Vertabratre Faunal Diversity with special reference to Avian and Mammalian Fauna of the Sardar-Samand Reservoir, Rajasthan; Studies on Odonata and Lepidoptera Fauna of foothills of Aravalli Range, Rajasthan; Faunal Exploration of Sitamata Wildlife Sanctuary, Rajasthan; Taxonomical study of aquatic nematodes of lakes of Udaipur; Studies on Vertebrate Faunal Diversity of Kachchh Biosphere Reserve (KBR), Gujarat; Exploration of Vertebrate Diversity of Chambal River in Rajasthan State; Studies on Faunal Diversity of Rajasthan-Gaps in Research Status Survey of Ardeotis nigriceps (Vigors, 1831) (Great Indian Bustard) in Grasslands of Rajasthan; Exploration of Ichthyofaunal Diversity in the Excape Reservoirs of Indira Gandhi Nahar Pariyojna (IGNP) Canal in the Bikaner and Jaisalmer districts of the Thar Desert, Rajasthan, Studies on Faunal Diversity of Rajasthan–Gaps in Research; Faunal Diversity of Sariska Tiger Reserve, Rajasthan; Faunal Diversity of Desert Ecosystem, Rajasthan & Gujarat; State Fauna–Rajasthan; Status Survey of Indian Wild Ass (Equus hemionuskhur Lesson, 1827) in Desert Ecosystem.

Since its inception, the DRC has been surveying various districts of Rajasthan and Gujarat. The Faunal exploration which includes both extensive and intensive surveys has produced lot of study material representing all the Classes of Vertebrates and most of the orders of invertebrate phyla. So far 68 species (Acarina, Isoptera, Coleoptera, Hemiptera, Hymenoptera, Thysanoptera, Nematodes and Reptilia) were described as new to science by the scientists of the Centre.

The Centre possesses Taxonomic expertise on Lepidoptera, Hymenoptera, Arachnida, Pisces, Amphiblans, Reptiles, Birds and Mammals. The National Zoological Collection maintained at the Centre contain 65,065 identified specimens, including both invertebrates and vertebrates. The centre so far published 28 Books and 775 research papers and provides advisory services on identification to students, researchers and scientists of other institutes. The facilities are also availed by Rajasthan and Gujarat State Forest Department for identification of confiscated specimens of insects, reptiles, birds, and mammals.

**Library**

The Library of the Centre has acquired 3,406 books and 21 Journals/periodicals are subscribed.

**Museum**

Exhibits, model and posters pertaining to the fauns of Rajasthan and Gujarat are in display at the Natural History Museum of the Centre, for generating public awareness towards biodiversity conservation.

**Other Extension activities**

Identification and advisory services are offered to students, researchers and scientists of other institutes. The facilities are also availed by Rajasthan and Gujarat State Forest Department for identification of confiscated specimens of insects, reptiles, birds and mammals. Talks/ lectures on various subjects related to faunal diversity and biodiversity conservation are delivered on request to the students as well as school/ College teachers.

**Contact :**

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# CONFERENCES/MEETINGS/SYMPOSIA/SEMINARS

## AIOC, 2021, 79TH ANNUAL CONFERENCE OF ALL INDIA OPHTHALMOLOGICAL SOCIETY, 18-21 FEBRUARY, 2021, KOLKATA

### Topic :

- ★ Eye Health Medicine and Medical Science
- ★ Medical ethics
- ★ Eye Health
- ★ Health
- ★ Public Health
- ★ Healthy Living

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**Website :** http://www.aioc2021.org/

Gaurav Sinha
**Event inquiry/Organizer email address** : secretariat@aioc2021.org

## INTERNATIONAL CONFERENCE ON EXPERT CLOUDS AND APPLICATIONS, (ICOECA 2021), 18-19, FEBRUARY 2021, BANGALORE

### Topics :

### TRACK 1 :

- ★ Cloud-as-a-Service
- ★ Data & Storage Architectures
- ★ Architectures for data processing
- ★ Data interoperability
- ★ Data security and privacy challenges
- ★ Data and sustainable information networks
- ★ Data simulation and modeling techniques
- ★ Distributed and Parallel processing
- ★ Sustainable Edge-Cloud applications
- ★ Fault tolerance, flexibility, reliability and availability
- ★ Case studies and innovative applications
- ★ Cloud-centered sustainable networks
- ★ Green data centers
- ★ Big Data Analytics
- ★ Intelligent optimization techniques and models
- ★ Dynamic resource management techniques
- ★ Sustainability for future computing frameworks
- ★ Quality of Service
- ★ Sustainable cloud service automation
- ★ Innovative access control techniques
- ★ Industry and business specific cloud models

### TRACK 2 :

- ★ Intelligent Information Systems
- ★ Artificial Intelligence
- ★ Machine learning
- ★ Knowledge-based systems
- ★ Computer and machine vision
- ★ Pervasive Computing
- ★ Problem Solving Models
- ★ Smart user interfaces
- ★ Expert Systems
- ★ Deep learning
- ★ Innovative knowledge discovery
- ★ Web Intelligence
- ★ Computational Intelligence models
- ★ Intelligent search optimization

- ★ Emotional intelligence
- ★ Cybersecurity and risk assessment techniques
- ★ Multi-Agent Systems
- ★ Cognitive Science
- ★ New algorithms and models
- ★ Smart healthcare
- ★ Smart networking environments
- ★ Fuzzy sets
- ★ Human-Computer Interaction techniques
- ★ Natural Language Processing
- ★ Neural networks
- ★ Cyber-Physical Systems & IoT
- ★ Smart cities

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**Website :** http://icoeca.com/index.html

## INTERNATIONAL CONFERENCE ONPERVASIVE COMPUTING AND SOCIAL NETWORKING (ICPCSN 2021), 19-20 MARCH, 2021, SALEM

### Topics :

### Pervasive Computing

- ★ Ubiquitous networking and sensing models
- ★ Data mining techniques
- ★ Human-Computer Interaction models
- ★ Adaptive Computing in Robotics systems
- ★ Machine-to-Machine Communication
- ★ Intelligent user interface models
- ★ Pervasive wearable communication models
- ★ Smart Grid Computing and Cloud Computing
- ★ Smart Space Systems and Techniques
- ★ Autonomic Computing
- ★ Smart interface design models
- ★ Smart crowdsourcing and intelligent models
- ★ Social intelligence and computing models
- ★ Artificial Intelligence and Machine Learning models
- ★ Brain-machine interaction
- ★ Deep Learning and Deep Computation
- ★ Smart systems [smart home, gaming, healthcare, Cities and transportation, etc.]

### Social Networking

- ★ Opportunistic networks Models and Applications
- ★ Wireless Sensor networks
- ★ Big data and cyber-physical systems
- ★ Peer to Peer Social Networking Models
- ★ Challenges and Opportunities in Social Networking
- ★ Context-Aware Mobile Social Networks
- ★ Cyber Security and Cyber-physical systems
- ★ Cloud Security models in Social Networks
- ★ BlockChain models in Social Information Networks
- ★ Internet of things and its Architectures
- ★ RFID systems, design and Implementations
- ★ Heterogeneous Multilevel Networks
- ★ Web-based Semantic models and commodities
- ★ Edge and Fog Computing in Social Networks
- ★ Smart authentication and authorization models
- ★ Security Issues and Technical Challenges in Social Information Networks

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# S&T ACROSS THE WORLD

## NANOWIRE DEVICE GENERATES ELECTRICITY FROM AMBIENT HUMIDITY

Scientists in the US claim to have developed a device that can generate electricity from moisture in the air. The device, based around a thin film of electrically conductive protein nanowires, can produce continuous electrical power for around 20 hr, before self-recharging. The researchers say that such technology could provide clean energy without the restrictions on location and environmental conditions of other renewable energy solutions such as solar cells (*Nature* **578**, 550-554, 2020).

The device consists of a roughly 7 μm thin film of protein nanowires, harvested from the microorganism *Geobacter sulfurreducens*, deposited on a gold electrode with an area of around 25 $mm^2$. A smaller, roughly 1 $mm^2$, electrode is placed on top of the nanowire film.

Jun Yao, an electrical engineer at the University of Massachusetts, and his colleagues found that this set-up was able to produce a continuous current for more than 20 hr. After 20 hr, the voltage had dropped from around 0.5 V to 0.35 V, but when the load was removed, it went back up to 0.5 V within five hours, showing a self-recharging process.

The researchers also connected multiple devices together to increase the output. With 17 devices they were able to generate 10 V, and demonstrated that these connected devices could power an LED or a small liquid crystal display.

*G. sulfurreducens* was discovered by Derek Lovley, a microbiologist at the University of Massachusetts. He tells *Physics World* that the bacteria use the electrically conductive nanowires to make connections with other microbial species and with minerals. "For example, in soils and sediments, *Geobacter* 'feeds' electrons to methane-producing microorganisms, which use the electrons to convert carbon dioxide to methane," Lovley says. "*Geobacter* also electrically connects to iron minerals in soils and sediments to use iron minerals similarly to how we use oxygen."

**Electricity from thin air**

Energy is generated in the device due to a moisture gradient that forms within the nanowire film when it is exposed to the humidity naturally present in air, according to the researchers. The smaller electrode on the top is key, as it leaves one side exposed to the humid air, allowing the moisture gradient to develop.

Yao tells *Physics World* that the way the device works can be compared with lightning. "The cloud builds up positive and negative charges at the upper and lower sides, and upon a certain threshold, it discharges through the lightening," he explains. "This indicates that charge can be build up from the ambient environment and we may be able to harvest it for electricity production. One can think of our device to be a small 'cloud', with one side open to air and the other sealed. Water molecules in the air constantly bump into the open surface, creating more charges than on the other one. The charge difference eventually will build up electric field or potential difference, which will drive the electric current output."

The team experimentally determined that ambient humidity was the source of energy by sealing the top of the device, to block water-molecule exchange with the nanowires. This cut the electrical output, which returned once the seal was removed. They also found that increasing the ambient humidity, and

thus the water-molecule exchange rate, increased the electric output. To check that there were no electrochemical reactions with the gold plates, the team replaced them with inert carbon electrodes, and were able to generate similar voltages. The device also worked in the dark, eliminating a photovoltaic effect.

Yao says that the researchers are now working on connecting devices together to increase the power volume. "We have demonstrated that the devices can be connected to increase the power, so at a certain point, it is proven this will scale," he says. "We are working on material sciences and engineering strategies to scale up the technology."

(Source : https://physicsworld.com)

## ASTRONOMERS DETECT BIGGEST EXPLOSION IN THE HISTORY OF THE UNIVERSE

Scientists studying a distant galaxy cluster have discovered the biggest explosion seen in the Universe since the Big Bang.

The blast came from a supermassive black hole at the centre of a galaxy hundreds of millions of light-years away. It released five times more energy than the previous record holder.

Professor Melanie Johnston-Hollitt, from the Curtin University node of the International Centre for Radio Astronomy Research, said the event was extraordinarily energetic. "We've seen outbursts in the centres of galaxies before but this one is really, really massive," she said. "But it happened very slowly—like an explosion in slow motion that took place over hundreds of millions of years."

The explosion occurred in the Ophiuchus galaxy cluster, about 390 million light-years from Earth.It was so powerful it punched a cavity in the cluster plasma—the super-hot gas surrounding the black hole.

Lead author of the study Dr Simona Giacintucci, from the Naval Research Laboratory in the United States, said the blast was similar to the 1980 eruption of Mount St. Helens, which ripped the top off the mountain. "The difference is that you could fit 15 Milky Way galaxies in a row into the crater this eruption punched into the cluster's hot gas," she said.

Professor Johnston-Hollitt said the cavity in the cluster plasma had been seen previously with X-ray telescopes.But scientists initially dismissed the idea that it could have been caused by an energetic outburst, because it would have been too big. "People were sceptical because the size of outburst," she said. "But it really is that. The Universe is a weird place."

The researchers only realised what they had discovered when they looked at the Ophiuchus galaxy cluster with radio telescopes. "The radio data fit inside the X-rays like a hand in a glove," said co-author Dr Maxim Markevitch, from NASA's Goddard Space Flight Center. "This is the clincher that tells us an eruption of unprecedented size occurred here." The discovery was made using four telescopes; NASA's Chandra X-ray Observatory, ESA's XMM-Newton, the Murchison Widefield Array (MWA) in Western Australia and the Giant Metrewave Radio Telescope (GMRT) in India.

Professor Johnston-Hollitt, who is the director of the MWA and an expert in galaxy clusters, likened the finding to discovering the first dinosaur bones. "It's a bit like archaeology," she said. "We've been given the tools to dig deeper with low frequency radio telescopes so we should be able to find more outbursts like this now." The finding underscores the importance of studying the Universe at different

wavelengths, Professor Johnston-Hollitt said. "Going back and doing a multi-wavelength study has really made the difference here," she said. Professor Johnston-Hollitt said the finding is likely to be the first of many. "We made this discovery with Phase 1 of the MWA, when the telescope had 2048 antennas pointed towards the sky," she said.

(Source : https://www.sciencedaily.com/releases/2020/02/200227114459.htm)

## NOVEL COMPOUND SPARKS NEW MALARIA TREATMENT HOPE

A novel class of antimalarial compounds that can effectively kill malaria parasites has been developed by Australian and US researchers.

In preclinical testing, the compounds were effective against different species of malaria parasites, including the deadly *Plasmodium falciparum*, and at multiple stages of the parasite lifecycle. The compounds target a previously unexplored parasite pathway and could overcome existing issues of parasite drug resistance, an ongoing and increasingly urgent problem. The researchers hope that drugs based on these early compounds will soon enter phase 1 clinical trials.

**Exciting new development**

Professor Alan Cowman, an international malaria expert and deputy director at the Walter and Eliza Hall Institute, led the Australian research team, alongside MSD scientist and US team lead Dr David Olsen. "This is an exciting new class of antimalarial compounds that could fill a critical and widening gap in our efforts to control and eliminate malaria," Professor Cowman said. "In preclinical testing, the lead compound WM382 inhibited growth of the malaria parasite in the host and prevented transmission back to the mosquito. These results indicate that this class of compounds is very promising as a potent new treatment for malaria. We hope that drugs based on these compounds will soon progress to human phase I clinical trials."

WM382 not only killed malaria parasites in the blood, it also killed parasites in the liver and prevented parasites in the blood being transmitted to mosquitoes, he said. "This novel class of compounds has the potential to not only cure people with malaria, but also prevent transfer of the parasite to the mosquito and, consequently, halt further transmission of the disease. This is an exciting prospect, as current antimalarial drugs kill the malaria parasite in the blood but do not fully prevent transmission," Professor Cowman said.

**An emerging crisis**

A major problem with current antimalarial drugs is that malaria parasites evolve and develop resistance to the drugs over time. "Much like antibiotic resistance, malaria resistance is an emerging crisis," Professor Cowman said. "Effective antimalarial drugs are not just critical for the infected individual, they are also critical for breaking the cycle of infection and an important way for us to reach our goal of eliminating malaria from highly endemic regions."

Once parasite resistance emerges, it can quickly spread through a region, or even globally. "In some areas, parasites are resistant to all three frontline malaria treatments. So novel drugs are urgently needed," he said.

In recent years, the focus of international efforts to develop new malaria drugs have centred on two criteria; they must target a novel process or pathway to avoid pre-existing resistance to current drugs; and they must be active at multiple stages of the parasite lifecycle.

Professor Cowman said WM382 successfully met both of these criteria. "An exciting feature of

WM382 is that it kills the malaria parasite in a very different way to current antimalarial drugs. In preclinical testing, malaria parasites that were resistant to the lethal effects of current antimalarial drugs were fully susceptible to WM382. It was also very difficult to induce resistance to this compound in malaria parasites in the lab. This is uncommon in drug discovery, and is a positive sign, as it suggests it will be harder for malaria parasites to acquire resistance in the field," Professor Cowman said.

**Combatting malaria**

More than 600,000 people—predominantly pregnant women and children under the age of five—die from malaria every year. According to the World Health Organization, one child in Africa continues to die from malaria every two minutes.

The malaria parasite has a complex lifecycle. Humans are infected by the bite of an infected mosquito. The parasites migrate to the liver to grow and divide undetected. It is then released into the blood, where it can be transmitted back to a mosquito and passed on to their next victim.

Professor Cowman said WM382 targeted two crucial enzymes in the malaria parasite, blocking their function and killing the parasite. "This compound has a two-pronged approach to disable the parasite, which helps explain its potency and effectiveness," Professor Cowman said. "It targets plasmepsin IX (PMIX) and plasmepsin X (PMX), two 'master regulators' that are critical for parasite survival. PMIX and PMX are involved in multiple stages of the parasite lifecycle and, because the compound hits both these targets, it is harder for parasites to develop resistance."

(Source : https://www.sciencedaily.com/releases/2020/03/200304141514.htm)

## 'SMART WATER' MAY AID OIL RECOVERY

Rice engineers survey crude variety to see how water can maximize reservoir production. Now there's evidence that oil and water do mix, sort of.

Scientists at Rice University's Brown School of Engineering show that microscopic saltwater droplets emulsify crude oil when each has the right composition. Understanding how they combine is important to enhanced oil recovery.

Rice chemical and biological engineer Sibani Lisa Biswal and her colleagues went to great lengths to characterize the three elements most important to oil recovery : rock, water and the crude itself.

They confirmed wells are more productive when water with the right salt concentration is carefully matched to both the oil and the rock, carbonate or sandstone formation. If the low-salinity brine can create emulsion droplets in a specific crude, the brine appears to also alter the wettability of the rock. The wettability determines how easily the rock will release oil.

The team's work appears in the open-access Nature journal *Scientific Reports*, 2020; 10 (1) DOI: 10.1038/s41598-020-60106-2

Co-lead author Jin Song said the first hints of seawater's effect came from wells in the North Sea. "Oil companies found that when they injected seawater, which has relatively low salinity, oil recovery was surprisingly good," he said.

Even with that understanding, he said research has been limited. "Usually in the oil and gas industry, when they're looking into low-salinity water, they tend to focus on the effect of the brine and ignore the effect of the oil," said Song, who earned his Ph.D. at Rice this year and is now a researcher at Shell." So people haven't been able to find a good

indicator or any correlation between the effectiveness of low-salinity water and experimental conditions," he said. "Our work is the first to identify some of the properties of the oil that indicate how effective this technique can be in a specific field."

The team tested how injected brine is dispersed and how it affects oils' interfacial tension and electrostatic interactions with rock. "How to characterize wettability accurately is a challenge," Biswal said. "Oftentimes, we assume that reservoir rock underground are under a mixed-wet state, with regions that are oil-wet and regions that are water-wet." If you can alter your oil-wet sites to water-wet sites, then there's less of a driving force to hold the oil to the mineral surface," she said. "In low-salinity water injection, the brine is able to displace the trapped oil. As you change from oil-wet to water-wet, the oil is released from the mineral surface."

The researchers tested two brines, one high-salinity and one with a quarter of the salinity of seawater, on Indiana limestone cores against six crude oils from the Gulf of Mexico, Southeast Asia and the Middle East and a seventh oil with added asphaltene. They found that high-salinity brine clearly inhibited water droplets from emulsifying in crude, unlike the low-salinity samples.

To better understand the thermodynamic nature of the emulsion, Rice research scientist Wenhua Guo took cryogenic electron microscope images of about 100 mixtures of oil and water. Because oil is opaque, the samples had to be placed in very thin containers, and then frozen with liquid nitrogen to keep them stable for imaging. "This is the first time anyone has seen these water droplets inside crude oil," Biswal said. "They spontaneously arise inside the crude oil when you expose it to a low-salinity brine."

The images revealed droplets varying in size from 70 to just over 700 nanometers. Biswal said chemical surfactants—aka soap—are also good at loosening oil in a reservoir, but are prohibitively expensive. "You can change the salt concentration to modify the composition of the brine and get the same effect as in including the detergent," she said. "So it's basically a low-cost technique trying to achieve the same goal as detergent."

(https://www.sciencedaily.com/releases/2020/03/200302153556.htm)

# भारतीय विज्ञान कांग्रेस संस्था

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## सदस्यता की शर्तें और सदस्यों की विशेषाधिकार :

संस्था की सदस्यता उन सभी लोगों के लिए खुली हैं, जो स्नातक या उसके समान स्तर पर शैक्षणिक योग्यता अर्जन कर चुके हैं, और जिन्हें भारत में विज्ञान की तरक्की में रूचि हैं।

1. **वार्षिक सदस्य :** जो व्यक्ति नये रूप से वार्षिक सदस्यता ग्रहण करना चाहता है उसे वार्षिक सदस्यता शुल्क ₹ 200/- के साथ भर्ती शुल्क ₹ 50/-* (विदेशियों के लिए** U.S. $ 70) मात्र देने पड़ेंगे। वार्षिक सदस्यता शुल्क प्रत्येक वर्ष के 01 अप्रैल को देय हो जाएगा। जो भी 15 जुलाई के भीतर अपनी सदस्यता शुल्क नहीं अदा कर पाएगा वह उस साल के लिए अपनी वोट देने की क्षमता से वंचित हो जाएगा और/या वह उस वर्ष के लिए संस्था के कार्यालय को भी नियंत्रण नहीं कर पाएगा। वार्षिक सदस्य अपनी सदस्यता दोबारा अगले साल 15 जुलाई के भीतर बिना शुल्क दिए पुन: अपनी सदस्यता प्राप्त कर सकता हैं।

   सदस्यगण अपना पेपर कांग्रेस सत्र के समय पेश कर सकते हैं। उन्हें वार्षिक विज्ञान कांग्रेस सत्र की कार्यविवरण की एक प्रति बिना मूल्य में प्राप्त हो सकती है। इसके साथ वे संस्था के रोज़नामचा ''एवरीमैन्स साइंस'' की प्रति भी बिना मूल्य उस साल के लिए प्राप्त कर सकते हैं। सदस्यता के नवीकरण के लिए कृपया ISCA वेबसाइट से फार्म डाउनलोड करें।

2. **सत्र सदस्य :** यदि कुछ कारणों से वार्षिक सदस्य अपनी सदस्यता उस वर्ष के 15 जुलाई के अंदर दोहराना भूल जाएँ, तो उनकी सदस्यता, सत्र सदस्यता के रूप में बिना वोट डालने की क्षमता में सीमित कर दिया जाएगा। सत्र सदस्यको ₹ 200/- (विदेशियों के लिए $ 50) अदा करना पड़ेगा। एक सत्र सदस्य को लेख/पोस्टर प्रस्तुतीकरण का अधिकार प्राप्त होगा जिस कांग्रेस सत्र का वह सदस्य हैं। एक सत्र सदस्य वोट प्रक्रिया में भाग लेने के योग्य नहीं हैं। सत्र सदस्य को विभागों के व्यवसाय बैठकों और साधारण बैठकों में भाग लेने की योग्यता प्राप्त नहीं हैं।

3. **छात्र सदस्य :** जो व्यक्ति स्नातक स्तर से नीचे पढ़ाई कर रहा हैं, उसे वार्षिक सदस्यता शुल्क ₹ 100/- मात्र देने पड़ेंगे अपना नाम छात्र सदस्य के रूप में लिखवाने के लिए, बशर्ते उसके आवेदन पत्र पर उसके प्राचार्य/विभागाध्यक्ष/संस्थान के प्रधान के हस्ताक्षर हों। एक छात्र सदस्य को यह अधिकार दिया जाएगा, कि वह अपना पेपर कांग्रेस सत्र के समय पेश कर सकें, बशर्ते वह पेपर वह किसी वार्षिक सदस्य या संस्था के कोई अवैतनिक सदस्य के साथ पेश करें। उसे वोट करने का या कार्यालय को नियंत्रण करने का अधिकार प्राप्त नहीं होगा। छात्र सदस्य को विभागों के व्यवसाय बैठकों में भाग लेने की योग्यता प्राप्त नहीं हैं।

4. **आजीवन सदस्य :** एक सदस्य अपने भविष्य की सारी वार्षिक सदस्यता शुल्क एक बार में ₹ 2,000/- (विदेशियों के लिए U.S. $ 500) मात्र अदा करके पा सकता हैं। एक व्यक्ति जो 10 साल या उससे अधिक नियमित रूप से सदस्यता प्राप्त कर चुका है, उसे उसकी संयुक्त सदस्यता शुल्क के ऊपर प्रतिवर्ष ₹ 50/- की छूट दी जाएगी, बशर्ते कि उसकी संयुक्त शुल्क ₹ 1,200/- से नीचे न हों (विदेशियों के लिए U.S. $ 12.50 और U.S. $ 300 क्रमश:)। एक आजीवन सदस्य को उसके पूरे जीवन काल में सदस्यता की सारे विशेषाधिकार प्राप्त होंगे।

5. **संस्थान सदस्य :** एक संस्थान जो ₹ 5,000/- सदस्यता शुल्क के रूप में दे वही संस्था के संस्थान सदस्य उस वित्तीय वर्ष के लिए बन सकता है, (विदेशियों के लिए U.S. $ 2,500)। इसमें वह विज्ञान कांग्रेस के वार्षिक सत्र में अपने एक व्यक्ति का नाम नामांकित कर सकता हैं, जो उनका प्रतिनिधि हों। एक संस्थान सदस्य को वार्षिक विज्ञान कांग्रेस सत्र की कार्यविवरण की एक पूर्ण प्रति बिना मूल्य में प्राप्त हो सकती है। इससे साथ वे संस्था के रोज़नामचा ''एवरीमैन्स साइंस'' की प्रति भी बिना मूल्य प्राप्त कर सकते हैं।

6. **दाता :** कोई भी व्यक्ति जो एकसाथ ₹ 10,000/- (विदेशियों के लिए U.S. $ 5,000) मात्र दें, वह संस्था के दाता बन सकते हैं। एक व्यक्तिगत दाता को वह सारे अधिकार और विशेषाधिकार मिलेंगे जो एक सदस्य को उसके पूर्ण जीवन काल में प्राप्त होते हैं।

   एक संस्थान जो एकसाथ ₹ 50,000/- (विदेशियों के लिए U.S. $ 25,000) मात्र दें, सदा के लिए इस संस्था के संस्थान दाता बन सकते है, जिसे वह एक व्यक्ति को नामांकित करके उसे अपने संस्थान के प्रतिनिधि के रूप में विज्ञान कांग्रेस के वार्षिक सत्र में भेज सकते हैं। एक संस्थान/व्यक्तिगत दाता वार्षिक विज्ञान कांग्रेस के कार्यविवरण और संस्था के रोज़नामचा ''एवरीमैन्स साइंस'' की प्रति भी विना मूल्य प्राप्त कर सकते हैं।

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* भर्ती शुल्क ₹ 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रुरी है। यह सत्र सदस्य/आजीवन सदस्य/संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रुरी नहीं है।

** (एक विदेशी सदस्य का अर्थ हैं, जो भारतवर्ष के बाहर का नागरिक हों।)

(अ) **पेपर पेश करना :** एक पूर्ण पेपर की प्रति उसके साथ तीन सारांश की प्रति जो 100 शब्दों से ज्यादा न हों और ज़िसमें कोई आरेख या फार्मूला न हों, वह प्रत्येक वर्ष 15 सितम्बर के अंदर अनुभागीय अध्यक्ष तक पहुँच जाना चाहिए।

(ब) सभी वर्गों के सदस्य जो विज्ञान कांग्रेस सत्र में भाग लेने के पश्चात लौटते समय के टिकट में रियायत प्राप्त कर सकता है, बशर्ते कि उनकी यात्रा के खर्च का थोड़ा भी भाग सरकार (केन्द्रीय या राज्य), कोई कानूनी सत्ता या कोई विश्वविद्यालय या कोई नगरपालिका न उठाएँ और उनकी कुल कमाई या परिलब्धियां ₹ 5,000/- (प्रति माह पाँच हजार रुपए) से अधिक नहीं हैं। कृपया ISCA वेबसाइट से रेलवे रियायत फार्म डाउनलोड करें।

(स) संस्था के पुस्तकालय में सभी वर्गों के सदस्य को पढ़ने की सुविधा सुबह 10.00 बजे से शाम को 5.30 बजे तक सभी काम के दिनों में (शनिवार और रविवार) को छोड़कर प्राप्त होगी।

(ड) समय समय पर संस्था द्वारा तय की गई मूल्य दरों पर विश्रामगृह, सभागार आदि सुविधाओं की प्राप्ति भी सभी वर्गों के सदस्य कर सकते हैं।

(ई) भविष्य में भारतीय विज्ञान कांग्रेस संस्था द्वारा आयोजित परिसंवाद, सम्मेलन और वार्षिक कांग्रेस में सभीवर्गों के सदस्यों द्वारा भाग लेने के लिए अपनी—अपनी सदस्यता पत्र को लाना ज़रुरी होगा।

**ध्यान दें :** (1) सभी बैंक ड्राफ्ट The Indian Science Congress Association के नाम से ही लिखा जाएँ, सदस्यता के विषय में बैंक ड्राफ्ट की प्राप्ति और जो कोलकाता के किसी भी शाखा में देय हों। सदस्यों से यह निवेदन किया जा रहा है, कि वे अपनी सदस्यता संख्या का उल्लेख भारतीय विज्ञान कांग्रेस संस्था के कार्यालय के साथ पत्राचार के वक्त अवश्य करें।

(2) भारतीय विज्ञान कांग्रेस संस्था द्वारा मनीऑर्डर, आई. पी. ओ., ई. सी. एस. या चेक से भुगतान ग्रहण नहीं किया जाएगा। कोई भी सदस्यता निर्धारित सदस्यता फार्म (आवेदन-पत्र नई सदस्यता/सदस्यता की नवीकरण के लिए) में विधिवत बिना भरने से नहीं लिया जाएगा।

(3) नकदी केवल ISCA मुख्यालय में हाथ से लिया जाएगा। कृपया डाक द्वारा लिफाफे के भीतर नकदी नहीं भेजें।

# THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, Dr. Biresh Guha Street, Kolkata-700 017, INDIA

Telephone : (033) 2287-4530, 2281-5323
Fax : 91-33-2287-2551
Website : http://sciencecongress.nic.in
E-mail : es.sciencecongress@nic.in


## Terms of Membership and Privileges of Members :

Membership of the Association is open to person with Graduate or equivalent Academic Qualifications and interested in the advancement of Science in India.

1. **Annual Member :** A person willing to be enrolled as new Annual Member has to pay an annual subscription of ₹ 200/- along with an admission fee of ₹ 50/-* (for foreign** U.S.$ 70) only. The annual subscription of a Member shall become due on the 1st April of each year. Anyone who fails to pay the subscription on or before the 15th July in any year shall lose the right of voting and/or holding any office of the Association for that year. A member failing to pay the annual subscription by the end of March of the following year shall cease to be a Member. Annual members can renew their Membership without paying the admission fee in the next year by remitting subscriptions in time i.e. within 15th July. Members may contribute papers for presentation at the Science Congress. They will receive, free of cost, reprints of the Proceedings of the Session of any one section of their interest and also the bi-monthly journal of the Association Everymans Science for that year only. For Renewal of Membership please download the form from ISCA website.
2. **Sessional Member :** If for some reasons, Annual Members fail to renew their Membership by remitting subscription prior to 15th July each year, their Membership for the year would be restricted to Sessional Membership without voting right. Sessional Member has to pay ₹ 200/- (for foreign $50). A Sessional Member shall have the right to present paper/poster at the session of the congress of which he/she is a member. A Sessional Member shall not be eligible to participate in the voting process. A Sessional member shall not be eligible to participate in the Business meetings of the Sections and the General Body.
3. **Student Member :** A person studying at the under-graduate level may be enrolled as a Student Member by paying an annual subscription of ₹ 100/- **only provided his/her application is duly certified by the Principal/Head of the Institution/Department.** A student member shall have the right to submit papers for presentation at the Session of the Congress of which he/she is a member, provided such papers be communicated through a Member, or an Honorary Member of the Association. He/She shall not have the right to vote or to hold any office. A student member shall not be eligible to participate in the Business Meetings of the Sections and the General Body.
4. **Life Member :** A Member may compound all future annual subscriptions by paying a single sum of ₹ 2,000/- (for foreign** U.S. $ 500) only. Any person who has been continuously a member for 10 years or more, shall be allowed a reduction in the compounding fee of ₹ 50/- for every year of such membership, provided that the compounding fee shall not be less than ₹ 1,200/- (for foreign** U.S. $ 12.50 and U.S. $ 300 respectively). A life Member shall have all the privileges of a member during his/her lifetime.

5. **Institutional Member :** An Institution paying a subscription of ₹ 5,000/- (for foreign** U.S. $ 2,500) only, can become an Institutional Member of the Association for that financial year. It shall be eligible to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional Member shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also a copy each of the Associations journal Everymans Science.
6. **Donor :** Any person paying a lump sum of ₹ 10,000/- (for foreign** U.S. $ 5,000) only, can become an Individual Donar of the Association, an ***INDIVIDUAL DONOR*** shall have all the rights and privileges of a member during his/her lifetime.

   An Institution paying a lump of ₹ 50,000/- (for foreign** U.S. $ 25,000) only, can become an ***INSTITUTIONAL DONOR*** of the Association forever, which shall have the right to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional/ Individual Donor shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also the Associations journal Everymans Science.

* *Admission fee of ₹ 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.*

** *(A Foreign Member means one who is normally Resident outside India).*

(A) **Presentation of Papers :** A copy of complete paper accompanied by an abstract in triplicate not exceeding one hundred words and not containing any diagram or formula, must reach the Sectional President latest by September 15, each year.

(B) Members of all categories are entitled to **Railway Concession** of return ticket by the same route with such conditions as may be laid down by the Railway Board for travel to attend the Science Congress Session provided that their travelling expenses are not borne, even partly, by the Government (Central or State), Statutory Authority or an University or a City Corporation and their total earning of or emoluments drawn do not exceed ₹ 5,000/- (Rupees Five Thousand per month). Please download the Railway Concession form from ISCA Website.

(C) Members of all categories are entitled to reading facilities between 10.00 a.m. to 5.30 p.m. on all weekdays (except Saturdays & Sundays) in the library of the Association.

(D) Members of all categories may avail Guest House facilities, Lecture Hall hiring at the rates fixed by the Association from time to time.

(E) Members of all categories should bring the Membership Card always for attending any Seminar, Conference and Annual Congress organized by ISCA in future.

**Note :** (1) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association,* membership subject to realisation of the bank draft, Payable at any branch in Kolkata. Members are requested to mention their Membership No. while making any correspondence to ISCA office.

(2) No money order, I.P.O., ECS or cheque will be accepted by ISCA. No Membership will be taken without duly filled in prescribed Membership Form (Application From for New Membership/ Application for Renewal of Membership).

(3) Cash will only be taken by hand at ISCA Hqrs. Pl. do not send the Cash by Post within the envelop.

# भारतीय विज्ञान कांग्रेस संस्था

14, डॉ० बिरेश गुहा स्ट्रीट, कोलकाता–700 017, भारत

दूरभाष : (033) 2287-4530, 2281-5323
फैक्स : 91-33-2287-2551
वेबसाइट : http://sciencecongress.nic.in
ई–मेल : es.sciencecongress@nic.in

## सदस्यता के लिए नया आवेदन पत्र

सेवा में

महासचिव (सदस्यता कार्य)
भारतीय विज्ञान कांग्रेस संस्था
14, डॉ० बिरेश गुहा स्ट्रीट,
कोलकाता–700 017

स्टैम्प आकार का फोटो

महोदय,

मैं भारतीय विज्ञान कांग्रेस संस्था का आजीवन सदस्य/वार्षिक सदस्य/सत्र सदस्य/छात्र सदस्य/संस्थान सदस्य/व्यक्तिगत दाता/संस्थागत दाता अपना नाम लिखवाना चाहता/चाहती हूँ।

मैं इसके साथ ——————— सदस्यता शुल्क के रूप में नक़द ₹ ———————/बैंक ड्राफ्ट संख्या ——————— दिनांकित ——————— प्रचालक बैंक ——————— 01 अप्रैल 20—— से 31 मार्च 20—— तक भेज रहा/रही हूँ।

मैं निम्नलिखित विभाग में रुचि रखता/रखती हूँ (कृपया किसी एक में निशान लगाएँ)।

**विभाग**

1. कृषि और वानिकी विज्ञान
2. पशु, पशुचिकित्सा और मत्स्य विज्ञान
3. मानवशास्त्रीय और व्यवहारपरक विज्ञान (जिसमें सम्मिलित, हैं, पुरातत्व–विज्ञान, मनोविज्ञान, शैक्षिक विज्ञान और सेना विज्ञान)
4. रसायन विज्ञान
5. भू–पद्धति विज्ञान
6. अभियन्ता विज्ञान
7. पर्यावरण विज्ञान
8. सूचना और संचारण विज्ञान और प्रौद्योगिकी (जिसमें कंप्यूटर विज्ञान भी सम्मिलित है)
9. भौतिक विज्ञान
10. गणित विज्ञान (जिसमें सांख्यिकीय सम्मिलित है)
11. चिकित्सा शास्त्र (जिसमें शरीर विज्ञान भी सम्मिलित है)
12. नया जीवविज्ञान (जिसमें जीव रसायन, जीव भौतिकी और आणविक जीवविज्ञान और जीव–प्रौद्योगिकी भी सम्मिलित है)

13. भौतिकीय विज्ञान
14. वनस्पति विज्ञान

(कृपया टंकित करें या ब्लॉक अक्षरों में भरें)

नाम (ब्लॉक अक्षरों में) :

श्री/सुश्री/श्री/श्रीमती/डॉ०/प्रो० (कृपया टिक करें)

कुलनाम प्रथम नाम मध्य नाम

शैक्षणिक योग्यता :

(अंतिम शैक्षणिक योग्यता प्रमाण-पत्र अंक-सूची का स्वत:सत्यापित जिराक्स प्रति संलग्न करना है)

पदनाम

सम्पर्क का पता :

(राज्य, शहर/नगर और पिन कोड सहित)

दूरभाष संख्या/मोबाईल संख्या और ई-मेल :

किसी भी सरकारी अनुमोदित पहचान पत्र (अनिवार्य) :

वर्तमान वर्ष विश्वविद्यालय प्रवेश-पत्र :

स्थायी पता :

दिनांक : भवदीव

हस्ताक्षर

**ध्यान दें :** (i) सभी बैंक ड्राफ्ट The Indian Science Congress Association के नाम से ही लिखा जाएँ, सदस्यता के विषय में बैंक ड्राफ्ट प्राप्ति और जो कोलकाता के किसी भी शाखा में देय हों।

(ii) सभी सदस्यता और सदस्यता के नवीकरण के लिए आवेदन-पत्र आवेदकों को अपने खुद के पते उपलब्ध कराके करने चाहिए न कि देखभाल के पते प्रस्तुत करने चाहिए।

(iii) भर्ती शुल्क ₹ 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रुरी है। वह सदस्य/आजीवन सदस्य/संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रुरी नहीं है।

(iv) सदस्यों से यह निवेदन किवा जा रहा है कि वे अपनी सदस्यता संख्या का उल्लेख भारतीय विज्ञान कांग्रेस संस्था के कार्यालय के साथ पत्राचार के समय अवश्य करें।

(v) भारतीय विज्ञान कांग्रेस संस्था द्वारा मनीऑर्डर, आई. पी. ओ., ई. सी. एस. या चेक से भुगतान ग्रहण नहीं किया जाएगा।

(vi) कोई भी सदस्यता निर्धारित सदस्यता फार्म (आवेदन-पत्र नई सदस्यता/सदस्यता की नवीकरण के लिए) में विधिवत बिना भरने से नहीं लिया जाएगा।

(vii) नकदी केवल ISCA मुख्यालय में हाथ से लिया जाएगा। कृपया डाक द्वारा लिफाफे के भीतर नकदी नहीं भेजें।

# THE INDIAN SCIENCE CONGRESS ASSOCIATION

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Fax : 91-33-2287-2551
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E-mail : es.sciencecongress@nic.in


## Application Form For New Membership

To

The General Secretary (Membership Affairs)
The Indian Science Congress Association
14, Dr. Biresh Guha Street,
Kolkata-700 017

Stamp Size Photograph

Dear Sir,

I like to be enrolled as a Life Member/Annual Member/Sessional Member/Student Member/Institutional Member/Individual Donor/Institutional Donor of The Indian Science Congress Association. (Pl. Tick)

I am sending herewith an amount of ₹ ..... in payment of my subscription by Cash/Bank Draft No. .....dated ..... issuing bank ..... from the year 1st April 20..... to 31st March 20..... .

I am interested in the following section (Please tick any one).

**Sections**

1. Agriculture and Forestry Sciences
2. Animal, Veterinary and Fishery Sciences
3. Anthropological and Behavioural Sciences (including Archaeology, Psychology, Education and Military Sciences)
4. Chemical Sciences
5. Earth System Sciences
6. Engineering Sciences
7. Environmental Sciences
8. Information and Communication Science & Technology (including Computer Sciences)
9. Materials Science
10. Mathematical Sciences (including Statistics)
11. Medical Sciences (including Physiology)
12. New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology)

13. Physical Sciences

14. Plant Sciences

( Please type or fill up in Block Letters)

Name (in Block Letters) :

Mr./Ms./Shri/Shrimati/Dr./Prof. (Please tick)

Surname First Name Middle Name

Academic Qualifications :

Self attested xerox copy of last educational certificate/marksheet must be attached)

Designation

Address of communication :

( including state, city/town and pin code)

Phone No./Mobile Number & E-mail :

Any Govt. approved ID Card (Mandatory) :

Current Year University Admit Card :

Permanent Address :

Date : Yours Faithfully

Signature

**Note :**

(i) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association,* membership subject to realisation of the bank draft, Payable at any branch in Kolkata.

(ii) All Application Forms for Membership and the renewal of Membership must be submitted by providing the address of the applicants themselves only and not any care of address.

(iii) Admission fess of ₹ 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.

(iv) Members are requested to mention their Membership No. while making any correspondence to ISCA office.

(v) No Money Order, I.P.O., ECS or Cheque will be accepted by ISCA.

(vi) No Membership will be taken without duly filled in prescribed Membership Form (Application Form for New Membership/Application For Renewal of Membership).

(vii) Cash will only be taken by hand at ISCA Hqrs. Pl. do not send the cash by Post within the envelope.

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## REMINDER

TO
ALL ANNUAL MEMBERS (2019-20)

## RENEWAL OF ANNUAL MEMBERSHIP SUBSCRIPTION FOR 2020-2021

Dear Sir/Madam,

1. Kindly fill up the renewal form given on the opposite page and remit ₹ 200/- by Bank Draft on a Kolkata Bank in favour of "The Indian Science Congress Association" to renew your membership for 2020-2021. No Cheque, Postal order or Money order will be accepted by ISCA.
2. For exercising **Voting Right** the enrolment of Annual Membership is required to be made by **July 15, 2020**. Subscription received after July 15, 2020 will be treated as Sessional Member.
3. Last date of receiving **full papers along with 3 copies of Abstracts** for presentation at the **108th Session of Indian Science Congress** to be held from 3-7 January, 2021 is **September 15, 2020.**
4. As per the resolution of the **Executive Committee** in its meeting held on **October 15, 2011,** all Application forms for Membership and the renewal of membership must be submitted by providing the address of the applicants themselves only and not any 'Care of Address'.
5. While sending your subscription, **Please quote your last year (i.e. 2019-2020 only) Annual membership number.**

   *If your subscription is already remitted, please ignore this letter.*

Yours faithfully

**Dr. S. Ramakrishna**
General Secretary
(Membership Affairs)

**N.B. :** Sending of membership subscription without the duly filled in renewal form will not be accepted.

# The Indian Science Congress Association

**14, Dr. Biresh Guha Street,**
**Kolkata- 700 017**

Telephone : (033) 2287-4530 / 2281-5323
Website : http:/sciencecongress.nic.in

Fax : 091-33-2287-2551
E-mail : es.sciencecongress@nic.in


Dated :———————

**APPLICATION FOR RENEWAL OF ANNUAL MEMBERSHIP SUBSCRIPTION FOR 2020-2021**

Annual Membership Number :
(Last Year i.e. 2019-2020 only)

Name : Middle Name : Surname :

Affiliation :

Present Address (only for persons changing the address)

*If there is any change in the address as given earlier in your application, please state the original address mentioned previously.

Original Address :

+Enclosed Bank draft No. ..... dt. ..... of ₹ 200 (two hundred only)

Signature of the Applicant

Date : _____ Contact No : _____

+in favour of *"The Indian Science Congress Association"* payable at any branch of Bank in Kolkata.

# *GUIDELINES FOR SUBMISSION OF MANUSCRIPTS*

1. Everymans's Science intends to Propagate the *latest message of science* in all its varied branches to its readers and through them, to every one interested in Science or Engineering or Technology. *Research articles* usually meant for publication in periodicals devoated to particular branches of Science & Technology and addressed to specialised sections of the readers, are not appropriate for Everyman's Science. Instead, popular or easily intellegible expositions of new or recent developments in different branches of Science & Technology are welcome.

2. Manuscripts should be typewritten on one side of the paper with double spacing. Articles should be written generally in non-technical language and should not ordinarily *exceed 2000 words*. Articles must be understandable by the average enthusiastic readers with some modest scientific background but outside the field. It should not be a review article in a specialised area. Without being too technical, it must also reflect state of the art situation in the field. *A summary* in 50 words should be submitted along with the paper highlighting the importance of the work. *Two copies* of the manuscript complete in all respects should be submitted. The title should be written in capital letters and name(s) of the author(s) should be given along with the Department, Institution, City and Country of each author.

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# THE INDIAN SCIENCE CONGRESS ASSOCIATION

## 14. Dr. Biresh Guha Street, Kolkata-700 017

## ISCA Best Poster Awards Programme : 2020-2021

To encourage Scientists, The Indian Science Congress Association has instituted two Best Poster Awards in each Sections. These awards carry a sum of Rs. 5,000/- besides a Certificate of Merit.

1. Applications are invited from members **(Life, Annual & Student)** of the Association who have paid their subscription on or before **July 15, 2020.**
2. Four copies of full length paper along with four copies of the abstract (not exceeding 100 words) must reach the office of the General Secretary (Membership Affairs) not later than **September 15, 2020**. At the top of each copy of the paper and its abstract, the name of the Section under which the paper is to be considered should be indicated. For details of Sections see http://www.sciencecongress.nic.in/html/paper_presentations.php
3. Along with the Four copies of paper, Four copies of the Application Form (to be downloaded from ISCA website http://www.sciencecongress.nic.in/best_poster_awards.php ) with brief bio-data of the candidate (not exceeding 2 pages), full length paper and abstract in the form of a CD must also be sent simultaneously along with the hard copies. **(In MS Word, NOT PDF format).**
4. The number of authors of each poster submitted for the award shall be limited to two only. **The first author of the poster shall be the presenting author. Both the authors should be the members of the Association and have paid their subscription on or before 15th July, 2020.**
5. The research work should have been carried out in India and this has to be certified by the Head of the Institution from where the candidate is applying.
6. The candidate should give an undertaking that the paper being submitted has not been published in any journal or presented in any other Conference / Seminar / Symposium or submitted for consideration of any award.
7. A scientist shall submit only one poster in any one Section (and not a second poster on the same or any other topic in any other Section) for consideration for poster presentation award.
8. A person who has already received ISCA Best Poster Award in any section once will not be eligible to apply for the above Award in the same or any other section.
9. Incomplete Applications will not be considered.
10. Full length papers will be evaluated by experts and maximum twenty posters in each section will be selected for presentation during 108th Indian Science Congress.
11. The final selection for the Awards will be made by a duly constituted committee and the awards will be given during the Valedictory Session of 108th Indian Science Congress session on **January 7, 2021**.
12. Applications submitted for the above award will not be returned.
13. The last date for receiving applications for the above award at ISCA Headquarters is **September 15, 2020**.

**All correspondences should be made to:** The General Secretary (Membership Affairs), The Indian Science Congress Association, 14, Dr. Biresh Guha Street, Kolkata-700017. Tel. Nos. (033) 2287-4530/2281-5323, Fax No.91-33-2287-2551,
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