



# MANTHAN

International Journal of Scientific Research and Innovation

Published Quarterly by B.Brains Scholastic Center (Under BBrains Development Society)

APRIL 2012

[www.bbmanthan.info](http://www.bbmanthan.info)



## *Special Issue* *4th Bihar Science Conference 2011*





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**Manthan** is an International Journal of Scientific research and innovation published quarterly by B. Brains Scholastic Center (under BBrains Development Society), "A Gyan Kendra" under guidance of Global Scientific Council of the society with the objectives of sharing ideas, innovation, knowledge and achievements which can be benefited to the scientific and non-scientific community.

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## From Editors desk

BBrains Scholastic Center (under BBrains Development Society) organized Fourth International Conference on Science & Technology "Fourth Bihar Science Conference 2011 (BSC 2011)" in association with BRA Bihar University at its LS College, Muzaffarpur (India) from Feb 11 to 13, 2011. The theme of the conference was "Developing attitude of product development and transforming ideas into implementation". On this occasion, around 600 delegates and eminent scientists of from various universities were participated. The highlight of this conference was the inauguration and keynote lecture by Dr. R. K. Pachauri, Director General of TERI and Chairman of IPCC who got Nobel Peace Prize in 2007.

The universities who participated this year are Thammasat University (Thailand), Isik University (Turkey), university of Puebla (Mexico), King Saud University (Riyadh), Massetues Institute of Technology (USA), Chevron (USA), National Polytechnic Institute, (Mexico), CINVESTAV (Mexico), DRDO (Delhi), IIT (Patna), IIT (Delhi), IIT (Kanpur), University of Hyderabad (Hyderabad), Aligarh Muslim University (Aligarh), Gautam Budha university (NOIDA), CFRI (Mumbai), Indian Institute of Packaging (Hyderabad), NIT (Patna), Tata Institute of Fundamental Research (Mumbai), West Bengal University of Science & Technology and all Bihar and Jharkhand based universities etc.

This conference has become forum to help and support research activities of the colleges and universities of Bihar. Since the start of the conference, the research quality and working style of the local scientists has visibly improved.

This SPECIAL 13th Issue of **Manthan** is the supplement of BSC 2011 which covers selected full length papers/ articles of delegates, keynote speakers and young scientist awardees of the said conference. This issue also includes two recent research articles. All the articles in this issue of Manthan is peer reviewed before acceptance.

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**Bibhuti Bikramaditya**  
Chief Editor

## A floristic reconnaissance of Churdhar wildlife sanctuary of Himachal Pradesh, India

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### Abstract

Present study is an outcome of the floristic study carried out at Churdhar Wildlife Sanctuary, Himachal Pradesh of India. The survey was conducted in order to discover and document sensitive or special interest vascular plant species to help managing the sensitive plant resources. A list of botanically important plants is being given here along with the details on their medicinal and other economic values. Besides, indicator taxa, floristic records, affinities with Chinese and Korean flora and conservation status are also briefly discussed.

**Key words:** Flora, Churdhar Wildlife Sanctuary, Endemism, Phyto-geographical affinities.

### Introduction

The Himalayan region in India is stretched from Jammu and Kashmir to the northeast corners of Arunachal Pradesh and has always been a centre of attraction for the botanists. With a varied ecological climate and diverse flora and fauna, it is a home for a number of threatened and endemic taxa. Botanists from across the world are attracted by the places like Himachal Pradesh, Uttarakhand, Sikkim, Assam, West Bengal and Arunachal Pradesh. The diversity of climate, altitude, rainfall and soil conditions generates a variety of unique plant communities or eco-regions. This can be seen in the vegetation from the foothills of southern section to the cold deserts of the northern part. The Indian Red Data Book [14] has listed 619 species of vascular plants as threatened in Indian territories and out of them 137 species belongs to the Himalayan region. In view of protecting this natural heritage, a number of Wildlife Sanctuaries and Biosphere Reserves have been established in all parts of India including the Himalayas. At present there are five biosphere reserves, 28 national parks and 98 wildlife sanctuaries covering 51,889.238 sq. kms area [13]. Churdhar Wildlife Sanctuary is a recent addition to this chain which is nestled within the beautiful valley of Solan in the state of Himachal Pradesh and spread over in an area of 56.16 sq. kms. Geographically, it lies at 30° 52'N and 77° 32'E with varying elevations. The

sanctuary was named after the 'Chur' peak where a big statue of Lord Shiva is situated on the top. It is perched at an altitudinal range of ca. 1500-3647 meters and surrounds an area of 5616 hectares with a thick forest cover sheltering a number of threatened flora and fauna. The peak of Churdhar is known to be the highest peak of the outer range of the Himalaya. The climate of this area exhibits considerable variations at different elevations and exposures. January is the coldest month with around 5°C and June as the warmest month with around 19°C. Snowfall is also observed infrequently during the month of December whereas during the months of June to September it receives heavy rainfall with an average of 1320 mm. Mean relative humidity round the year ranges from 15 % to 86%.

The history of Botanical explorations in this region dates back to the year 1848 when several workers including Hooker [11] made their collections from some remote localities of this area. However, the earliest noteworthy collections made by the Countess of Dalhousie from Shimla and surrounding areas can also be mentioned. Later on, some botanists like William Munro (1818-1880), Madden (1840), Strachey & Winterbloom (1846-1849), Arnott Walker (1779-1868), Edgeworth (1812-1881), Griffith (1810-1845), Jacquemont (1801-1832) and Thomson (1819-1878) explored the area and most of the collections are housed in the National Herbarium at Kew. A perusal of the herbarium collections housed at herbarium of Botanical Survey of India at Dehradun (BSD), India reveals further explorations by the botanists of Botanical Survey of India with report of many threatened and interesting plants from the area. Some other notable contributions are from Subramani and others [2, 10, 18].

### Materials and Methods

The plant specimens of Churdhar Wildlife sanctuary were thoroughly examined and identified using relevant references [4, 6, 8, 11, 15, 16, 23]. They were cross checked with the herbarium specimens housed at the herbarium of Botanical Survey of India, Dehradun

(BSD). The nomenclature given in latest taxonomic literatures [1, 17] and websites like Tropicos and IPNI were followed. Data on the medicinal use were collected following various literatures [3, 5, 7, 9, 12, 20, 21, 22].

## Results and Discussion

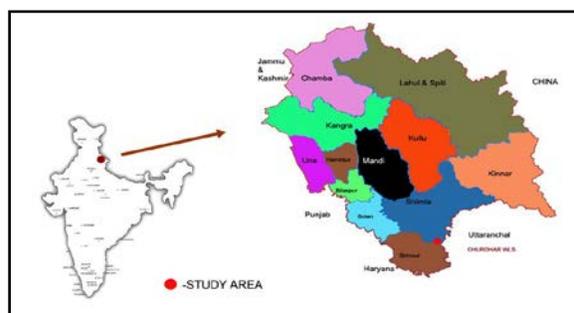
It is interesting to mention that the district of Shimla possess only two peaks with sub-alpine vegetation. One of them is *Chur* and another one is *Hatugarh*. The vegetation of Churdhar wildlife sanctuary is quite interesting with the occurrence of a number of threatened and endemic plants. The forests include Pine groves with Oak trees (*Quercus* sps.), *Castanopsis*, *Rhododendrons* etc. The occurrence of a few subtropical elements in the sub temperate mixed forest like *Aesculus indica*, *Alnus nepalensis*, *Berberis aristata*, *Indigofera exilis*, *Arisaema jacquemonti*, *Cissampelos pareira*, *Stephania japonica* etc. makes the flora interesting. Unlike deciduous forest the sub temperate deciduous coniferous forests exhibit a high degree of species diversity along with many shrubs, undershrubs and herbaceous species although there is no clear stratification of the forests. The number of monocotyledonous plants is quite high; though comparatively lesser than the dicotyledonous plants. The top five dominant families observed in the area are Poaceae, Leguminosae, Asteraceae, Lamiaceae and Rosaceae.

The vegetation of Churdhar Wildlife Sanctuary can be classified in four distinct type viz.: (A) Sub-tropical forests: at ca 1500-2000 msl (I) Sub-tropical mixed deciduous forests, (II) Sub-tropical mixed coniferous forests; (B) Sub-temperate forests: at ca 2000-3000msl; (C) Temperate to Sub-alpine forests: at ca 3000-3647 msl.

Some of the genera with a single species only observed from the area are *Drosera*, *Melastoma*, *Balanophora*, *Phytolacca*, *Styrax*, *Monotropa*, *Orobanchane* etc. While *Ranunculus*, *Rhododendron*, *Cyanoglossum*, *Silene*, *Polygonum*, *Impatiens*, *Habenaria*, *Pedicularis*, *Polygala* and *Viola* are among some of the genera represented with more than one species.

**Arboreal flora:** The tree flora of Churdhar wildlife Sanctuary is mostly dominated by a mixed population of Pines and Angiosperms. Some of the notable pines are *Pinus excelsa*, *P. longifolia*, *Cedrus deodara*, *Abies pindrow*, *Cupressus torulosa* etc. The angiosperms include trees of *Betula alnoides*, *Alnus nepalensis*, *Quercus diltata*, *Q. glauca*, *Q. incana*, *Litsea polyantha*, *Cinnamomum tamala*, *Oroxylum indicum*, *Cordia myxa*, *Juglans regia*, *Ficus semicordata*, *Ficus religiosa*, *Morus indica*, *Limonia acidissima*, *Aegle marmelos*, *Cedrella serrata*, *Cedrella toona*, *Rhus*

*chinensis*, *Euonymous hamiltonianus*, *Rhododendron arboreum* etc. Most of them are confined upto the lower elevations of the sanctuary and the canopies in the sanctuary characterize the successive zones. While moving towards the *Chur* peak, the habitat of *Pinus longifolia*, *P. excelsa*, *Cedrus deodara* and *Picea morinda* can be observed. Undoubtedly, conifers are the most prominent elements in each climatic belt of the sanctuary. They are very well stepped in different regions viz. *Pinus longifolia* from about 700 to 1500m, *Pinus excelsa* from about 1500 to 2200m, *Cedrus deodara* upto 2500m high. In the upper elevations, *Abies pindrow* with *Quercus semecarpifolia* can be seen. Besides, the occurrence of *Ilex dipyrena* and *Rhododendron arboreum* is quite common. Presence of trees like *Rhus chinensis* and *Toona ciliata* is the indicative of subtropical vegetation at lower altitudes.



**Shrubs and Undershrubs:** The area is also occupied with a variety of shrubs and undershrubs. *Indigofera atropurpurea*, *Bauhinia variegata*, *Rosa sericea*, *Rumex nepalensis*, *Swertia tetragona*, *Berberis aristata*, *Cotoneaster microphylla*, *Gaultheria trichophylla*, *Coriaria nepalensis*, *Salix elegans*, *Rubus ellipticus*, *R. niveus*, *Lonicera angustifolia*, *L. quinquelocularis*, *Viburnum cotinifolium*, *Desmodium tiliaefolium*, *Spiraea canescens*, *Elsholtzia polystachya*, *Buddleja paniculata* are common.

**Herbaceous flora:** Churdhar wildlife sanctuary harbors a very rich and interesting herbaceous flora. Many of them are typical representative of the Himalayas or confined to the Asian region. Some of them are *Micromeria biflora*, *Thymus serphyllum*, *Impatiens racemosa*, *Corydalis thyrsoflora*, *Polygonum amplexicaule*, *P. capitatum*, *P. posumbu*, *P. aviculare*, *P. effusum*, *P. nepalense*, *Bupleurum candollei*, *Roscoea purpurea*, *R. alpina*, *Aster thomsoni*, *Koenigia nepalensis*, *K. delicatula*, *Hedychium spicatum*, *Pilea umbrosa*, *Cautleya spicata*, *Begonia picta*, *Codonopsis viridis*, *Androsace sarmentosa*, *Cotoneaster microphyllus*, *Drosera peltata*, *Conyza aegyptiaca*, *Cirsium falconeri*, *Strobilanthes atropurpureus*, *Potentilla polyphylla*, *P. nepalensis*, *P. gerardiana*, *P. lineata*, *Euphorbia pilosa*, *Morina*

*longifolia*, *Prunella vulgaris*, *Arisaema jacquemontii*, *Cynoglossum amabile*, *C. officinale*, *Anaphalis margaritacea*, *Justicia simplex*, *Chirita bifolia*, *Silene inflata*, *S. setisperma*, *Gentiana argentea*, *Epilobium brevifolium*, *Anemone vitifolia*, *Thalictrum foliolosum*, *Ranunculus sceleratus*, *R. hirtellus*, *Delphinium denudatum*, *Pedicularis siphonantha*, *P. bicornuta*, *Hypericum cernuum*, *Rhodiola trifida*, *Commelina benghalensis*, *Rumex hastatus*, *R. acetosa*, *Cissampelos pareira* *Viola canescens* etc. In contrary to the eastern Himalayas, members of Orchidaceae and Melastomataceae are quite less in number. Orchidaceae is represented by a some terrestrial elements like *Epipactis helleborine*, *Habenaria pectinata*, *H. intermedia*, *Malaxis muscifera*, *Neottia listeroides*, *Peristylus elisabethae*, *Platanthera edgeworthii*, *Satyrium nepalense*, *Spiranthes sinensis* etc. We report here *Goodyera fusca* as a new record to the state of Himachal Pradesh. This taxon had earlier been reported from Eastern Himalaya and Uttarakhand state in India. Present report shows its extended distribution from Uttarakhand to Himachal Pradesh. Globally, it is distributed in Bhutan, China, Myanmar, Nepal and Tibet. Besides, *Arundinaria spathiflora* is also common in the subalpine zones. Many of the exotics like *Taraxacum officinale*, *Thymus serpyllum*, *Verbascum thapsus*, *Stellaria media*, *Cannabis sativa*, *Eupatorium odoratissimum*, *Ageratum conyzoides* also inhabit the area at lower elevations.

### Medicinal Plants

Churdhar Wildlife Sanctuary is full of medicinal plants along with a number of plants that could be of potential use for mankind. A list of medicinal plants observed in the WLS is being appended here along with their phenology and distribution details.

01. *Aegle marmelos* (L.) Correa  
Family: Rutaceae  
Phenology: Apr.-May  
Distribution: Asia-Tropical  
Uses: Fruits are used in chronic diarrhoea and dysentery. Unripe fruits are astringent, diuretic, anthelmintic and antipyretic.
02. *Ageratum conyzoides* (L.) L.  
Family: Asteraceae  
Phenology: throughout the year  
Distribution: In tropics & subtropics  
Uses: Leaf juice is used to stop bleeding.
03. *Anaphalis margaritacea* (L.) Benth. & Hook. f.  
Family: Asteraceae  
Phenology: Aug.-Nov.  
Distribution: Pakistan to SW China  
Uses: Whole plant is anodyne, antiseptic, astringent expectorant and sedative.

04. *Androsace sarmentosa* Wall.  
Family: Primulaceae  
Phenology: June-Aug.  
Distribution: Native to the Himalayas; Sikkim to Kashmir  
Uses: Entire plant is used in Tibetan medicine. Used for the treatment of tumors.
05. *Anemone vitifolia* Buch.-Ham. ex DC.  
Family: Ranunculaceae  
Phenology: Aug.-Sept.  
Distribution: Himalayas; Afghanistan, SW China & Myanmar  
Uses: Fresh root is antirheumatic and vermifuge.
06. *Begonia picta* Sm.  
Family: Begoniaceae  
Phenology: Aug.-Sept.  
Distribution: Asia-Temperate and tropical  
Uses: Plant juice is drunk to relieve headache.
07. *Berberis aristata* DC.  
Family: Berberidaceae  
Phenology: Mar.-May  
Distribution: Asia-Tropical  
Uses: Dried stems are highly medicinal. Used as tonic, laxative and diaphoretic. Infusion of leaf is used to treat Malaria, skin diseases and jaundice.
08. *Buddleja asiatica* Lour.  
Family: Buddlejaceae  
Phenology: Jan.-Oct.  
Distribution: Asia-Temperate and tropical  
Uses: Juice of the plant is applied to cure skin diseases.
09. *Bupleurum candollei* Wall. ex DC.  
Family: Apiaceae  
Phenology: June-Aug.  
Distribution: Himalayas  
Uses: Decoction of root is useful to cure cough and fever. A traditional Chinese medicine.
10. *Cautleya spicata* (Sm.) Baker  
Family: Zingiberaceae  
Phenology: July-Sept.  
Uses: Distributed in the Himalayas ranging from Himachal Pradesh to Arunachal Pradesh in India. Juice of the rhizome is used in the treatment of stomachache.
11. *Cedrus deodara* (Roxb. ex Lamb.) G. Don  
Family: Pinaceae  
Phenology: Oct-Nov.  
Distribution: Afghanistan to Nepal  
Uses: Decoction of wood is medicinal. Cures fever, flatulence and urinary disorders.
12. *Cissampelos pareira* (Roxb. ex Lamb.) G. Don  
Family: Menispermaceae

- Phenology: Aug.  
Distribution: Native of America; Naturalized  
Uses: A potential medicine for gynaecological disorders.
13. *Coriaria nepalensis* Wall.  
Family: Coriariaceae  
Phenology: Feb.-Aug.  
Distribution: Endemic to Indo-Pakistan  
Uses: Juice of the bark is used in the treatment of Stomachache.
14. *Cotoneaster microphyllus* Wall. ex Lindl.  
Family: Rosaceae  
Phenology: May-Aug.  
Distribution: Afghanistan to SW China  
Uses: Potential Bonsai plant. The stolons are believed to be astringents.
15. *Cynoglossum officinale* L.  
Family: Boraginaceae  
Phenology: Aug.-Sept.  
Distribution: Native to Asia-temperate and Europe  
Uses: Leaves and roots are analgesic, antihemorrhoidal, astringent but slightly narcotic.
16. *Delphinium denudatum* Wall. ex Hook. f. & Thomson  
Family: Ranunculaceae  
Phenology: Jul.-Aug.  
Distribution: Native to Asia tropical  
Uses: Decoction of the roots is a good stimulant and tonic.
17. *Desmodium elegans* DC.  
Family: Fabaceae  
Phenology: Aug.-Oct.  
Distribution: Native to Asia temperate and tropical  
Uses: Roots are carminative, diuretic and tonic.
18. *Drosera peltata* Thunb.  
Family: Droseraceae  
Phenology: Throughout the year  
Distribution: Himalayas; Japan & China  
Uses: Plant is a good blood tonic and carminative.
19. *Duchesnea indica* (Andrews) Focke  
Family: Rosaceae  
Phenology: Throughout the year  
Distribution: Asia-temperate and tropical  
Uses: Whole plant is anticoagulant, antiseptic and febrifuge. Fruits are used to cure skin diseases.
20. *Eclipta prostrata* (L.) L.  
Family: Asteraceae  
Phenology: Aug.-Oct.  
Distribution: Native to warm-temperate and tropical America; widely naturalized worldwide  
Uses: Highly medicinal and used for hair. A decoction of leaf is also used to cure uterine hemorrhage. Equally good for skin diseases.
21. *Habenaria intermedia* D. Don  
Family: Orchidaceae  
Phenology: Jul.-Aug.  
Distribution: E. Asia; Himalayas  
Uses: Leaves and roots are boiled and eaten.
22. *Hedychium spicatum* Sm.  
Family: Zingiberaceae  
Phenology: Jul.-Aug.  
Distribution: E. Asia; Himalayas  
Uses: Rootstocks are carminative, expectorant, stimulant and tonic.
23. *Ligularia amplexicaulis* DC.  
Family: Asteraceae  
Phenology: Aug.-Sept.  
Distribution: Himalayas  
Uses: Stem, leaves and flowers are digestive and emetic. Used for the treatment of vomiting.
24. *Micromeria biflora* (Buch.-Ham. ex D. Don) Benth.  
Family: Lamiaceae  
Phenology: June-Aug.  
Distribution: Almost throughout the country; E. Asia; Himalayas: Bhutan to Myanmar  
Uses: Root paste is used to cure toothache; a good antiseptic and odontalgic.
25. *Morina longifolia* Wall.  
Family: Acanthaceae  
Phenology: June-Sept.  
Distribution: Kashmir to Bhutan (Himalaya)  
Uses: Used in Tibetan medicine. Leaf, stem and flowers are digestive, emetic and stomachic.
26. *Pedicularis bicornuta* Klotzsch  
Family: Scrophulariaceae  
Phenology: Jul.-Sept.  
Distribution: Himalayas  
Uses: The flowers are used in Tibetan medicine to cure leucorrhoea.
27. *Polygonum aviculare* L.  
Family: Polygonaceae  
Phenology: June-Oct.  
Distribution: Origin unknown; Naturalized worldwide  
Uses: A potential medicinal herb. Considered to be a very good astringent, anthelmintic, diuretic, emetic, expectorant and for so many purposes.
28. *Polygonum nepalense* Meisn.  
Family: Polygonaceae

- Phenology: June-Sept.  
Distribution: Native of Asia-tropical and temperate  
Uses: Juice obtained from roots is used to cure fever.
29. *Potentilla nepalensis* Hook.f.  
Family: Rosaceae  
Phenology: June-Sept.  
Distribution: Himalayas (Kashmir to Nepal)  
Uses: The root is depurative.
30. *Ranunculus sceleratus* L.  
Family: Ranunculaceae  
Phenology: May-Sept.  
Distribution: Throughout the world  
Uses: Whole plant is anodyne, antirheumatic, antispasmodic, diaphoretic and rubefacient.
31. *Rheum australe* D. Don  
Family: Polygonaceae  
Phenology: June-Jul.  
Distribution: Himalayas: India, China, Bhutan, Myanmar, Nepal & Pakistan  
Uses: Most widely used herb in Chinese medicine. Used as digestive, purgative, tonic and for many other ailments.
32. *Rhododendron arboreum* Sm.  
Family: Ericaceae  
Phenology: Apr.-Aug.  
Distribution: Asia tropical & temperate: India, China, Bhutan, Nepal, Myanmar & Thailand  
Uses: Young leaves are good astringent and tonic.
33. *Rosa sericea* Lindl.  
Family: Rosaceae  
Phenology: May-Aug.  
Distribution: Himalayas; SW China to Myanmar  
Uses: A paste of the flower applied on the head to cure headache. Also known to possess some anti-cancer properties.
34. *Rubia cordifolia* L.  
Family: Rubiaceae  
Phenology: Jul-Sept.  
Distribution: Native of Asia-tropical and temperate; Africa  
Uses: The roots are astringent, anodyne, diuretic, febrifuge and tonic.
35. *Rubus ellipticus* Sm.  
Family: Rosaceae  
Phenology: Feb.-Apr.  
Distribution: Asia tropical & temperate  
Uses: Root juice is used in the treatment of fever, gastric troubles, diarrhea and dysentery.
36. *Rumex hastatus* D. Don  
Family: Polygonaceae  
Phenology: June-Oct.  
Distribution: Himalayas: Afghanistan to Nepal  
Uses: Crushed leaf applied to check bleeding. Root is laxative, tonic and anti-rheumatic.
37. *Rumex nepalensis* Spreng.  
Family: Polygonaceae  
Phenology: Jul.-Aug.  
Distribution: Asia tropical and temperate; Europe  
Uses: Leaf extract is used to cure skin sores.
38. *Satyrium nepalense* D. Don  
Family: Orchidaceae  
Phenology: Jul.-Dec.  
Distribution: Asia tropical and temperate  
Uses: Powdered tubers are known to have medicinal properties as tonic
39. *Stellaria media* (L.) Vill.  
Family: Scrophulariaceae  
Phenology: Throughout the year  
Distribution: Probably origin of Eurasia; widely naturalized  
Uses: Known to possess astringent, carminative, diuretic and many medicinal properties.
40. *Taraxacum officinale* Webb  
Family: Asteraceae  
Phenology: Apr.-Aug.  
Distribution: Origin of Eurasia; widely naturalized  
Uses: Commonly used medicinal plant. Known to possess diuretic, laxative and hepato-protective properties.
41. *Thalictrum foliolosum* DC.  
Family: Ranunculaceae  
Phenology: Aug.-Sept.  
Distribution: Himalayas; India, China, Bhutan, Nepal, Pakistan and Myanmar  
Uses: Used in eye disorders.

### Other economic plants

Besides, the area is also full of plant resources that could be highly economical for the mankind like *Berberis aristata* which is used to obtain a yellow dye from its root and stem. It is perhaps one of the best tannin dyes available in India. The wood is also used as a fuel. *Polygonum aviculare*, besides being a medicinal herb, could be used to yield a blue dye. A red dye is obtained from *Rubia cordifolia*, which is frequently found in the area. *Cotoneaster microphyllus* is a good candidate for preparing Bonsai. The flowers of *Buddleja asiatica* are a source of perfume. The area is also filled with a number of wild ornamental plants such as *Morina longifolia*, *Ligularia amplexicaule*, *Epilobium laxum*, *Chirita bifolia*, *Silene setisperma*, *Codonopsis viridis*, *Polygonum amplexicaule*,

*Pedicularis siphonantha*, *P. bicornuta*, *Anemone vitifolia*, *Geranium himalayense*, *Potentilla nepalensis*, *Rhododendron arboreum*, *Thalictrum foliolosum*, *Strobilanthus atropurpureus*, *Swertia tetragona*, *Rhodiola trifida*, *Prunella vulgaris*, *Euphorbia pilosa*, *Androsace sarmentosa*, *Arisaema jacquemontii*, *Bupleurum candollei*, *Cautleya spicata*, *Corydalis thyrsoflora* etc. These plants are of immense horticulture potential and could be a future source of economy to the state.



**Fig. 1:** A bird's eyeview on the topography of Churdhar Wildlife Sanctuary



**Fig. 2:** Temperate vegetation

### Phytogeographical affinities

Several species occurring in the sanctuary appear to have migrated from Tibet, W. China and adjoining north-east Asia. There are also some species which show restricted distribution in the Western Himalayas (upto Afghanistan) like *Anaphalis margaritacea*, *Androsace sarmentosa*, *Arisaema jacquemontii*, *Cautleya spicata*, *Cedrus deodara*, *Cirsium falconeri*, *Chirita bifolia*, *Coriaria nepalensis*, *Cotoneaster microphyllus*, *Gaultheria trichophylla*, *Hedychium spicatum*, *Habenaria intermedia*, *Morina longifolia*, *Micromeria biflora*, *Lonicera quinquelocularis*, *Pedicularis bicornuta* etc. but many of them are distributed throughout the world. Some of the plants

are known from both Western and Eastern Himalayan regions. The subtropical elements in this area are well represented in the lowlands of Taiwan and Philippines. Though the area shows much floristic affinity with the flora of China with occurrence of a number of similar plants like *Anaphalis margaritacea*, *Anemone vitifolia*, *Arisaema jacquemontii*, *Berberis aristata*, *Buddleja asiatica*, *Cirsium falconeri*, *Cotoneaster microphyllus*, *Cynoglossum amabile*, *C. officinale*, *Drosera peltata*, *Epilobium laxum*, *Lonicera quinquelocularis*, *Rosa sericea*, *Morina longifolia* etc. but the presence of several taxa like *Cedrus deodara*, *Eclipta prostrata*, *Euphorbia pilosa*, *Fallopia convolvulus*, *F. dumetorum*, *Gnaphalium affine*, *Gynura crepidioides*, *Oenanthe javanica*, *Polygonum aviculare*, *Ranunculus scleratus*, *R. cantoniensis*, *Rhus javanica*, *Rubia cordifolia*, *Rumex acetosa*, *Spiranthes sinensis* and many genera like *Alnus*, *Aster*, *Bupleurum*, *Cirsium*, *Codonopsis*, *Corydalis*, *Cotoneaster*, *Drosera*, *Daphne*, *Duchesnea*, *Elsholtzia*, *Epilobium*, *Ligularia*, *Prunella*, *Rhododendron*, *Sedum*, *Senecio*, *Silene*, *Smilax*, *Sonchus*, *Spiraea*, *Swertia*, *Symplocos*, *Thalictrum*, *Thymus*, *Viburnum*, *Viola*, *Vitex* etc. proves that the Korean flora is also closely related to this area. This gives an important clue for understanding the ecological niches created during the course of evolution and the diversification of plants in the Himalayan region.



**Fig. 3:** Sub-alpine zone of the sanctuary



**Fig. 4:** A glimpse of the sanctuary area showing the land under cultivation



*Geranium himalayense* Klotzsch



*Anemone vitifolia* Buch.-Ham. ex DC.



*Anaphalis margaritacea* (L.) Benth. & Hook. f.



*Codonopsis viridis* Wall.



*Androsace sarmentosa* Wall.



*Cotoneaster microphyllus* Wall. ex Lindl.



*Morina longifolia* Wall.



*Polygonum amplexicaule* D. Don



*Pedicularis bicornuta* Kl. ex Kl. & Garcke



*Ligularia amplexicaulis* DC.



*Pedicularis siphonantha* D. Don



*Silene setisperma* Majumdar



*Goodyera fusca* (Lindl.) Hook. f.

*Peristylus elisabethae* (Duthie) R.K. Gupta

## Conservation issues

Some of the areas in WLS are under human settlements, characterized by grassy slopes and patches of cultivation. Terrace cultivation is common and patches of forests in ravines and on the steeper hillsides can be seen. Oaks and Rhododendrons are common to these areas. As estimated by Gupta & Gupta [10], the sanctuary has 127.12 ha of agriculture land, 486.61 ha of Barren/wasteland, 50.17 ha of pasture, 204.9 ha of snowbound area, 3.6 ha of rocky area and 4866.6 ha of reserved Forests. It is heartening to see that a major area is still enjoying virgin forests. 23 villages are located within and outside the protected area having population of 558 permanent inhabitants [10]. The local people residing in the WLS area are given the rights to agriculture, extraction of timbers, fuel wood and minor forest produce, grazing and collection of fodders. Fortunately, the WLS is famous as a pilgrimage due to the *Chur* peak. A temple of lord Shiva is situated on the top which is considered the lord of surrounding villages. The religious beliefs associated with the *Chur* peak helps conserving the bioresources. The area is considered a sacred grove and hence lot of restrictions are imposed by the local people on cutting and lopping of trees, grasses and collection of non timber forest products before seeds fall. This practice is prevalent in the whole area of the sanctuary. However, grazing and land sliding is a major concern for the conservation of some threatened species. Forests adjacent to the human settlement areas are also under exploitation for timber, fuel and fodders. There is a need to preserve the natural habitat of the threatened plant species by integrating traditional forest knowledge system with sustainable forest management. This should be achieved with an inter-village agreement on grazing in a particular forest in a particular area, creating awareness for the most threatened species and a limited and sustainable use of the resources.

## Acknowledgements

Thanks are due to Sri Krishan Lal Ji, PWD, Sangrah, Himachal Pradesh for his help during the study and to Dr. Pankaj Kumar, Wildlife Institute of India, Dehradun, India for confirming the identity of orchids.

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## Adaptogenic and anti-stress activity of *Withania somnifera* in stress-induced mice

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### Abstract

The aim of the study was to evaluate the effect of ethanolic extract of roots of *Withania somnifera* (23 mg/kg, p.o) on acute stress-induced biochemical and immunological perturbations in mice. The standard group was administered water soluble root powder of *Panax ginseng* (100 mg/kg, p.o) while the stress control group was administered distilled water orally. After 7 days of pretreatment with the extract, the animals were concomitantly exposed to swim endurance test and cold restraint stress (4°C for 1 hour). Cold restraint stress resulted in significant increase in adrenal gland weight with concomitant decrease in spleen weight in stress control group which was significantly reverted by pretreatment with extract of *Withania somnifera*. The activation of HPA system results in secretion of corticotropin hormone, adrenocorticotropin hormone (ACTH),  $\beta$ -endorphin and glucocorticoids into the circulation. Pretreatment of animals with *Withania somnifera* extract (23 mg/kg, p.o) improved the swim duration in mice and significantly restored back the stress-induced alterations in plasma cortisol, blood glucose and triglyceride levels.

**Key words:** HPA system, *Withania somnifera*, Adrenocorticotropin hormone, Cortisol, Swim endurance test, Cold restraint stress.

### Introduction

Adaptogens are naturally occurring substances found in plants. It is absolutely safe and non-toxic to the human body and increases the body's non-specific resistance to internal and external stimuli and brings the dysfunctioning body's system back into balance. Adaptogens can successfully combat the negative effects of stress, improve health and well-being, and enhance body's performance [1-10, 13].

*Withania somnifera* (Ashwagandha) has been used for thousands of years as a popular remedy for many conditions. Perhaps its main use, as described in Ayurvedic literature, is as a "rasayana" or rejuvenating drug. The word Ashwagandha indicates the equine (of horses) odour of the plant. Another name Avarada suggests the application of this plant for enhancing

longevity. The root drug is considered a tonic and roborant. The root of *Withania somnifera* is used to make the Ayurvedic sedative and diuretic "Ashwagandha", which is also considered an adaptogen. It is said to "protect the organism from illness" through maintaining the healthy balance of the physical energies [16, 31]. The root contains the steroid lactone withaferin A and related withanolides, besides various alkaloids [38, 39]. The sitoindosides IX and X represent C-27-glycowithanolides, the sitoindosides VII and VIII, acyl-esterly glucosides. The sitoindosides VII, VIII, IX and X represent the adaptogenic active substances of *Withania somnifera*, in spite of diverse steroidal structures [11, 15].

Ashwagandha is one of the main herbs for promoting ojas and rejuvenating the body. It is well-known semen promoter and it treats impotency and infertility. It increases physical endurance and improves sexual function [17, 19-26]. It is a rejuvenative general tonic, which stimulates immune system. Ashwagandha has adaptogenic, immunomodulatory and anti-inflammatory effects [11, 12, 28]. It regenerates hormonal system and has anti-stress properties. It is used in many general tonics and preparations, such as chayavana prash [14, 15]. The present study has been undertaken to find out the mechanism of anti-stress activity of *Withania somnifera* in stress-induced mice.

### Materials and Methods

Plant material roots of *Withania somnifera* were collected, dried in shade, and finely powdered. The powder was soaked in absolute ethanol (95%) and left for 48 hours. The supernatant was collected and the residue was further soaked in absolute ethanol (95%) for 24 hours. The supernatant was collected and filtered. The filtrate was subjected to Rota vapour extraction at a temperature below 60°C for 24 hours. The concentrated form of the extract was obtained and freeze-dried.

The study was conducted on healthy, adult, male albino mice having a body weight of  $35 \pm 5$  g. They were acclimatized to laboratory condition for 2 weeks prior to experimentation. Animals were housed in propylene cages (6 mice/cage) in a mice

experimentation laboratory at a temperature of  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$  with 12 – 12 h dark - light cycle. They were provided with standard food and water ad libitum. Institutional animal ethical committee (I.A.E.C) approval was obtained before the experiment and care was taken to handle the mice in humane manner. All the chemicals used in the present study were obtained from Euro Diagnostics (Mumbai, India), India Scientific Company (Patna, Bihar) and Bihar Scientific Corporation (Patna, Bihar).

### Experimental Design

The adult animals (8 weeks old) were divided into 4 groups (n = 6 in each group) as follows: Group I consisted of Normal control (NC), these mice remained undisturbed in the home cage throughout the experimental period. Group II consisted of Stress control (SC), which were fed with equivolume of distilled water orally for 7 days. Group III (Stress+*P.ginseng*) consisted the standard group, these mice were fed with aqueous root powder of *Panax ginseng*, (p.o) for 7 days. Group IV consisted of (Stress+*W.somnifera*), treatment group which were fed with ethanolic extract of *Withania somnifera*, (p.o) for 7 days.

### Stress Procedure

**Swim Endurance Test:** The mice in group IV were given ethanolic extract of *Withania somnifera*, 23 mg/kg, (p.o), using oral gauge for 7 days. The standard group (III) was administered water soluble root powder of *Panax ginseng* 100 mg/kg, (p.o), while the stress control group (II) was administered distilled water for 7 days orally. On the 8<sup>th</sup> day, the animals were allowed to swim till exhausted in a propylene tank of dimension 24 cm\* 17 cm\* 14 cm, filled with water to a height of 10 cm. The end point was taken when the animals drowned and 'swimming time' for each animal was noted. The mean swimming time for each group was calculated and the data was statistically analyzed.

**Cold Restraint Stress:** The mice in group IV were given ethanolic extract of *Withania somnifera* 23 mg/kg, (p.o), using oral gauge for 7 days. The standard group (III) was administered water soluble root powder of *Panax ginseng* 100 mg/kg, (p.o), while the stress control group (II) was administered distilled water for 7 days orally.

On the 8<sup>th</sup> day, the animals were individually placed in plastic containers of capacity 350 ml. They were immobilized in their normal position, using adhesive tape. The containers were placed in a cold chamber maintained at  $4^{\circ}\text{C}$  for 1 hour. The blood was collected by orbital sinus veinpuncture method in a heparinised tube and the following investigations were carried out. Total WBC count was done using

Neubauer's chamber, blood glucose was determined by GOD/POD method, plasma cortisol was determined by Enzyme Linked Immunosorbent Assay (ELISA) [32], serum triglyceride was determined by GPO-POD method [27], total cholesterol was determined by CHOD-POD method and HDL cholesterol was determined by CHOD-PAP method.

### Statistical Analysis

Data was analyzed by application of one way analysis of variance (ANOVA) using Graph pad in stat software.  $P < 0.01$  was considered to be significant.

### Results and Discussion

Acute toxicity studies with the extract revealed that  $\text{LD}_{50}$  is 1750 mg/kg body weight, (p.o). As shown in figure 1, the extract of *Withania somnifera* improves swim duration in mice. Mice pretreated with ethanolic extract of *Withania somnifera* 23 mg/kg, (p.o), and water soluble root powder of *Panax ginseng* 100mg/kg, (p.o), show significant improvement in the swimming time ( $P < 0.01$ ), as compared to control. (n = 6 in all groups, SC vs S+*W.somnifera*,  $P < 0.01$ ; SC vs S+*P.ginseng*,  $P < 0.01$ ; One way ANOVA,  $P < 0.01$ , F = 41.336; Fig. 1).

The induction of cold restraint stress led to a rise in total WBC count, blood glucose, plasma cortisol and serum triglyceride levels. All the two treatments produced a significant reduction in total WBC count ( $P < 0.01$ ), as compared to controls. (n = 6 in all groups, NC vs SC,  $P < 0.01$ ; SC vs S+*W.somnifera*,  $P < 0.01$ ; SC vs S+*P.ginseng*,  $P < 0.01$ ; One way ANOVA,  $P < 0.01$ , F = 6.006; Fig. 2).

The blood glucose was significantly increased, when the animals were subjected to cold restraint stress compared to control ( $P < 0.01$ ). Pretreatment of animals with the extract of *Withania somnifera* 23 mg/kg, (p.o), or water soluble root powder of *Panax ginseng* 100 mg/kg, (p.o), prevented this ( $P < 0.01$ ). (n = 6 in all groups, NC vs SC,  $P < 0.01$ ; SC vs S+*W.somnifera*,  $P < 0.01$ ; SC vs S+*P.ginseng*,  $P < 0.01$ ; One way ANOVA,  $P < 0.01$ , F = 60.373; Fig. 3).

The plasma cortisol level which was found to be elevated in the animals subjected to cold restraint stress was significantly reduced by all the four treatments ( $P < 0.01$ ), compared to controls. (n = 6 in all groups, NC vs SC,  $P < 0.01$ ; SC vs S+*W.somnifera*,  $P < 0.01$ ; SC vs S+*P.ginseng*,  $P < 0.01$ ; One way ANOVA,  $P < 0.01$ , F = 92.616; Fig. 4).

The triglyceride level was increased in the animals subjected to cold restraint stress compared to control ( $P < 0.01$ ). However, no significant change in the serum cholesterol level was observed. Treatment of animals with the extract of *Withania somnifera* 23 mg/kg, (p.o), or water soluble root powder of *Panax ginseng* 100

mg/kg, (p.o), before subjecting them to cold restraint stress, prevented the increase in serum triglyceride levels ( $P < 0.01$ ). (n = 6 in all groups, NC vs SC,  $P < 0.01$ ; SC vs S+W.somnifera,  $P < 0.01$ ; SC vs S+P.ginseng,  $P < 0.01$ ; One way ANOVA,  $P < 0.01$ , F = 98.553; Fig. 5).

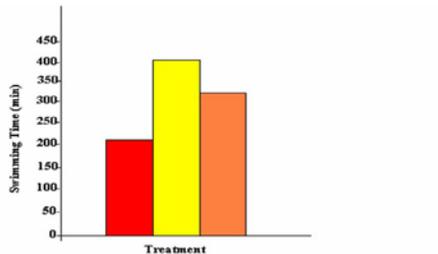


Figure 1: Effect of ethanolic extract of *Withania somnifera* and aqueous root powder of *Panax ginseng* on swimming performance in mice.

■ Stressed  
 ■ P. ginseng (100 mg/kg, p.o)  
 ■ W. somnifera (23 mg/kg, p.o)

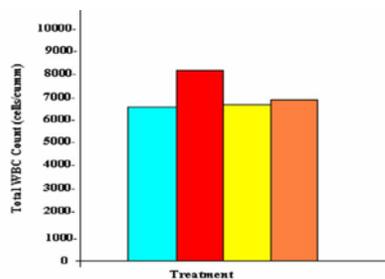


Figure 2: Effect of ethanolic extract of *Withania somnifera* and aqueous root powder of *Panax ginseng* on cold restraint stress induced changes in total WBC count in mice.

■ Control  
 ■ Stressed  
 ■ P. ginseng (100 mg/kg, p.o)  
 ■ W. somnifera (23 mg/kg, p.o)

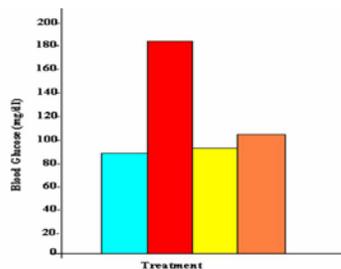


Figure 3: Effect of ethanolic extract of *Withania somnifera* and aqueous root powder of *Panax ginseng* on cold restraint stress induced changes in blood glucose level in mice.

■ Control  
 ■ Stressed  
 ■ P. ginseng (100 mg/kg, p.o)  
 ■ W. somnifera (23 mg/kg, p.o)

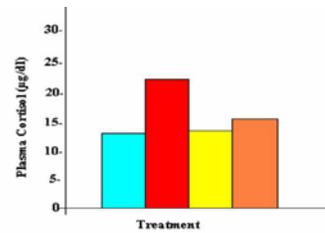


Figure 4: Effect of ethanolic extract of *Withania somnifera* and aqueous root powder of *Panax ginseng* on cold restraint stress induced changes in plasma cortisol level in mice.

■ Normal  
 ■ Stressed  
 ■ P. ginseng (100 mg/kg, p.o)  
 ■ W. somnifera (23 mg/kg, p.o)

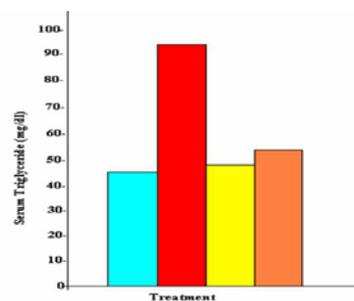


Figure 5: Effect of ethanolic extract of *Withania somnifera* and aqueous root powder of *Panax ginseng* on cold restraint stress induced changes in serum triglyceride level in mice.

■ Normal  
 ■ Stressed  
 ■ P. ginseng (100 mg/kg, p.o)  
 ■ W. somnifera (23 mg/kg, p.o)

The testing of the physical endurance of mice, after pre-treatment with *Withania* extract showed a near doubling of the length of perseverance in the swimming test. Pretreatment with the ethanolic extract of the roots of *Withania somnifera* 23 mg/kg, (p.o), increased swimming endurance in mice and significantly reduced cold restraint stress-induced changes in mice [18, 33]. No significant change in serum cholesterol level was observed. Stress-induced increase in plasma cortisol, total WBC count, blood glucose and serum triglyceride levels were blocked by administration of *Withania somnifera* to mice, while swimming time was increased [29, 30, 34-46].

Thus, on the basis of the above findings it is concluded that the extract of *Withania somnifera* improves the swim duration in mice and prevented the increase in total WBC count, blood glucose, plasma cortisol, and serum triglyceride levels.

### Acknowledgements

This study was supported by the Department of Biochemistry, Patna University, Patna.

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## Biodeterioration of active principles of *Catharanthus roseus* by *Colletotrichum gloeosporoides*

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### Abstract

Majority of the members of Coelomycetes are diseases causing mostly associated with leaf spots. Leaf spot diseases are the expressions of abnormal metabolic changes due to loss of photosynthetic area. Such symptoms are produced as a result of physiological disorders in the host. These disorders may be due to nutritional imbalance or due to living organisms, usually active in localized areas of the host. Leaf spot diseases are known to cause severe damage to the plants of great economic and ornamental value. Cultivated plants are usually more susceptible to such diseases. These diseases, which deprive the plants of the aesthetic value and cause a decrease in photosynthetic area, require greater probe and attention. A general survey undertaken by the research team of TMBU under AICOPTAX Program, MoEF, New Delhi showed greater frequency of Coelomycetous fungi. Particularly *Colletotrichum gloeosporoides* which have been selected in the present research work for the study in detail. A general pattern of decrease of sugars, biomass and alkaloid contents were observed after pathological studies of *C. roseus*. The percentage decrease in Total Sugar was found 30.36%, Reducing Sugar 28.57%, Non-Reducing Sugar 30.61%, biomass (7%) Alkaloids 21% under pathogenesis.

**Key words:** Coelomycetes, Biodeterioration, Medicinal plants.

### Introduction

The Coelomycetes are predominantly leaf spotting fungi though many of them grow on twigs, fruits and other parts of the plants causing different symptoms like blight, rot, cankers etc. The pycnidia are with or without the ostiole and the acervuli are saucer shaped structure which are the characteristics of this group. The present work deals with taxonomical and pathological studies of Coelomycetous fungi associated with medicinal plants. The main object of the present investigation was to explore the diverse localities of Eastern Bihar to collect different nature of genera of Coelomycetous fungi associated with medicinal and the plants of other economic importance. As early as in 1972 Vidyashekharan and

Kandaswamy [1] showed severe reduction in both starch and sugar contents of infected tissue of *Phaseolus aureus*. The observation [2] supported this findings the facultative parasite such as *Cercospora* was found to deplete starch and sugar contents in groundnut and banana leaves [3], also found a quick decline in sugar content of banana due to *Cercospora* infection. The simple sugars are preferably assimilated by pathogens as carbon source which determines the quality of the fruits and leaves [4-8]. The impact of coelomycetous fungi on medicinal plants as a whole or on deterioration of carbohydrates and active principles has been studied by several earlier workers [9-16], moreover, it still requires further studies to generate scientific information by plant wise in relation to severity of fungal diseases. Keeping these in view changes in leaf photosynthates, biomass & alkaloids of *Catharanthus roseus* due to fungal disease caused by *C. gloeosporoides* have been studied.

### Materials and Methods

**Estimation of Total Sugar:** To 200 mg of each sample, 25 ml hot 80% ethanol was added and stirred thoroughly. After 5 minutes, it was centrifuged and supernatant was decanted. Extraction was repeated by adding 30ml of hot 80% ethanol. The extracts were mixed and ethanol was evaporated to dryness in an evaporating disc. The residue left at the bottom was dissolved in 5ml of glass-distilled water and centrifuged again. To 2ml of the supernatant 0.14 ml of 80% aqueous phenol was added and then with fast flowing pipette 5 ml of conc.  $H_2SO_4$  was mixed and shaken gently. The tubes were allowed to stand for ten minutes and then placed in a water bath at 25°C for 10-20 minutes. The optical density was recorded against the blank at 490nm. The percent amount of the total sugar was determined by comparing the readings with that of standard curve of glucose [17].

**Estimation of Reducing Sugar:** 300mg of each sample was finely crushed and blended with 1.5ml of glass distilled water in a glass homogeniser. To this 0.2ml of 0.3N Barium hydroxide solution was added followed by 0.2ml of 5%  $ZnSO_4$  solution and was thoroughly mixed. The total volume was centrifuged. To one ml of the supernatant, one ml of alkaline copper reagent (Prepared by dissolving 4 gm  $CuSO_4$ ,

5H<sub>2</sub>O; 24 gm Anhydrous Na<sub>2</sub>CO<sub>3</sub> and 16 gm Na-K tartarate in 1 liter of water) was added. To this one ml of Arsenomolybdate reagent was added and left to stand for few minutes till the effervescence ceased. The blue colour was diluted with glass distilled water up to 10ml and was read at 510 nm. The optical density was compared with that of the standard fructose solution [18].

**Estimation of Non-reducing Sugar:** The amount of non-reducing sugar was calculated by subtracting the value of reducing sugar from total sugar. It is because the total sugar constitutes equally reducing and non-reducing sugars.

**Loss in Biomass:** The test plant (*Catharanthus roseus*) was inoculated artificially by the test fungus (*Colletotrichum gloeosporoides*). The plant after artificial infection was left for 15 days for the development of disease symptom under an aerated poly bag. After 15 days symptoms was appeared on the leaf surface. The healthy and diseased leaves were detached separately. weight. was taken after proper washing and kept into oven at 60-80°C for 48 hours. The biomass was calculated by the following method: -  
For healthy leaves: Wt. of healthy fresh leaves – Wt. of oven dried leaves.  
For diseased leaves: Wt. of diseased leaves – Wt. of oven dried leaves.

**Changes in Total Alkaloid:** 20gm of powdered sample was soaked in 28% ammonium hydroxide solution and little dried-up. Subsequently the sample was soxhlated with a mixture of chloroform & ethanol (3: 1 v/v) for 8 hours. 100ml of solvent was extracted and vigorously shaken with 25ml of N/2 H<sub>2</sub>SO<sub>4</sub> and the acid extract was collected. The process was repeated thrice for the complete extraction of alkaloids. The combined acid extract was made alkaline with dilute NH<sub>4</sub>OH. The alkaloids were extracted from alkaline extract with 20 and 15ml of chloroform. The chloroform extract was distilled on water bath until only few ml was left. The left solvent was completely dried up and left residue was weighed on monopan balance to calculate the total crude alkaloids [19].

## Results and Discussion

**Changes in sugar:** Carbohydrates or sugars are the chief photosynthetic products of the plants. The utilization of any particular sugar by fungi depends on its configuration as well as on the potential endowment of specific fungi. Fungi satisfy their carbon requirements from various carbohydrates present in host tissues by (i) Breaking the complex sugars to simpler utilizable form and by (ii) Enhancing the respiratory rate in diseased tissues. Di- and Polysaccharides are hydrolyzed by various hydrolyzing

enzymes and are converted into hexose sugars which are preferably used by various pathogenic fungi mainly for two purposes i.e. to augment the required amount of energy for various metabolic process and for structural frame work of cell however, the rate of utilization varies with the variation of nature and type of fungi.

**Loss In Biomass:** All living plant cells requires an abundance of water and an adequate amount of organic and inorganic nutrients in order to live and to carry out their physiological function. Plant absorbs water and inorganic (mineral) nutrients from the soil through their root system. The minerals and part of the water are utilized by the leaf and other cells for the synthesis of the various plant substances, but most of the water evaporates. On the other hand, nearly all organic nutrients of plants are produced in the leaf cells, following photosynthesis and are located downward and distributed to all the living plant cells. When a pathogen interferes with the upward movement of inorganic nutrients and water with the downward movement of organic substances, diseased conditions results in the parts of the plant denied these materials. The diseased parts in, turn, will be unable to carry out their own functions and deny the rest of the parts, their services or their products. For example if water movement to the leaves is inhibited the leaves cannot function properly, photosynthesis is reduced or stopped and few or no nutrients are available to move to the roots, which in turn become starved and diseased and may die or resulting in the loss of biomass [20-22]. In the present study two months old healthy and diseased leaves at *C. roseus* was taken for the determination of loss in biomass and the results are depicted in table 1.

**Changes in Alkaloid Contents:** The term Alkaloid has been proposed by pharmacists as basic nitrogen containing compounds from the plants and other natural resources in which at least one nitrogen atom forms a part of the cyclic system. The above stated definition is not fully satisfactory because a number of synthetic compounds satisfy all the above criteria of alkaloid except for the facts that they are not derived from biological resources. Thus in the modern chemistry they are defined as heterocyclic nitrogenous compounds. The further work carried out [23-29] suggested that some proteins, amino acids, nicotinic acid and anthranilic acid may act as precursor for the biosynthesis of alkaloid. In general alkaloids have been isolated and characterized from almost all the parts of the plants; however, their concentration is more in those parts where the metabolic activity is maximum. The curative properties of alkaloids against various diseases have led their wide range use in medicine preparation at a large scale. 30 and 31 listed number of plant alkaloid viz. Atropine, Caffeine, Cocaine,

Codeine, Emetine, Morphine, Ergometrine, Serpentine and Quinine which are used to cure different ailments of human being. Previously it was reported [32] that Reserpine obtained from *Rauvolfia serpentina* have a strong hypotensive property, Vinblastine and Vincristin isolated from *C. roseus* as well as ergine, ergometrine, ergoline and isergine isolated from *Argeria* sp. are antidiabetic and hypoglycaemic [33-36].

**Table 1:** Changes in Sugar contents, Biomass and Alkaloids of *C. roseus* by *C. gloeosporoides*.

		Healthy	Diseased
Total sugar (TS)mg/g	TS	5.6	3.9
	% loss	-	30.96
Reducing sugar (RS)mg/g	RS	0.7	0.5
	% loss	-	28.57
Non reducing sugar (NRS)mg/g	NRS	4.9	3.4
	% loss	-	30.61
Biomass (B)mg/g	B	8.7	-
	% loss	8.1	7
Total Alkaloid (TA)	TA	0.81	-
	% loss	0.63	21

The data in table 1 clearly reveals that there was a general pattern of decrease of all kinds of sugars. 5.6mg/g total sugar, 0.7mg.g reducing sugar and 4.9mg/g non-reducing sugar in healthy leaves whereas only 3.9mg/g, 0.5mg/g and 3.4mg/g were estimated from diseased leaves samples respectively. The biomass of healthy and diseased leaves was recorded 8.7g/50g, and 8.1g/50g respectively. The amount of total alkaloid in healthy leaves was found 0.81 mg/g and 0.63 mg/g in diseased one. The percentage decrease in total sugar, biomass and alkaloids was found to the tune of 30.96%, 7% and 21% respectively under pathogenesis. The growth of a plant or its particular organ is an important endogenous process which results in variation in the concentration of plant metabolites. The percent decrease in diseased leaves might be due to the utilization of organic and inorganic components by the test fungus (*C. gloeosporoides*).

### Conclusions

A general trend of decrease in sugar content of *C. roseus* was observed. Total sugar (TS) decreased by 30.36%, reducing sugar (RS) by 28.57% and non-reducing sugar by 30.61% respectively. The biomass was found to decrease up to 7% after the infection by *C. gloeosporoides*. The total alkaloid content in

healthy leaves of *C. roseus* was 0.81 mg/g fresh leaves, however in diseased leaves it was decreased by 21%.

### Acknowledgements

The authors are thankful to the Head, University Department of Botany, T.M. Bhagalpur University, Bhagalpur for providing laboratory facility and Ministry of Environment & Forests, Government of India for financial assistance.

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## Surface analysis of steel samples polarized anodically in $H_3PO_4$ -HCl mixtures by SEM and EDAX techniques

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### Abstract

Potentiodynamic polarization experiments were performed on 304 stainless steel in 14M  $H_3PO_4$  containing 0-20000 ppm HCl at 298, 308 and 318  $^{\circ}K$ . Photomicrographs of the test samples were obtained from Scanning Electron Microscopy after performing anodic polarization experiments on steel samples in 14M phosphoric acid and in 14M phosphoric acid containing critical concentration of HCl at 298, 308 and 318  $^{\circ}K$ . It is witnessed that severe pitting of the surface occurs when chloride ions are added to phosphoric acid. Morphology of pits is studied and pits are found to be partially hemispherical with some corrosion product spread unevenly. The increase in temperature results in increased number of pits but the size of pits becomes smaller. The composition of passive film formed on 304SS is investigated by the Energy Dispersive x-ray analysis (EDAX) technique. The analysis of alloy samples after interrupting polarization of samples in the passive region at critical concentration of HCl shows the presence of chlorine atoms in the film (0.23 -0.36%). The result supports the Point Defect Model proposed by Macdonald et al to explain pitting phenomenon.

**Key words:** Stainless steel; pitting; Scanning Electron Microscopy; Energy Dispersive x-ray analysis.

### Introduction

Present study involves surface analysis of AISI 304SS after treatment in  $H_3PO_4$  - HCl medium. It is observed that stainless steels which are quite resistant to corrosion in various mediums [1] and also in presence of  $H_3PO_4$  (due to formation of passive film), suffer severe destruction in the form of pitting if the medium has aggressive ions like  $Cl^-$ . This type of situation is faced during manufacture, storage and transport of phosphoric acid as HCl is added during acidulation process of its manufacture [1,2]. This added impurity (HCl) makes medium highly corrosive leading to pitting attack on alloy surface.

The corrosion behaviour of 304SS in concentrated phosphoric acid having different concentrations of added impurity in the form of HCl at different temperatures has been described earlier [3,4]. It was inferred from these studies that at a certain temperature,

there is a certain critical concentration of HCl below which pitting doesn't occur but at and above critical concentration of HCl localized attack on alloy surface in the form of pitting is witnessed. Hence the presence of aggressive ion in the form of HCl limits the utilization of 304SS in this medium.

Surface analysis of steels has been done earlier by investigators but Scanning Electron photomicrographs of steels having other compositions are available in literature [5,6]. Furthermore earlier studies were carried out primarily to study stress corrosion, cracking and pitting in other mediums. Hence it seems desirable to study the severity of pitting and effect of temperature on it by surface analysis of steel samples after exposing them to  $H_3PO_4$ -HCl medium. The Present study is done with a view to study the morphology of pits and its dependence on temperature. Energy Dispersive X- Ray Analysis (EDAX) is carried out to ascertain if there is any change in alloy composition on steel surface and to investigate whether chlorine atoms are present on alloy surface.

### Materials and Methods

Test samples were prepared from stainless steel sheets obtained from M/s Goodfellow Metals Ltd, England. The composition of 304SS was 18 Cr, 10 Ni and balance Fe. Test samples were polished and cleaned as mentioned elsewhere [3,4]. The electrode system consisted of the austenitic stainless steel working electrode, a counter electrode of platinum and a saturated calomel electrode (SCE) with  $KNO_3$  salt bridge. The electrochemical experiments were carried out in an air thermostat maintained at 298, 308 and 318  $^{\circ}K$  under still condition. The solution consisted of 14M phosphoric acid with different ppm of HCl (BDH AR Grade) added to it. Potentials were impressed on the working electrode by a fast power potentiostatic Wenking model POS 73.

Potentiodynamic polarization experiments were recorded at scan rate of  $1mV.sec^{-1}$ . Steady state potential of the steel sample in  $H_3PO_4$  was determined and starting from  $E_s$  (steady state potential), potential was increased automatically with a scan rate of  $1mV.sec^{-1}$  and polarization was stopped when potential was well in the transpassive region. Scanning Electron Microscopy of the steel samples was carried

out after the anodic polarization experiments. For this Scanning Electron Microscope JEOL-JSM 840A was used. The samples for such studies were mounted on studs using silver paste and photographs of the desired locations were taken at various magnifications.

Energy dispersive x-ray analysis (EDAX) of the steel samples was carried out after polarization was stopped within the passive region. EDAX was employed for studying point to point composition and elemental distribution of a variety of samples. It was accomplished by employing a detector which was a negatively biased Si chip into which lithium has been diffused and onto which a thin contact Au layer had been evaporated – rays from the specimen entered a wafer of pure silicon carefully treated with lithium. As the x-rays entered the silicon, each one gave up its energy by creating photoelectrons. Electrons were collected in less than a microsecond by an applied bias voltage and integrated by a field – effect – transistor preamplifier. Signal was further amplified to produce a string of pulses. Since the time was proportional to pulse height and thus to x ray energy, the result was build up of a spectrum of counts verses x-ray energy. The energy at which peaks occurred was identified with the elements that produce x-rays. The size of peaks is used to determine the amount of various elements present.

## Results and Discussion

The Potentiodynamic polarization curves obtained by anodic polarization of 304SS at different temperatures have been shown elsewhere [3]. It is observed that irrespective of concentration of HCl and temperature, nature of the potentiodynamic polarization curves is same. It has an active region followed by a passive range and then the curves enter into transpassive region indicating dissolution of passive film. When the concentration of HCl is less than certain critical value steel surface doesn't undergo pitting attack but at and above critical concentration of HCl pitting corrosion takes place (it is ascertained by SEM analysis of alloy surface after the experiment). The critical concentration of HCl at which pitting starts is found to be 7600 ppm at 298<sup>o</sup>K, 3800 ppm at 308<sup>o</sup>K and 2900 ppm at 318<sup>o</sup>K [3,4]. It is observed that at a lower temperature a higher concentration of HCl may be tolerated by alloy without suffering destructive attack in the form of pitting. It has been discussed earlier that the resistance against pitting offered by Mo containing stainless steel alloy in this medium also depends on temperature in a similar manner [7,8].

The photomicrographs of test samples obtained from Scanning Electron Microscopy after performing polarization experiments on 304SS in 14M phosphoric acid and in phosphoric acid containing 7600 ppm HCl

at 298<sup>o</sup>K are shown in fig -1. In Fig 1 (B) a few large scattered pits are shown to be formed on alloy surface. The morphology of pits is same i.e. they are partially hemispherical (Fig 1C). Some corrosion product is spread in and around the pits. It is evidenced from Fig 1(D-E) that at a higher temperature (318<sup>o</sup>K), number of pits formed on alloy surface is increased but the size of pits is smaller.

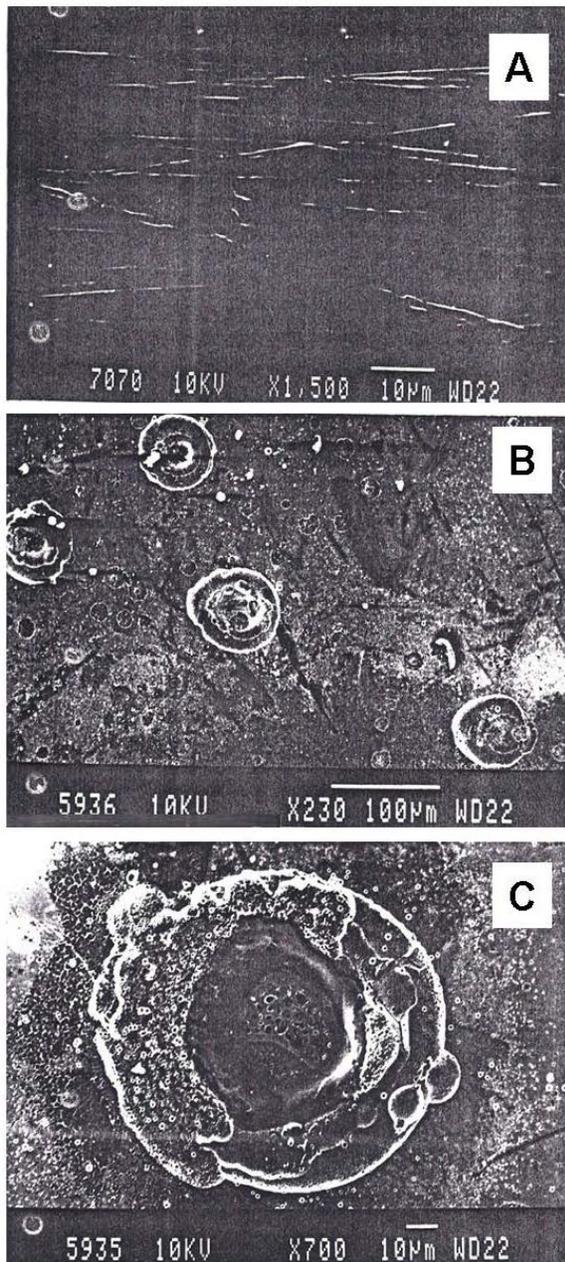
**Table 1** Atomic percentage of different elements in 304SS obtained from EDAX.

Electrolyte Composition	Atomic percentage(%)					
	Cl	Cr	Fe	Ni	Cr/Fe	Ni/Fe
14M H <sub>3</sub> PO <sub>4</sub>	-	19.32	70.58	10.10	0.273	0.143
	-	19.31	70.74	9.95	0.272	0.140
14M H <sub>3</sub> PO <sub>4</sub> + 7600 ppm HCl	0.36	19.55	70.17	9.92	0.278	0.141
	0.23	20.31	70.74	8.72	0.267	0.133

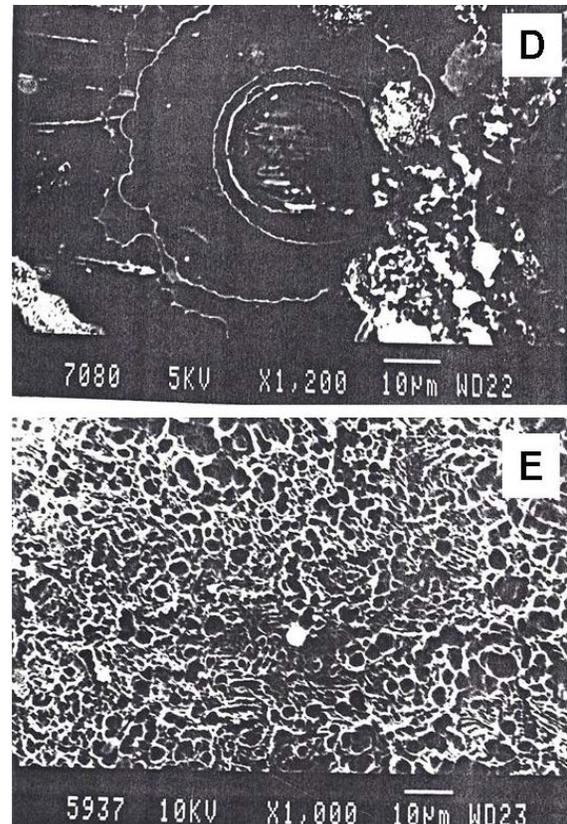
When Cl<sup>-</sup> ions are present in the medium, a very small amount of corrosion takes place in spite of the passive state of the alloy [9]. As the formation of metal oxide film progresses, anodic areas are reduced to very small dimensions. The film growth is due to interaction among metal cations and oxygen ions. The rate of transport of cation vacancies and anion vacancies decide the growth of passive film. Anion vacancies are generated at metal film interface and consumed at film solution interface. At a higher temperature, rate of generation of anion vacancies is more but rate of their consumption by oxygen ions slows down. This is due to the presence of aggressive chloride ions in the medium, which adsorb competitively at anion vacant sites. This in turn creates cation vacancies [10]. At a higher temperature, cation vacancies are generated rapidly due to stronger chemisorptions of halide ions at film solution interface. Due to presence of more cation vacancies and anion vacancies the formation of compact passive film is restricted. This leads to the formation of more porous passive film at a higher temperature as anodic areas are more and density of vacancies is greater [7]. At more noble potentials when metal holes start piling up, formation of void takes place at metal film interface and pitting starts when void grows beyond a certain size. At a higher temperature, pitting starts at several local sites resulting in more number of pits. Size of pits is smaller at a higher temperature as adsorption of halide ions on film surface is limited.

Spectra of 304SS obtained by EDAX analysis after treatment in 14M H<sub>3</sub>PO<sub>4</sub> and in 14M H<sub>3</sub>PO<sub>4</sub>-HCl are shown in Fig-2 and Fig-3 respectively. It is clear from results that when treated in HCl containing medium, chlorine atoms are found to be present on

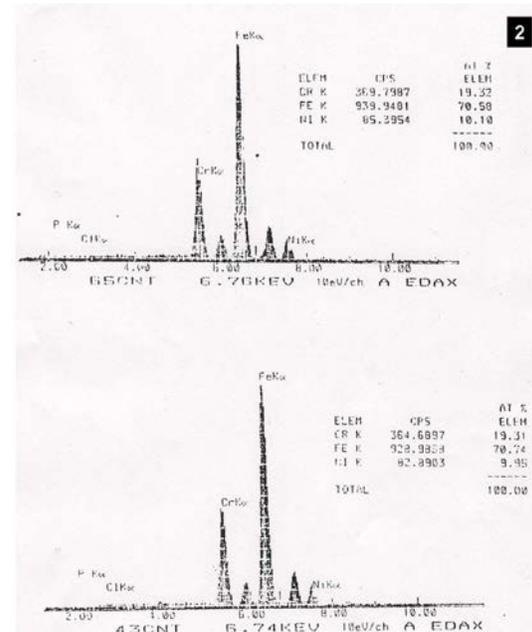
surface of steel samples besides Fe, Cr and Ni. From EDAX analysis of steel samples it is found that 0.23% - 0.36% chlorine atoms are present in passive film



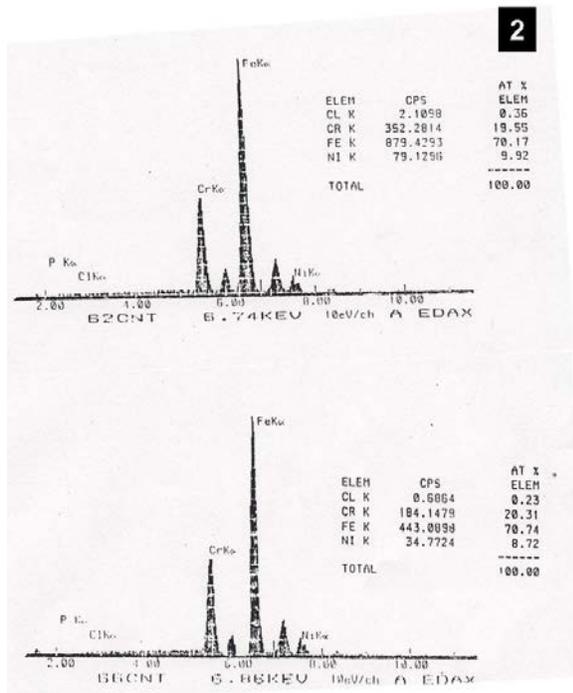
(Table-1). Presence of less than 1% chlorine atoms indicates that passive film has defects and oxygen ion vacancies are occupied up to some extent by halide ions. The result supports Point Defect Model proposed by Macdonald et al [10], according to which chloride ions occupy anion vacancies present in the passive film leading to creation of cation vacancies. When the rate of growth of cation vacancies is more than the rate of their submergence in the bulk, pits are formed.



**Fig. 1:** Photomicrographs obtained by SEM analysis of 304SS samples in 14M phosphoric acid. A. No HCl, at 298<sup>0</sup>K; B-C: with HCl, at 298<sup>0</sup>K; D-E: with HCl at 318<sup>0</sup>K



**Fig. 2:** EDAX spectra of 304SS after treatment in 14M phosphoric acid.



**Fig. 3:** EDAX spectra of 304SS after treatment in 14M phosphoric acid containing HCl.

### Conclusions

It is found from SEM analysis that when concentration of HCl is below critical concentration, pitting doesn't take place. At and above critical concentration pitting corrosion is evidenced. The morphology of pits formed remains the same in all the cases i.e. they are partially hemispherical. At higher temperature more pits having smaller size are found to be present. Porosity of passive film depends on the temperature being more porous at a higher temperature.

It is inferred from EDAX analysis that when steel samples are treated in HCl containing medium, chlorine atoms are present in the passive film. This

supports the view that oxide ion vacancies are occupied by chloride ions up to some extent from the very beginning and continues so long as the passive film formation is completed. The defect density in the passive film leads to the formation of pits ultimately.

### Acknowledgements

Author gratefully acknowledges the experimental facilities provided by Institute of Technology B.H.U., Varanasi. Facilities for SEM and EDAX provided by Dept of Metallurgy, I.T., B.H.U. and Department of Physics, B.H.U. respectively are also gratefully acknowledged. Discussions with Dr M.M. Singh and Dr A.K. Mukherjee, from I.T., B.H.U. were fruitful in the preparation of this paper.

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## Preparation of Mixed Phase Strontium Ferrite Nanoparticles and Effect on Magnetic Properties

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### Abstract

Pure phase and mixed phase strontium ferrite powder were prepared using citrate precursor method. The annealing temperature for both samples was 450°C. The samples were structurally characterized using X-Ray diffractometer (XRD) and magnetically characterized using Vibrating sample magnetometer (VSM). The particle size was observed 15 nm and 8 nm at same annealing temperature 450°C. Some additional phase appears in addition to hexaferrite. The retentivity and magnetization was found 3.321 emu/g, 36.615 emu/g for pure phase sample while 0.64 emu/g and 33.332 emu/g for mixed phase sample respectively. This behaviour suggests that non-stoichiometric preparation as a possible route for engineering preparation of samples for a particular set of magnetic parameter values. In these samples we observed a change in retentivity that seemed independent of magnetization.

**Key words:** Mixed phase ferrite, Citrate precursor method, Magnetic behaviour

### Introduction

Ferrite is an important magnetic material. It has applications in high frequency electronics due to its better heat resistance and higher corrosion resistance [1,2,3]. It has been estimated that in the world market ferrites consist of 40% of the total hard magnetic materials [4,5]. Magnetic core materials and switched mode power supplies are applications involving easy magnetization and demagnetization at high frequencies. They use soft ferrites which have coercivity less than 10 Oe [6]. Hexa-ferrite such as strontium and Barium ferrite find applications in information processing devices, permanent magnets, electromagnetic wave shielding [7,8]. The aim of the present work is to study and compare pure and mixed phased Strontium ferrite in terms of their magnetic properties.

### Materials and Methods

**Experimental procedure:** Nitrates of two cations ( $\text{Sr}^{2+}$ , and  $\text{Fe}^{3+}$ ) were taken in proper stoichiometric proportions as starting materials for pure phase ferrite.

Aqueous solutions of these salts were prepared separately by dissolving the salts in minimal amount of deionized water and stirring constantly. The solutions were then mixed together. Aqueous solution of citric acid was prepared in adequate quantity by weight and was added to the prepared salt solutions. The mixture was heated at 60°C-80°C for two hours with continuous stirring for both the cases. The solutions were allowed to cool to room temperature and finally they were dried at 60°C -65°C in an oven until they turned into brown colour fluffy mass that was later used for preparation of the ferrite powder. The precursor was annealed at temperatures 450°C for one hour in a muffle furnace. During this process, the precursor thermally decomposed and gave brown coloured powder (Sample 1, Fig 1). Another sample (Sample 2) was prepared in similar way except that the stoichiometric proportion was not followed. The amounts taken are given in Table 1. The phase and crystallite size was determined for both the samples using X-ray diffractometer (XRD) (RINT-2200V, Rigaku, Japan). The magnetic measurement of resultant powder was done by Vibrating sample magnetometer (VSM) (BHV-35, Riken Denshi, Japan)

### Results and Discussion

The XRD pattern for  $\text{SrFe}_{12}\text{O}_{19}$  prepared from a stoichiometric mixture of Ferric Nitrate and Strontium nitrate (sample 1) is shown in figure 2 and peak search analysis data in table 2. The XRD pattern for Strontium nitrate with mixing of phase that was prepared from a non-stoichiometric mixture of Ferric Nitrate and Strontium nitrate (sample 1) is shown in figure 3 and peak search analysis data in table 3. We can identify some of the peaks as belonging to  $\text{SrFe}_{12}\text{O}_{19}$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{SrO}_2$ ,  $\text{SrFe}_2\text{O}_3$  [9]. Although an annealing temperature of 450°C is considered to be on the lower side for pure-phase formation in the case of hexa ferrites by many researchers [10, 11], yet the sample of  $\text{SrFe}_{12}\text{O}_{19}$  that we prepared at annealing temperature 450°C had quite good phase. The crystallite sizes as determined by Scherrer formula [12,13.] are 15 nm for sample 1 and 8 nm for sample 2. Such small particle size observed by us at low annealing temperature 450°C. XRD peak search

analysis detail for sample 1 is given in table 2 and for sample 2 in table 3 shows interplaner distance(d) intensity of diffraction peaks of the synthesized samples. This results shows that the mechanism for ferrite formation is different for the given two samples. Monophase hexa ferrite become possible at annealing temperatures as low as 700°C in the citrate precursor method where as it requires high temperature of the order 900°C in other chemical method(18).  $D_{space}$  of the order 3.697 was observed only in sample 2, which belong to hexa ferrite( ICDD file no-27-1029).

**Table 1:** Stoichiometric detail for the two ferrite powder samples

Chemical	Mol. weight	Sample 1		Sample 2	
		Moles	Amount	Moles	Amount
Strontium nitrate	211.63 g	1/20	10.58 g	1/20	11.585g
Ferric nitrate	404 g	12/20	242.4 g	2/20	40.4g
Citric acid	210.14 g	13/20	136.5 g	3/10	31.7g

**Table 2:** XRD peak search analysis detail for sample 1

Angle( Degree)	D space ( A)	Intensity %
30.351	2.9425	38.4
33.342	2.6850	26.4
35.692	2.5135	100
57.047	1.6131	30.7
57.386	1.6044	26.4
62.881	1.4767	41.3
63.280	1.4684	32.0

**Table 3:** XRD peak search analysis detail for sample 2

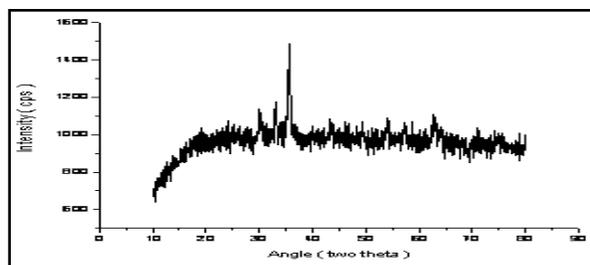
Angle ( Degree)	D-space (A)	Relative Intensity
24.05	3.697	97
25.45	3.497	100
30.55	2.924	68
33.71	2.657	70
35.91	2.499	94
38.35	2.345	61
41.05	2.197	59
41.61	2.169	58
44.31	2.043	76
45.11	2.009	55
46.25	1.961	58
49.65	1.835	61
50.35	1.811	65
57.35	1.605	70
62.41	1.487	73
63.32	1.468	79
64.45	1.445	64
72.61	1.301	59
73.41	1.298	56
80.05	1.198	53
88.61	1.103	52

**Table 4:** Magnetic parameters values for Sample 1 and sample 2

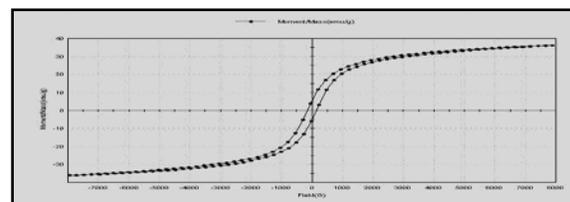
Sample	Phase	Parti- cle size	Coer- civity	Retentivity	Magnet- ization
SrFe <sub>12</sub> O <sub>19</sub>	Hexa ferrite	15 nm	76 G	3.321 emu/g	36.615 emu/g
SrFe <sub>2</sub> O <sub>4</sub>	Hexa ferrite, SrO, Fe <sub>2</sub> O <sub>3</sub> , SrFe <sub>2</sub> O <sub>3</sub>	8 nm	13 Oe	0.641 emu/g	33.332 emu/g



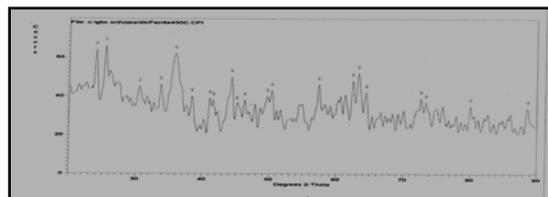
**Figure 1:** Ferrite annealed powder (above); B. Citrate Precursor for SrFe<sub>2</sub>O<sub>4</sub>(below)



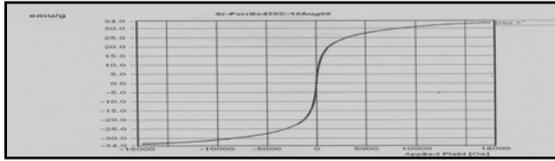
**Figure 2:** XRD spectrum for sample 1



**Figure 3:** Magnetization curve for SrFe<sub>12</sub>O<sub>19</sub> Nanoparticles



**Figure 4:** XRD spectrum for sample 2



**Figure 5:** Magnetization curve for sample SrFe<sub>2</sub>O<sub>4</sub> Nanoparticle.

The magnetic behaviour was studied using Vibrating sample magnetometer. The magnetic hysteresis loop for sample 1 is shown in figure 3 and for sample 2 is shown in figure 5. A comparison of magnetic parameters is done in Table 4. It can be seen that the impure phase sample (2) shows smaller coercivity and retentivity compared to the pure phase sample, but the magnetization is almost same in both samples. The magnetization tends to saturation around 8000 Oe although there is a slight increasing trend. Looking at the hysteresis curves and magnetic parameter values, the samples do not appear to show superparamagnetism [14]. Several researchers have found the magnetic parameters value of this order in ferrites however they have used different method of synthesis [15,16,17,18]. Retentivity and magnetization are generally reported to be inversely related [19,20]. But we have found in our samples a variation in retentivity that is accompanied with relatively small change in magnetization. The possibility of particle-size dependence of the magnetic properties cannot be ruled out, however. It is also generally considered that high anisotropy in hexa ferrite has contribution from all the five sublattices. In case of Barium hexa ferrite, prepared using Sodium Citrate –Aided synthetic process, superparamagnetism behaviour was observed in particles that were less than 10 nm in size [21]. Coercivity 1389 Oe with big particle size 89nm was observed in rare earth substituted Ba-hexa ferrite, synthesized by Citrate approach [22].

## Conclusions

We have observed small particle size 8nm and 15nm at low annealing temperature 450°C using Citrate precursor method. We have made comparison between pure phase and mixed phase of Strontium based oxide material and found almost similar magnetization values but a relatively large difference in coercivity and retentivity. It is not proper to base any conclusion on just two samples, however it will be interesting to investigate further, the variation of parameters in non-stoichiometric cases as we have done. If a correlation of the type that our data suggest is also observed in other cases, then non-stoichiometric sample preparation might open a possibility for engineering

properties of magnetic oxide materials for given values of magnetic parameters.

## Acknowledgements

The authors are thankful to Professor H. C. Verma, Department of Physics, IIT Kanpur, Dr. R.K. Kotnala, Head, Magnetic standard laboratory, NPL, New Delhi for help in sample characterization. We are also thankful to Nishit K. Pandey, Research Scholar, Department of Physics, Patna University for help in phase analysis of XRD spectrum.

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## Information Technology in Educational System in India: A Critical Review

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Today in globalize world, the educational system of India has not been out of touch from information technology. Before globalization, educational system of our country has based on traditional system. The information age is changing the way to work. Some jobs are disappearing, others are emerging and still others are being radically transformed by information technology. But the information age is not just affecting the workplace; its influences are felt in our educational system, too. Before it is over, the information revolution will have a profound and permanent effect on the way, we learn.

Our educational system was developed more than a century ago to teach students the basic facts and survival skills they would need for industrial and agricultural jobs they would probably hold for their entire life. This model has been described as a previous model for reasons (a) It assumes that all students learn the same way and that all students learn the same things, (b) The teacher's job is to 'Pour' facts into students, occasionally checking, (c) The level of knowledge in each student and (d) Students are expected to work individually, absorb facts and to spend most of their time sitting quietly listening to the teacher.

With all of its faults, this educational system helps the students succeed in their professions till the last decade. Now the world has changed and is changing by the day. Schools and colleges have changed too, but not fast enough to keep with the information revolution.

The traditional age may have passed, but the need for reading and writing hasn't. In fact, it is more important than ever, that today's students graduate with the ability to read and write. Many jobs that did not require reading and writing skills a generation ago now use high-tech equipment that demands computer literacy. Recently, worker who can't read printouts is not likely to survive the transition to an automated system today. In the age of cheap calculators, many students think that learning mathematics is a waste of time. In fact, the argue that spend too much time teaching students how to do things like division and calculating square roots - a skill that students seldom do by hand. These arithmetic skills have little to do

with being able to think mathematically. To survive in the high-tech, Indian students need to be able to see the mathematical systems in the world around them and apply mathematical concepts to solve problems. No calculator can do that. In the information age, communication is a survival skill. Modern jobs involve interactions between people and machines and between people and people, the fact is that information-based society depends on our human ability to communicate, negotiate, cooperate, and collaborate, both locally and globally.

The information technology clearly makes new demands on the educational system in India requiring radical changes in what and how people learn. Today information technology are essential parts of these changes. Many of the elementary and secondary schools are now introducing information technology, Students and teachers are using the concepts of information technology in a variety of ways to learn.

The most important application of information technology in the schools & colleges distance learning - using technology to extend the educational process through satellite video transmissions, the internet and other communication technologies offer many promising possibilities. Students can communicate in other parts of the world through the Internet. Two-way video links allow "visiting" experts to talk to students in the virtual classrooms and answer their questions in real time. Networked school can offer multi-school videoconference courses in India. Information technology is particularly important for students in remote locations. Where a student feels difficulties to understand the solution of the problem, the internet offers solution of their problem by on-line reference materials on webpage.

Distance Learning System promises the workers whose jobs are changed or eliminated by a shifting economy by providing the facility to learn new skills for many displaced workers who can't afford to relocate their families to college. On the other hand if a worker has to do the job with schooling, the similar problem arises. Colleges and Universities offer electronic outreach programs, these people can update their skills through Distance Learning System. Since 1990 online degree programs are introduced in colleges and universities.

The future of India will be fashioned in the classrooms. While India has made great strides in improving their education system much still remains to be done. The goal of this report is to outline how information technology (IT) can help to create an educational system that is based on the principle of helping teachers, be effective in what they do; the quality and relevance of class room instruction; and making quantifiable and measurable progress towards improving efficiency. All this is to be done with an understanding of the special social, cultural, political, infrastructural and economic factor prevalent in the country. We have elected to focus on school-level education, simply because that is where the foundations for learning are laid and it is where the most challenges lie.

Educational system in India, information technology is used as teaching aid, research tool and analyzing system. When computer is used as a teaching aid referred to as computer-assisted instruction (CIA.). The computer asks questions to test the student's ability to understand the subject. When a student gives an answer; the computer gives some comments to indicate that answer is right or wrong. If the answer is not correct the computer gives some error signal. The CIA Programs can be prepared in a variety of modes, such as tutorial, discovery, problem solving, modeling, and drill & practice. In tutorial mode the computer presents new ideas followed by text questions. In discovery mode the computer presents information and asks students to draw conclusions. In problem solving mode computer allows students to apply their concepts in solving a problem. In modeling,

mode of process or a system is presented mathematically to make its analysis. Computers can also repeat the presentation of the material as many times as desired. This helps students to make certain concepts clear if they are not clear in earlier attempts. Question banks may be prepared and stored in computer's memory. Test - questions may be stored in such a way that students can simulate an examination to test their knowledge, as and when desired.

Lastly the challenges are to face effective implementations of information technology in the educational system in India. Now a day in educational system in India, the implementation of information technology are not satisfactory because of several causes i.e. lack in Information Technology Acts 2000 & 20064, lack of knowledge of implementing agencies, lack of experts in IT, lack of awareness of the people about the benefits of IT etc. To take a suitable place in globalize world India should be speedy and implement smoothly the IT in educational system from beginning (Primary level to University level) and short out the lacking points in implementation of IT in Educational system. Now regarding IT in educational system in India, the matter of study should be how, when and where?

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## The Multi-Dimensional Aspects of Plant Tissue Culture Research

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**P**lant tissue culture refers to growth and multiplication of cells, tissues and organs on a defined solid or liquid media under aseptic and controlled environment. Plant tissue culture technology is being widely used for large-scale plant multiplication. The commercial technology is primarily based on micropropagation, in which rapid proliferation is achieved from tiny stem cuttings, axillary buds, and to a limited extent from somatic embryos, cell clumps in suspension cultures and bioreactors.

The term tissue culture is actually a misnomer borrowed from the field of animal tissue culture. It is a misnomer because plant propagation is concerned with the whole plantlet and not just isolated tissues, though the explants may be a particular tissue. Although most nurserymen have been introduced to the techniques and advantages of micropropagation, few have ventured to use it as a propagation tool. Some firms having established tissue culture facilities on commercial scale operations are presently in operation for the mass propagation of apples, crabapples, rhododendrons, and a few other selected woody species. The applicability of micropropagation for woody trees has been demonstrated as feasible since all aspects of the technology have confirmed the fact that trees produced by this method look like and grow like their counterparts produced by traditional methods of cloning. The potential for selecting pathogen free plants, for selecting stress-tolerant and pathogen-resistant clones of plants, and the novel genetic combinations to be achieved through somatic hybridization are all lines of research which can have a profound impact on the nursery industry.

### **Plant improvement through tissue culture**

The updates of plant tissue culture reveals that major impact of tissue culture technology would not be in the area of micropropagation, but rather in the area of controlled manipulations of plant germplasm at the cellular level. Researches on the ability to rearrange, and reorganize the constituents of higher plants is already being conducted on ornamental trees and

shrubs with the intent of obtaining new and better landscape plants.

### **Multiplication of plants with enhanced stress or disease resistance**

The most widely researched area of tissue culture today is the concept of selecting disease, insect, or stress resistant plants through tissue culture. As significant, gains in the adaptability of many species have been obtained by selecting and propagating superior individuals, so the search for these superior individuals can be tremendously accelerated using *in vitro* systems. Recent research in this area extends across many interests including attempts to select salt tolerant lines of tomato, freezing resistant tobacco plants, herbicide resistant agronomic crops, and various species of plants with enhanced pathogen resistance.

### **Production of pathogen free plants**

Obtaining, maintaining, and mass propagating of specific pathogen-free plants is another purpose for which plant tissue culture has been utilized. Plant tissues which are free of pathogen under consideration (viral, bacterial, or fungal) are primarily selected as the explants for tissue culture. Cultures which reveal the presence of the pathogen are destroyed, while those which are indexed free of pathogen are maintained as a stock of pathogen-free material. The impact of obtaining pathogen-free nursery stock can only be speculative, since little research documenting viral, bacterial, or fungal diseases transmitted through propagation of woody ornamentals is available.

### **Somatic hybridization**

The non-conventional genetic process of fusion between isolated somatic protoplasts under *in vitro* conditions and subsequent development of their product to a hybrid plant is known as somatic hybridization. Protoplasts are single cells which have been stripped of their cell walls by enzymatic treatment. A single leaf treated under these conditions may yield tens of millions of single cells, each theoretically capable of eventually producing a whole

plant. The potential use of somatic hybridization to bring about novel combinations of genetic material has been demonstrated in the genera *Petunia* and *Nicotiana*. Research funded in part by the Horticultural Research Institute at the University of Wisconsin is investigating the feasibility of using such techniques with woody species. Brent McGown and co-workers have succeeded in obtaining naked cells from tissue cultures of *Betula* and *Rhododendron*, but as of yet, they have neither obtained plants from single cells nor achieved cellular fusion. Not only is the desired information transmitted to succeeding generations of bacteria, but the bacterial cultures become synthesizers of insulin as well. Plant cells can be made to take up foreign genetic codes, but evidence that this can be transmitted into the daughter cells and serve the intended function is lacking.

### Secondary metabolites production

The production of secondary metabolites has long been a subject of interest for biotechnologists. The tissue cultured plants have advantages in metabolite production over intact plants. About 25% prescription medicines and various raw materials used in the industries are obtained from plants. Further, the number of patents on pigments, cosmetics, perfumes and food additives has increased in recent years. Manufacturing these products from natural source are not enough to meet the consumer's demand and efforts have to be made to develop technology for their production at the industrial level. Considering the high economical and pharmacological importance of secondary metabolites, industries are deeply interested

in utilizing plant tissue culture technology for large-scale production of these substances.

In conclusion, the last four decades have seen rapid and exciting advances equal to any seen in biology and the applications of the technology have had global implications. There is no doubt, however, that the combination of genetic modification, and cell and tissue culture applied with due caution presents immense opportunity for progress. Like any other area of science, it started as an academic exercise to answer some questions related to plant growth and development, but proved to be of immense practical value, as an aid to plant propagation, raising and maintenance of high health-status plants, germplasm storage, and a valuable adjunct to the conventional methods of plant improvement

### Acknowledgements

The author extend their appreciation to DST, Serc Div., for research funding through Women Scientist (WOSA) scheme.

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## Acid Rains: Causes, Effects and Remedy

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Since the beginning of civilization, human beings have used various natural resources for their benefit. To make their life easier, they have produced facilities that use many of the Earth's energy resources. Energy is mainly produced by burning fuels such as coal, oil and natural gases. On one side this kind of development makes our lives easier, but on the other hand it results into pollution by release of harmful substances into the environment. Acid rain is one of the most serious environmental problems emerged due to air pollution. Acid rain is a broad term that describes several ways through which acid falls out from the atmosphere. Acid rain includes acidic rain, fog, hail and snow. Acid rain is a global problem that is gradually affecting environment. This communication briefly reviews the causes, effect and remedies of acid rain.

### Chemistry of acid rain

The degree of acidity is measured in pH units, which indicate the concentration of hydrogen ions. The pH scale vary from 14 (most basic) to 0 (most acidic). Distilled water is neutral because it is in the middle of the pH scale i.e. pH 7. A decrease of 1pH unit means increasing of hydrogen ion concentration. Unusually normal rain water is also slightly acidic because carbonic acid is formed from carbon dioxide in the atmosphere. "Acid Rain," or more precisely acidic precipitation, is the term used to describe rainfall that has a pH level of less than 5.6--a pH of 7 being neutral.

Acid rain is formed by a chemical reaction that begins when compounds like sulphur dioxide and nitrogen oxides are released into the air. The two primary sources of acid rain are Sulphur dioxide (SO<sub>2</sub>), and oxides of nitrogen (NO<sub>x</sub>). Sulphur dioxide is a colorless gas released as a by-product of combusted fossil fuels containing Sulphur variety of industrial processes, such as the production of iron and steel, utility factories, and crude oil processing produces this gas. Sulphur dioxide can also be emitted into the atmosphere by natural disasters or means. This accounts for ten percent of all Sulphur dioxide emission, coming from volcanoes, sea spray, plankton, and rotting vegetation. Overall, 69.4 percent of

Sulphur dioxide is produced by industrial combustion. Only 3.7 percent is caused by transportation. The other chemical that is also chiefly responsible for the make-up of acid rain is nitrogen oxide. Oxides of nitrogen are a term used to describe any compound of nitrogen with any amount of oxygen atoms. Nitrogen monoxide and nitrogen dioxide are all oxides of nitrogen. Sulphur dioxide reacts with water vapour and sunlight to form sulphuric acid and nitrogen oxides form nitric acid in the air. This reaction takes hours or even days during which polluted air may move hundreds of kilometer. Thus acid rain can fall far from the source of their formation. Acid rains contain not only sulphur dioxide and nitrogen oxides but also heavy metals, carbon monoxide and photo chemical oxidants. Reactions between these substances strengthen their effect. See the ecological consequences of rain water at internationally in general and in India in particular in table 1-2.

**Table - 1:** Rainwater pH values in different regions of the world (modified from Khemani *et al.*, 1994)

Countries	Range of pH
Japan	4.7
Europe	4.1 - 5.4
China acid rain area	4.1 - 4.9
China non - acid rain affected area	6.3 - 6.7
US north west	5.1 - 5.2
US west- middlewest	5.0 - 5.5
US north west	4.1 - 4.2

**Table - 2:** Range of rainwater pH in different parts of India (modified from Khemani, 1993)

Regions	Cities	pH
Coastal area	Trivendrum	5.3
Industrial area	Chembur	4.8
Power plant	Inderprasth	5.0
	Koradi	5.7
	Singrauli*	5.8*
Urban area	Pune	6.3
	Delhi	6.1
Non urban area	Sirur	6.7
	Muktsar	7.3
	Goraur	5.3

### Causes and Effects

Human activities are the main cause of acid rain over the past few decades. Humans have released so many different chemicals into the air that they have changes the composition of the gases in the air. Industrial factories, power plants release the majority of sulphur

dioxide and much of the nitrogen oxides when they burn fossil fuels such as natural gas, coal to produce electricity. Another cause is vehicles that burn petrol, diesel, kerosene etc. The exhaust emitted by burning these fuels contains sulphur dioxide and nitrogen oxides

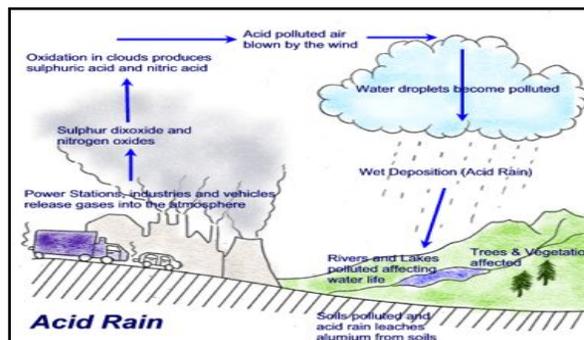
The word “environment” relates to surroundings. It includes virtually anything. Indeed Einstein once remarked: “The environment is everything that is not me”. We can also define “environment” as anything which may be treated as covering the physical surroundings that are common to all of us, including air, space, waters, land, plants and wild life. Acid raining is harming the environment. Figure 1-2 is the diagrammatic representation showing cause of acid rain and its effect.

**Effect on plants:** Acid rain seeps in to the earth, poisons plants and trees by dissolving toxic substances in the soil such as aluminum which get absorbed by the roots. Acid rain also dissolves the beneficial minerals and nutrients in the soil, which are washed away before the plants and trees have a chance of causing them in order to grow. When there is frequent acid rain, it corrodes the waxy protective coating of leaves. When this protective coating on the leaves is lost, it results in making the plant susceptible to disease. When the leaves are damaged, the plant loses its ability to produce sufficient amount of nutrition for it to survive. Then plants become vulnerable to the cold weather, insects and diseases.

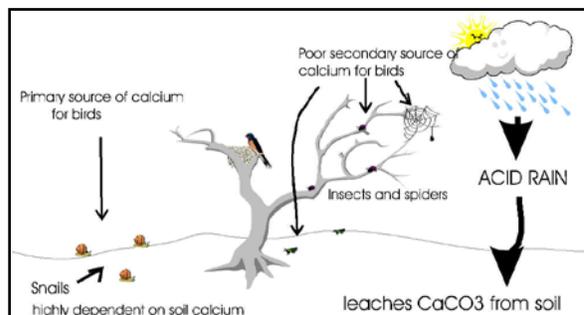
**Effect on aquatic Life:** Acid rain damages every thing over a period of time because it makes the living things in the environment die. Acid rain also affects the life in the water. It is almost worse in water than on land. All rain water contains some level of acidity. All the sea life will die when the water that they swim gets to be acidic. If the water goes below a pH of 4.5 all fishes including frogs, insects etc will die. With a pH of 5.5 all of the bottom-dwelling bacterial decomposes, animals that eat the remains will die. Aquatic plants will grow the best in a pH between 7 and 9.2. If acid rains get to be more of a problem then all of the sea life will die.

**Effect on human Health:** Acid rains effects to the human health also in many ways. It has the ability of harming us via the atmosphere as well as the soil. Acid rain results in toxic metals breaking from the chemical compounds they occur in naturally while toxic metals may be dangerous. Once acid rain causes these toxic metals to be released they can infiltrate into the drinking water, the animals or crops that human uses as source of food. The contaminated food can damage the nerves in children or result in severe brain damage or even death. Scientists suspected that Alzheimer’s disease is also associated with acid rain. Another

adverse health effect of acid rain on human is the respiratory problems it causes. The emissions of nitrogen oxides and sulphur dioxide causes respiratory problem like throat, nose, eye irritation, headache, asthma and dry coughs. It is particularly very harmful for those who have difficulty in breathing or suffer from asthma. In fact even the lungs of healthy people can be damaged by the pollutants in the acid rain.



**Figure 1:** Diagrammatic representation showing cause of acid rain and its effect on vegetation and aquatic system.



**Figure 2:** Diagrammatic representation effect of acid rain on animals.

### Acid Rain: an international problem

The pollutants that cause acid rain are carried by wind (travelling 1000-2000 km within the atmosphere in 3-5 days). They are therefore easily transported across international boundaries. This means that a country suffering the effects of acid rain is not necessarily responsible for its creation. Many forests and lakes in Scandinavia for example have been damaged by pollution which has travelled from Britain. Therefore international co-operation is essential to solve the problems caused by acid rain.

### Remedy measures

There are certain remedies measures which may be adopted against acid rain problem are as follows:

1. **Use of low sulphur coal:** The amount of sulphur dioxides emitted by power plants can be reduced by burning coal with a low percentage of sulphur present.

2. *Use of scrubbers:* Power plant and factory chimney can be fitted with scrubbers that release 90 to 95 % sulphur free smoke and also produce sludge from which gypsum, a building material can be produced. This problem can also be solved by enforcing tight emission standards of vehicles that burn gas and diesel. An another solution is fitting devices such as catalytic converter into car exhaust pipes to minimize the amount of sulphur-dioxide car can exhaust. Additionally alternative energy sources are gaining more prominence and funding is being given to the restoration of ecosystems damaged by acid rain world wide.
3. *Fluidized Bed Combustion:* In the system known as atmospheric fluidized-bed combustion, a turbulent bed of pulverized coal and limestone is suspended by an upward blast of air. The combustion chamber has many boiler tubes which convert water into steam. The turbulent mixing of coal and air allows the combustion to occur at a lower temperature which reduces the formation of nitrogen oxides. The limestone captures the Sulphur oxides by converting them to calcium sulfate which is a solid rather than a gas. This process also burns the coal more efficiently by about 5 %. This process removes 90 % of the Sulphur oxides and 15-35 % of the nitrogen oxides.
4. *Limestone Injection - Multistage Burner:* Limestone injection multiple burning is still in the development and testing stages. Crushed limestone is injected into a boiler burning powdered coal at lower than normal temperatures. The limestone combines with Sulphur dioxide to produce a solid ash (mostly gypsum, calcium sulfate). This process removes 70 % of both Sulphur and nitrogen oxides.

### Reports on acidic episodes

The first incidence of acid rain seems to have coincided with onset of the industrial revolution in the mid 19th century. Gorham, 1958 observed acid rain problem in England then as a regional phenomenon in Scandinavia in the late 1960's [1]. By 1965, the pH of rainwater in Sweden was about 4 or less and it was reported in 13<sup>th</sup> UN conference on the Human Environment held at Stockholm in 1972. This was the beginning of acid rain research. It was suggested that rain and snow in many industrial regions of the world are between five and thirty times as acidic as would be

expected in an unpolluted atmosphere [2]. In 1974, over the northeast United States, the pH of rain and snow was found to be around 4.0 [5]. Until the mid 1970s, the problem of acid rain was mainly confined to north America and Scandinavia, but thereafter pH of precipitation well below 4.5 in much of central and northern Europe and it was recorded. American records include a rain of pH 2.7 at Kane in Pennsylvania and a rain of pH 1.5 falling over wheeling in West Virginia in 1979 [3]. At Banchory in northeast Scotland, the pH of rain was sometimes as low as 3.5 [4].

### Acid rain in context to India

India Meteorological Department has found increasing acidity in rain samples from Pune and Nagpur. The samples were acidic with pH values less than 5 pH is a measure of the acidity or alkalinity of a solution.

Taj Mahal, one of the wonders of the world and the pride of India was facing serious threat from pollution caused by Mathura Refinery, iron foundries, glass and other chemical industries. As a result of very high toxic emissions from these industries, the Taj Mahal and 255 other historic monuments within the Taj trapezium were facing serious threat because of acid rain. The Petition was filed in the year 1984. The Supreme Court of India delivered a historic Judgment in December 1996. The apex Court gave various directions including banning the use of coal and coke and directing the industries to switch over to Compressed Natural Gas (CNG).

In sum, there are ways to reduce acid rain, but all ranging from societal changes to individual action.

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