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# 19

## Concept of Conventional Health Care System in Uttarakhand

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Prashant Arya and J. P. Mehta

### Abstract

*The present chapter is a study of the conventional medical practices use by the people of Uttarakhand region. Forest and forest products have historically played a significant role in the economy as well as culture and religious in this region since ancient time. Forest has played an important part in history of civilization. They have affected the distribution of mankind over the earth surface and have influenced the religious life of primitive people. Himalaya has great wealth of medicinal plants and traditional knowledge. Central Himalaya Region covers the new state of India which comprising the major divisions of Kumaon and Garhwal region. This region has played a significant role in the historical processes of Northern India and provides a mini model for understanding the Indian conventional medical system. Another important view of Himalaya is its mythological history. It is very interesting to note that this region has the local gods and goddesses who are more powerful than the Brahmanical gods. Such gods go back to prehistoric times. Himalayan concept of diseases is also belonging to these local*



## ROLE OF TRADITIONAL KNOWLEDGE IN HEALTH CARE SYSTEM OF INDIA INCLUDING COVID-19 PANDEMIC

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### Abstract

*This book chapter is a review-based study of the traditional medical practices of the people of India. Forest and its products have historically played a significant role in the economy as well as culture and religion since ancient times. The Himalayas possess great wealth of medicinal plants and knowledge. This region has played an important role in Northern India's historical processes and provides a mini-model for understanding the traditional Indian medical system. Approximately 80 percent of the population in the most developed countries still uses traditional plant-derived medicines to treat human diseases. Another aspect of the health care system of India is the highest uses of medicinal plants and several therapies for curing various diseases. Almost all our modern medicines are extracted from medicinal plants. Medicinal plants produce a wide variety of compounds which besides giving them characteristic pigments, odour and flavour may also have antimicrobial properties. Issues related to traditional Indian structure of medicine including Ayurveda are described in this chapter.*

### INTRODUCTION

Approximate 80 percent of people in developing countries depend on traditional medicines for primary health care needs, according to an estimate by the World Health Organization; a significant part of these involves the use of medicinal plants (Samant et al., 1998). Traditional Himalayan medicine system is a perfect example of Traditional Knowledge System (TKS) where small groups are protecting their lives from incurable diseases through conventional methods that came from their father or grandfather and go to the next generation (Konget et al., 2003). Via these traditional methods, they also cure their animals as well as humans of different diseases. These traditional approaches are entirely oral, and they are not documented. Generally, they use herbal products such as resin, leaf, bark, root, stem, foliage, bulb etc. (Agrawal et al., 1999).

#### Meaning of Ayurveda

“तवायुर्वेदयतीत्यायुर्वेदः” (Charak Samhita Sutra 30/23) Ayurveda is that which gives knowledge about life. Ayurveda is one of the oldest controlled healthcare systems for



## Chapter 13

# Vulnerability of Forest Vegetation Due to Anthropogenic Disturbances in Western Himalayan Region of India

Akash

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### ABSTRACT

*The Western Himalayan zone of India is not only threatened by rapid climatic changes, natural floods, and fires, but also by anthropogenic activities. Himalayan forests are vulnerable due to climatic changes and faced severe ecological deterioration due to anthropogenic pressures. The degradation of forests due to anthropogenic disturbances is increasing because of overgrowth of population, high poverty ratio, as well as the limitations of alternative livelihood options. Further resources from forest makes it inseparable to manage forest stands without considering the importance of socio-economic status and ecological aspects of forest management to the well-being of local communities. Therefore, the Himalayan forests and the communities depending on forests should be seen as a part of an evolving. This chapter will explore the vulnerability of the knowledge towards Western Himalayan forests and community-based management of forests. Additionally, it will sketch potential sites affected through anthropogenic pressures.*

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## Chapter 6

# Effects of Atmospheric Pollutants on Biodiversity

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### ABSTRACT

*Biodiversity is severely affected by the various anthropogenic activities. Humans depend on natural resources for survival. The resources include food, clean drinking water, timber for construction, fibers for clothing, natural gas, and coal for industries. The biggest threat to the atmosphere is pollutants caused by different human activities. The earth atmosphere is a layer of gases that surrounds the planet and allows us to breathe and live. The atmosphere is made up of Nitrogen, Oxygen, and others types of gases. This mixture of gases is known as air. Air pollution results from a variety of pollutants like  $\text{NO}_2$ ,  $\text{SO}_2$ ,  $\text{CO}$ , CFCs, and Ozone. Carbon dioxide, which is a greenhouse gas, warms the earth. This chapter will explore the effects of atmospheric pollutants on biodiversity due to various types of adulterants in the atmosphere and its effects on the survival of earth. Additionally, it will sketch various tools that can reduce these harmful activities.*

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## Chapter 14

# Wild Plants Used as a Forest Ecosystem Services by the Local Inhabitants of Champawat District of Uttarakhand to the Subsistence of Their Livelihood

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### ABSTRACT

*This chapter deals with scientific information about the wild socioeconomic plants used by the local inhabitants of the Champawat district of Uttarakhand for the enhancement of their livelihood. During this entire study, it was observed and documented that poor rural people of this area are educationally and financially backward, and they do not have any permanent source of income; due to this reason they are unable to fulfill their necessary requirements. Therefore, they are totally dependent on various forest ecosystem services, viz., selling prepared herbal medicines, wild edible fruits, and wild ornamental plants, etc., which shares approximately 45-50% of their total annual income and plays a vital role for the upliftment of their livelihood. During this research work, a total of 63 plant species belonging to 58 genera under 46 families have been documented, which are being used as livelihood resources by the locals of this area.*

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# Studies on the Fodder Resources in a Montane Valley of Uttarakhand, Western Himalaya, India

Dinesh Singh Rawat<sup>1</sup>, P.L. Uniyal<sup>2</sup>, Meena Nautiyal<sup>3</sup>, P. Tiwari<sup>4</sup> and J.K. Tiwari<sup>5</sup>

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## Abstract

The present study was aimed to document wild fodder resources with their seasonal availability, mode of feeding and total importance value (TIV) in western Ramganga valley, Uttarakhand. About 39.02 per cent species of the total existing flora (651 spp.) are used as fodder by inhabitants of the area. Majority of the species (201 spp.) are used as green fodder while 51 species as both green and dry fodder. TIV analysis revealed that the tree species have highest socio-economic importance to the local people (average TIV  $44.83 \pm 2.18$ ), followed by shrubs ( $27.58 \pm 1.10$ ), herbs ( $26.73 \pm 1.71$ ) and climbers ( $23.62 \pm 1.90$ ). TIV  $\geq 70$  was observed for *Aesculus indica*, *Cerasus cerasoides*, *Pyrus pashia*, *Quercus floribunda*, *Q. leucotrichophora* and *Q. semecarpifolia*. This study can serve as a ready reference for researchers and will be helpful in management, development and cultivation of livestock feed in the mountain ecosystem of Uttarakhand.

## ■ INTRODUCTION

The fragile mountain ecosystem of Uttarakhand is well known for its rich natural resources. Forests in the vicinity of human settlements play an important role in the life and livelihood of local people. Collection of fuel wood and fodder from the forest is the main step that turns the cycle of economy and livelihoods of the rural people across the Indian Himalayan Region (Patnaik, 1986; Dhyan *et al.*, 2011). Thus, the dependence on the forest in the vicinity for the basic needs like fodder, fuel wood, timber, medicines, *etc.*, is part of livelihood and economy (Kala, 2007). Up to 87 per cent of fodder requirement is met by the forest directly in the Himalaya region (Pandey and Singh, 1984). Extraction of fodder resources from forests often leads to forest degradation.

Uttarakhand comprises of two distinct physiographic regions, *viz.* plain (13.93%) and hills (86.07%). Larger part is characterized by a difficult terrain, undulating topography, remote and inaccessible villages, sparse population, tiny land holdings, agriculture based economy and weak infrastructure (Negi *et al.*, 2009). Agriculture based activities are the main source of livelihood to 75-90 per cent population, dominated by traditional subsistence on cereal farming (Maikhuri *et al.*, 2011). Fragmented and small land holdings, sloping lands and rainfall-dependent farming aggravated by migratory grazing leads to very poor yield (Chauhan *et al.*, 2016).

In Uttarakhand hills, the inhabitants mainly obtain feed and fodder for livestock from forests and agricultural residues (Singh and Sundriyal, 2009). Studies on fodder collected from wild are inadequate and



# 3

## Pollen Morphology of Some Anemophilous Plants in Srinagar Garhwal, Uttarakhand

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Shikha Arya<sup>\*1</sup>, Rattan Sharma<sup>1</sup>, Ajendra Singh Bagri<sup>1</sup>,  
Eja Gloch<sup>1</sup>, Prabhawati Tiwari<sup>1</sup>, Alok Sagar Gautam<sup>2</sup>

### Abstract

*Frequent surveys were made for the collection of anemophilous plants of Srinagar valley. There are several plant species which is pollinated through wind such as Pinus, Broussonatia, Morus etc. Pollen samples were collected from Srinagar valley for pollen morphological studies. Morphological studies on the pollen grains of some anemophilous plant species relieved in the study area were carried out by light Microscopy and Scanning Electron Microscopy (SEM). Many characters like unit, Amb, polarity, symmetry, shape, size, ornamentation, exine thickness were analyzed for morphology. All pollens recorded were monad. Most of them were circular with radial symmetry. Majority of the pollen were of shape class spheroidal and size class minutae. Phyllanthus emblica was having the thickest exine with the thickness of 2.84µm. Predominant aperture type was trizonoporate (4 spp). 2 species of plants were*

---

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Bhumi Nath Tripathi  
Dhananjay Kumar  
*Editors*

# Prospects and Challenges in Algal Biotechnology

 Springer



# Prospects and Challenges in Algal Biotechnology

Bhumi Nath Tripathi · Dhananjay Kumar  
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# Prospects and Challenges in Algal Biotechnology

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# Chloroplast Metabolic Engineering for Sustainable Agriculture

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## 7.1 Introduction

Metabolic engineering is the manipulation of key steps in the target metabolic process of plants to increase the production of specific plant metabolites used as food or that have nutritional value or that are used as therapeutically important compounds. Plant scientists and researchers have performed tremendous efforts to understand the mechanism and regulation of different metabolic processes of agriculturally significant plants. Understanding of these processes opens new avenues to modify agricultural crops that could introduce transgenic plants, also called genetically modified (GM) crops. The introduction of the first transgenic plant started a second green revolution with the aim of providing food to all through sustainable and eco-friendly development. GM crops could comply with the targets, but many social hurdles have limited their success.

Plants produce food via photosynthesis required to sustain the biosphere. There are three major components of photosynthesis: photosynthetic pigment and photo-systems involved in light absorption processes, electron transport systems, and carbon fixation systems. Because plants cannot move, they must cope with regular changes occurring in the atmosphere in the form of biotic and abiotic stresses. Light is the most important factor that limits photosynthesis and crop yield. It varies as low, moderate, and high light, and also in the form of variations in day–night cycles, all of which influence the intensity, direction, and spectral quality of light. To increase light absorption under low light conditions and minimize photo-damage under high light conditions, genetic manipulations of chlorophyll metabolism (both biosynthesis and degradation) and antioxidative defense mechanisms (specifically for singlet oxygen, which is most frequently damaging, and hydrogen peroxide) are the some approaches to improving crop yield in changing and challenging environmental conditions.

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# MICROALGAE: POTENTIAL AGENTS FOR CARBON DIOXIDE MITIGATION

Preeti Singh, Rahul Kunwar Singh and Dhananjay Kumar

*Department of Botany and Microbiology, HNB Garhwal University, Srinagar Garhwal, India*

## 4.1 INTRODUCTION

Nowadays, climate change, especially global warming, is drawing the attention of scientific and high-level political meetings throughout the world. Despite these discussions and consequent efforts, the world is unable to reduce the global average temperature which is continuously increasing after initiation of industrialization in 1850. According to an estimate by IPCC (2013), the global average temperature has increased by 1.53 °C during 1880–2012. NOAA has recorded the highest global average temperature in May 2016 over the 137-year period of record, at 0.87 °C above the 20th century average of 14.8 °C (NOAA, 2016). Recently a global climate agreement was set up by the participant countries in the Paris climate conference, which is due to enter into force in 2020. A long-term goal of keeping the increase in global average temperature to well below 2 °C above pre-industrial levels was set up in this agreement ([http://ec.europa.eu/clima/policies/international/negotiations/paris/index\\_en.htm](http://ec.europa.eu/clima/policies/international/negotiations/paris/index_en.htm)).

# Involvement of Reactive Species of Oxygen and Nitrogen in Triggering Programmed Cell Death in Plants



Vineet Kumar Maurya, Dhananjay Kumar, Chandramani Pathak,  
and Budhi Sagar Tiwari

**Abstract** Programmed cell death (PCD) is a multifaceted process involved in cell number control, removal of diseased or inflamed cells and maintaining homeostasis between dying and newborn cells. It is a fine regimented process under strict genetic control. The process is not only associated with developmental programs of plants and animals but also observed during extreme fluctuations in environmental factors, as well as during noncompatible biotic interactions. In particular, stress-induced PCD in plants has been hypothesized as one of the survival strategies. At the regulatory stages of the process, amplification of cellular reactive species of oxygen (ROS) and nitrogen (RNS) acts as key signalling events for execution of PCD. Although roles of ROS and RNS in execution of PCD have been well studied independently, information about cross-talks between ROS and RNS are limited. In this chapter, efforts have been made to compile the available information regarding involvement of ROS, RNS and their cross-talk during the execution of PCD in plants.

**Keywords** ROS · RNS · Signalling · PCD · Cross-talk · Abiotic stress · Chloroplasts · Mitochondria

## 1 Introduction

Every surviving organism in the universe is destined to die, thus signifying that life and death are the two wheels of a cart. Due to natural urge of longer and better life, continuous efforts have been made to decipher bio-physiochemical events of life, both in plants and animals. Compared to life, death seems an unimportant

---

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# 4

## *Molecular Mechanisms of Heavy Metal Hyperaccumulation in Plants*

Anupa Fonia, Preeti Singh, Vijetna Singh, Dhananjay Kumar, and Bhumi Nath Tripathi

### CONTENTS

4.1 Heavy Metal Pollution .....	99
4.2 Conventional Methods for Removal of Heavy Metals .....	100
4.3 Phytoremediation Technologies .....	100
4.4 Metal Hyperaccumulator Plants .....	102
4.5 Functions of Metal Hyperaccumulation in Plants .....	104
4.6 Mechanisms of Metal Hyperaccumulation in Plants .....	104
4.6.1 Heavy Metal Uptake by Roots .....	104
4.6.2 Root-to-Shoot Translocation of Absorbed Metals .....	106
4.6.3 Detoxification and Sequestration of Heavy Metals in Hyperaccumulators .....	107
4.7 Use of Transgenic Plants for Metal Hyperaccumulation .....	110
4.8 Conclusions and Future Perspectives .....	112
Acknowledgments .....	113
References .....	113

### 4.1 Heavy Metal Pollution

The term heavy metal has been used frequently in the scientific literature in referring to more than 60 metallic elements of a density greater than 5 g/cm<sup>3</sup> (Nies and Silver 1995). Many times, this term is also used collectively in discussing transition metals, some metalloids, lanthanoids, actinides, and organometallic compounds (Gadd 2009). Although low levels of some heavy metals, such as, Cu, Fe, Zn, Mn, Co, Mo, Ni, etc., are essential for the physiological machinery of living organisms, elevated concentrations of all kinds of heavy metals are invariably toxic to biota (Rai et al. 1981, Kotrba et al. 2009). Besides toxicity, heavy metals have bioenrichment tendencies due to their nonbiodegradable nature, and so they are considered more hazardous than other pollutants. The availability of heavy metals to living organisms is often low because the metals remain either immobilized in rocks in the form of ores or are restricted only to some specific locations, such as volcanic soils and hot springs. However, anthropogenic activities, particularly industries, have contributed much to today's enhanced metal concentrations in soils and aquatic systems. Several industries, like smelters and refining, electroplating, metal polishing, explosives, mineral mining, metal finishing, storage batteries, petroleum, welding, and alloy manufacture, have added enormous amounts of various heavy metals, such as cadmium, chromium, copper, nickel, lead, and zinc, to soils and natural water bodies. Certainly, if these toxic metals are allowed to enter the food chain, they will pose serious threats to living



## 5

### Ecology of the Diazotrophic Microbiome

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and Shree Prakash Tiwari<sup>2</sup>

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#### 5.1 Introduction

Nitrogen (N) is a crucial element for all forms of life on the earth; required for synthesis of nucleotides and amino acids. Though N is available in the atmosphere as a major component (78%), it is in the form of diazo nitrogen which cannot be utilized by the producers in any ecosystem due to its chemical inertness. So, limited availability of nitrogen is usually linked to nitrogen phosphorous ratio, productivity, as well as other processes, in several ecosystems (Hou et al. 2012). The conversion of atmospheric diazo nitrogen into biologically utilizable forms like nitrates ( $\text{NO}_3^-$ ) and ammonia ( $\text{NH}_3$ ) is known as nitrogen fixation and the microbial communities involved in the phenomenon are called nitrogen fixers or diazotrophic microbiome. There are several diazotrophs maintaining a symbiotic relationship with legumes and non-legumes; the majority of the diazotrophic microbiome is free living and found in the rhizospheric region of plants. Hence, the diversity and composition of the diazotrophic microbiome varies with the physico-chemical parameters and the vegetation of the ecosystem (Chen et al. 2019). This chapter focuses on the basics of biological nitrogen fixation (BNF) along with diversity and ecology of the diazotrophic microbiome in different ecosystems.

#### 5.2 Different Modes of Nitrogen Fixation

Nitrogen fixation is done artificially in industries for commercial production of chemical nitrogen fertilizers. In nature, nitrogen fixation may take place either naturally during thunderstorms and lightning, or biologically by a unique group of microorganisms, nitrogen fixers or diazotrophs, which utilize the atmospheric bimolecular nitrogen and convert it into ammonia using nitrogenase enzyme complex (Wagner 2011). The BNF accounts for about 50 percent of fixed nitrogen available on our planet and produces about 210 teragram

# MICROALGAE: POTENTIAL AGENTS FOR CARBON DIOXIDE MITIGATION

Preeti Singh, Rahul Kunwar Singh and Dhananjay Kumar

*Department of Botany and Microbiology, HNB Garhwal University, Srinagar Garhwal, India*

## 4.1 INTRODUCTION

Nowadays, climate change, especially global warming, is drawing the attention of scientific and high-level political meetings throughout the world. Despite these discussions and consequent efforts, the world is unable to reduce the global average temperature which is continuously increasing after initiation of industrialization in 1850. According to an estimate by IPCC (2013), the global average temperature has increased by 1.53 °C during 1880–2012. NOAA has recorded the highest global average temperature in May 2016 over the 137-year period of record, at 0.87 °C above the 20th century average of 14.8 °C (NOAA, 2016). Recently a global climate agreement was set up by the participant countries in the Paris climate conference, which is due to enter into force in 2020. A long-term goal of keeping the increase in global average temperature to well below 2 °C above pre-industrial levels was set up in this agreement ([http://ec.europa.eu/clima/policies/international/negotiations/paris/index\\_en.htm](http://ec.europa.eu/clima/policies/international/negotiations/paris/index_en.htm)).

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## The Plant Microbiome in Sustainable Agriculture

### Chapter 5

## Ecology of the Diazotrophic Microbiome

Preeti Singh, Rahul Kunwar Singh, Dhananjay Kumar, Shree Prakash Tiwari

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## Summary

This chapter focuses on the basics of biological nitrogen fixation (BNF) along with diversity and ecology of the diazotrophic microbiome in different ecosystems. BNF is the major source of nitrogen input to terrestrial ecosystems throughout the world. The BNF in tropical forests by non-symbiotic microbiome is affected by nutrient level as well as the soil characteristics. Several studies have been performed on genetics of the nitrogenase enzyme complex, as the structure of nitrogenase and dinitrogenase reductase enzymes is highly conserved throughout the majority of diazotrophic organisms. Termites have diazotrophic microbiome in their gut as normal flora and are distributed worldwide. The diazotrophic microbiome in the aquatic system consists of a variety of prokaryotes such as planktonic as well as benthic organisms, including autotrophs and heterotrophs. The generation of genetically modified plants that could fix their own nitrogen has been continuously discussed and attempted by scientists since the beginning of genetic engineering technologies.

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# Involvement of Reactive Species of Oxygen and Nitrogen in Triggering Programmed Cell Death in Plants



Vineet Kumar Maurya, Dhananjay Kumar, Chandramani Pathak,  
and Budhi Sagar Tiwari

**Abstract** Programmed cell death (PCD) is a multifaceted process involved in cell number control, removal of diseased or inflamed cells and maintaining homeostasis between dying and newborn cells. It is a fine regimented process under strict genetic control. The process is not only associated with developmental programs of plants and animals but also observed during extreme fluctuations in environmental factors, as well as during noncompatible biotic interactions. In particular, stress-induced PCD in plants has been hypothesized as one of the survival strategies. At the regulatory stages of the process, amplification of cellular reactive species of oxygen (ROS) and nitrogen (RNS) acts as key signalling events for execution of PCD. Although roles of ROS and RNS in execution of PCD have been well studied independently, information about cross-talks between ROS and RNS are limited. In this chapter, efforts have been made to compile the available information regarding involvement of ROS, RNS and their cross-talk during the execution of PCD in plants.

**Keywords** ROS · RNS · Signalling · PCD · Cross-talk · Abiotic stress · Chloroplasts · Mitochondria

## 1 Introduction

Every surviving organism in the universe is destined to die, thus signifying that life and death are the two wheels of a cart. Due to natural urge of longer and better life, continuous efforts have been made to decipher bio-physiochemical events of life, both in plants and animals. Compared to life, death seems an unimportant

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257

# Involvement of Reactive Species of Oxygen and Nitrogen in Triggering Programmed Cell Death in Plants



Vineet Kumar Maurya, Dhananjay Kumar, Chandramani Pathak,  
and Budhi Sagar Tiwari

**Abstract** Programmed cell death (PCD) is a multifaceted process involved in cell number control, removal of diseased or inflamed cells and maintaining homeostasis between dying and newborn cells. It is a fine regimented process under strict genetic control. The process is not only associated with developmental programs of plants and animals but also observed during extreme fluctuations in environmental factors, as well as during noncompatible biotic interactions. In particular, stress-induced PCD in plants has been hypothesized as one of the survival strategies. At the regulatory stages of the process, amplification of cellular reactive species of oxygen (ROS) and nitrogen (RNS) acts as key signalling events for execution of PCD. Although roles of ROS and RNS in execution of PCD have been well studied independently, information about cross-talks between ROS and RNS are limited. In this chapter, efforts have been made to compile the available information regarding involvement of ROS, RNS and their cross-talk during the execution of PCD in plants.

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# 5

## Mushrooms: A Review on Medicinal, Therapeutical and Nutritional Properties

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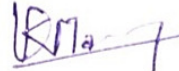
Reena Gangwar<sup>1</sup>, Rajendra Prasad Bhatt  
and Vineet Kumar Maurya<sup>1</sup>

### Abstract

*Mushrooms are higher fungi with additional nutraceutical attributes having low fat content and a trans-isomer of unsaturated fatty acids along with high fibre content, phenolic compounds, triterpenes, sterols and chitosan. They are considered as the unmatched source of healthy foods and drugs. They have excellent attractive taste, aroma and nutritional value, so they are considered functional food, meaning that they are beneficial to the body not only in terms of nutrition, but also for better health. Mushrooms and their extract have a large number of bioactive components known as secondary metabolites. In mushroom extracts, the presence of  $\beta$ -glucans polysaccharide or protein complex material polysaccharide is of great therapeutic application in human health as they have many properties such as anti-diabetic, anti aging, anti-obesity, hypocholesterolemia, anti-cancer, immunomodulatory, hepatoprotective nature. The present review focuses on a comprehensive account of the medicinal and nutritional properties of various wild and cultured mushrooms,*

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# 9

## Antibacterial Activity of *Grewia Optiva* Drummond Ex Burret Against Selected Bacteria

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Meena<sup>1</sup>, Vineet Kumar Maurya<sup>2</sup>, and Munesh Kumar<sup>1</sup>

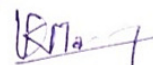
### Abstract

*Grewia optiva* is a small to medium sized tree growing abundantly in agroforestry field of Garhwal Himalaya and used for fodder, fuel and fiber by Himalayan farmers. The aim of the present study was to know the antibacterial properties of *Grewia optiva*. Leaves and bark of *G. optiva* were collected from nearby Chauras campus of HNB Garhwal Himalaya, and air dried under shade condition. Extract of leaves and barks were prepared separately, using polar organic solvents like chloroform and methanol. Antibacterial activities of the extracts were tested using well-diffusion assay, against the selected human pathogenic bacteria i.e., *Staphylococcus aureus*, *Streptococcus pneumonia* and *Klebisella pneumoniae*. Methanol extracts of leaves and bark of *Grewia optiva* showed good activity against all the selected bacteria used in present study, at concentration of 20mg/ml, except methanolic extract of leaf which

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## Herbal wound healing agents

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Abha Negi<sup>d</sup>, Asha<sup>e</sup>, and Vineet Kumar Maurya<sup>d</sup>

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### 8.1 Introduction

Wound occurs as a result of the disruption of the biochemical, cellular, and anatomic continuity of a tissue. Although wounds themselves are not dangerous unless they cause massive blood loss, they could be a gateway for pathogenic microbes to invade the body. In ancient wars, soldiers most commonly die of wound infection rather than their injuries. Wound healing is a natural process that starts just after a wound is caused. The immune system, blood, and epithelial tissue participate in the healing process of wound. For a healthy person, wounds take 3–4 days to months to heal depending on the severity of the wound. Infections delay wound healing and slow down regeneration of damaged tissue. For quick recovery of wound, it must be protected from infection, and the host's immune system must be fully functional. Most medications for wound healing, only protect the wound from infection but do not promote natural wound healing process. But there are descriptions of many herbal healing agents in ethnobotany and ancient literature that not only protect wound from infection but also promote wound healing process by supporting the body immune system. Plants and their extracts have immense potentials for the management and treatment of wounds.

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## Nutraceuticals and their impact on human health

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### Abbreviations

DSHEA	Dietary Supplement Health and Education Act
FDA	Food and Drug Administration, USA
FSSAI	Food Safety and Standards Authority of India
GMOs	genetically modified organisms
GOS	galactooligosaccharides
LAB	lactic acid bacteria
MUFA	monounsaturated fatty acids
PEG	mercutaneous endoscopic gastric tubes
PUFA	molyunsaturated fatty acids

### 11.1 Introduction

Food and medicines are two important requirements for healthy life. Food can be defined as an edible material, consumed to satisfy gastric appetite of a living being, which besides satisfying the appetite, provides nutrition for growth, development and general health of the body, while medicine could be defined as a crude or purified substance of natural or synthetic origin, that can cure structural of physiological abnormality of a diseased living organism. The purpose of consuming both food and medicine is entirely different, and one can't serve the purpose of the other, but

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## Bacteriocin producing lactic acid bacteria: Their relevance to human nutrition and health

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### 16.1 Introduction

Fermented foods have been prepared and consumed by humans since time immemorial. These foods are known for their refreshing qualities, nutritive, and therapeutic potentials. Fermentation is one of the oldest methods used by man for the preservation of different foods such as milk, grains, meats, fruits, and vegetables. Fermentation produces shelf-stable, micro-biologically safe foods that also possess additional organoleptic characteristic that make them more palatable and desirable. The bacteria that play major role in the preparation of fermented foods are lactic acid bacteria (LAB). As a result of their growth in the raw food, these bacteria function as biocatalysts that alter chemical and organoleptic characteristics of the original food substrate. The metabolic activities of the LAB preserve the nutritional attributes of food as they produce the some inhibitory metabolites, which prevent the growth of spoilage and pathogenic microorganisms that might also be present in the finished product. In many fermented foods, the metabolic activities of the microorganisms also enhance the nutritive value of the food as bioavailability of otherwise indigestible constituents is increased.

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R. Maurya

## Chapter 9

# Proteins Involved in Colorectal Cancer: Identification Strategies and Possible Roles



Sudhir Kumar, Divya Goel, Neeraj, and Vineet Kumar Maurya

**Abstract** Colorectal cancer is one of the five types of commonly occurring cancer in the world. Like other cancers, it is also a result of uncontrolled cell divisions. Each disease bears clear proteomic signatures, which if identified properly would assist in its early diagnosis and timely treatment. Comparative proteomics and microarray technologies enable the study of differential proteomics signatures of a disease. Using these two technologies, some proteins like beta-subunit of 14-3-3 proteins (14-3-3 $\beta$ ) and aldehyde dehydrogenase 1 (ALDH1), etc. have been identified as possible biomarkers for detection of colorectal cancer (CRC). Proteomics signature not only provides clue about biomarkers for colon cancer but also indicates drug targets that can be utilized for treatment of cancer. Most common drug targets for cancer are expected to be the proteins involved in cell cycle, protein synthesis, signaling and transport, etc. Tumor antigen p53 (p53), E2F transcription factor 1 (E2F1), ribosomal protein L15 (RPL15), vascular endothelial growth factor (VEGF), G protein-coupled receptor 35 (GPR35), nucleoside diphosphate kinases (NM23), erythroblastic oncogene-B (c-erbB-2), and urokinase-type plasminogen activator (uPA) are some of the proteins which have been explored for their possible roles in colorectal cancer. These proteins along with other crucial proteins are described in the present chapter for their role either as biomarker or drug target for colorectal cancer. Besides “omics,” “data mining technology”-based studies were also explored for their possible role in proteomic profiling of colorectal cancer.

**Keywords** p53 · GPR35 · E2F1 · RPL-15 · CD44 · ATM/ATR · JAK/STAT · Microarray · Data mining

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# 4 Role of Nano-Biotechnology in Agriculture and Allied Sciences

*Uma Chaurasia, Ashutosh Kumar, Deepak Kumar Maurya, Sudheer Kumar Yadav, Touseef Hussain, and Vineet Kumar Maurya*

## CONTENTS

4.1	Introduction .....	70
4.2	Nanotechnology for Agriculture.....	71
4.2.1	Nanopesticides/Insecticides and Nanofertilizers.....	71
4.2.1.1	Nanopesticides .....	71
4.2.1.2	Nanofertilizers .....	73
4.2.2	Nanosensors and Nano-Biosensors.....	75
4.2.3	Nanotechnology in the Food Sciences.....	76
4.2.4	Nanoscale Biosensors .....	77
4.3	Nanotechnology for Waste and Pollution Management .....	78
4.3.1	Nanotechnology in Agricultural Wastes/Residues Recycling .....	78
4.3.2	Microorganism Assisted Nanoparticle-Based Metal Remediation ....	79
4.4	Nanotechnology for Genetic Engineering and Crop Improvement.....	81
4.5	Nanotoxicity: Cause and Remediation .....	81
4.6	Quantum Effect of Nanomaterials and Their Different Forms .....	82
4.6.1	Nanoencapsulation.....	83
4.6.2	Nanoemulsions.....	84
4.6.3	Nanocomposites.....	85
4.6.4	Nanospheres.....	85
4.7	Conclusion .....	85
	Acknowledgement .....	86
	References .....	86

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*Uma*

69



## Microbes in drinking water: Control and prevention

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### 1 Introduction

One of the most essential parts of life is water. A major goal for health and a basic human right is to have access to clean, adequate, and safe potable water (Samra and Fawzi, 2011). There are finite numbers of freshwater resources present which are utilized for agricultural purposes, industrial benefits, and even for human survival. Adequate amounts and quality of freshwater are required for sustainable development; without water this is unimaginable (Bartram et al., 1996; WHO, 2008; Kirisits et al., 2019; Grayman et al., 2012). Inadequate supplies of freshwater and water pollution threaten the ongoing development of human welfare. To generate safe drinking water, several different kinds of water treatment programs are essential (WHO, 2008; Fogden and Wood, 2009; Javed et al., 2020). Dumping and discharge of toxic chemicals directly into fresh water sources, over-pumping of aquifers, transfer of long-range atmospheric pollutants, and tainting water bodies with substances and constituents that have potential to promote algal growth (which lead to eutrophication) are the foremost causes of degradation of quality of water (Bartram et al., 1996; Kirisits et al., 2019).

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## The role of government in urban water management

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### 1 Introduction

Water availability and security of potable water are the topmost global priorities of the present time. There are several dimensions of water security, but the availability of water is the prime aspect. At present, ~7 billion people in 43 countries suffer any sort of water scarcity, and approximately 4 billion people face severe water for at least 1 month each year (Mekonnen and Hoekstra, 2016). Worldwide, approximately 1.2 billion people (a fifth of the global population) live in areas having natural water scarcity, and almost 1.5 billion (a quarter of the global population) face water shortage problems due to insufficient infrastructure for water supply (WHO/UNICEF, 2019; Mishra et al., 2021). There are many natural and anthropogenic reasons for worldwide sub-optimal water supply, which include increasing population, rapid depletion and degradation of water sources, weak infrastructure, and poor administration of water resources.

'Water-related disasters' is the second dimension of water security, having a serious negative impact on both human lives and the economy. The latest reports show that 74% of all-natural disasters that occurred during 2001 and 2018, were water-related disasters. Droughts and floods have claimed more than 0.16 million lives and affected ~3.0 billion human beings over the past 20 years. At the same time, they have caused a total economic loss of almost 700 billion US dollars (Gomez San Juan et al., 2019; FAO, 2007, 2020; UNESCO World Water Assessment Programme, 2020).

# Environmental factors and plant–microbes (endophytes) interaction: an overview and future outlook

Ashutosh Kumar<sup>1,\*</sup>, Vineet Kumar Maurya<sup>2,\*</sup>, Cherukuri Susmita<sup>1</sup>, Uma Chuarasiya<sup>3</sup>, Deepak Kumar Maurya<sup>4</sup> and Sanjay K. Singh<sup>4</sup>

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## 15.1 Introduction

Agriculture demand will exert massive pressure on natural resources to nourish the increasing world population (FAO, 2009; Herforth et al., 2020). Presently, agricultural practices largely depend on synthetic fertilizers to ensure the food security of the world's continuously growing population. Uses of synthetic fertilizers in agriculture have several threatening results as synthetic fertilizers contaminate water via denitrification and leaching. To nourish the newly added human in the existing population is the prime responsibility for ensuring world soil sustainability. Regarding the continuation of agriculture sustainability, the whole perceptive of soil complexity is initially significant (Prasad et al., 2017) and soil sustainability for the future human population (Kumar et al., 2019; Kumar et al., 2021a). Currently, crop cultivation has gained its crest, and little challenging to increase agriculture productivity without exploring agricultural land. Therefore, it is an apt time to investigate non-conventional resources to develop sustainable agricultural cultivation methods with water, soil, and air quality sustainability insurance. Modern biotechnological tools and techniques help to understand microbial communities' abundance and functions associated with the plant and plant-associated materials (Wang et al., 2018, 2021a,b; Solanki et al., 2019c, 2020a,b, 2021a,b; Malviya et al., 2020, 2021a,b, 2022).

The endophytic microorganisms (fungi and bacteria) are potential means to manage agricultural productivity and sustainability. The rhizospheric microbiome has enormous latent in gaining agricultural sustainability in the current environmental changing scenario (Vaxevanidou et al., 2015; Patil and Solanki, 2016; Chaurasia et al., 2021). Many previous reports have concluded the significant development of analysis and application of rhizospheric microbiomes of different plants for growth promotion, biocontrol, nitrogen fixation, plant stress tolerance, and bioremediation (Solanki et al., 2011, 2016, 2019a,b, 2020c, 2021a,b; Kashyap et al., 2019a, b; Kumari et al., 2019, 2020; Anal et al., 2020; Mahapatra et al., 2020; Singh et al., 2020a,b; Malviya et al., 2021a,b). Thus, endophytic microbes can supplement plant health without deteriorating environmental quality (Maurya et al., 2021). Different kinds of bacteria were reported as plant growth promoters from the plant endosphere (Wang et al., 2017, 2020; Malviya et al., 2019; Solanki et al., 2019c; Singh et al., 2020a,b). Growth-promoting endophytic bacteria are the group of bacteria that promotes plant growth via N fixation (Rediers et al., 2003), phosphate solubilization (Senthilkumar et al., 2009), indole-3-acetic acid synthesis (Dias et al., 2009), production of siderophore (Logeshwaran et al., 2009), minimizing biotic or abiotic stresses, inducing pathogen tolerance (Bhattacharyya and Jha, 2012) and production of plant-growth substances (Dias et al., 2009).

\*Contributed as the first author.

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# 1

## Development of Traditional System of Medicine in India, Prospects of Traditional Medicine

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Dinesh Kumar Yadav\*  
Hina Mathur, Neetu Kumari\*  
Vineet K. Maurya\*\*  
Mohammad Faheem Khan\*\*\*  
Devendra P. Mishra\*\*\*\*

### Traditional Medicine

The World Health Organization (WHO) have defined the traditional medicine (TM) as “health practices, approaches, knowledge, and beliefs incorporating plant, animal and mineral based medicines, spiritual therapies, manual techniques and exercises, applied singular or in combination, to treat, diagnose and prevent illnesses or maintain well-being”<sup>1</sup>.

In India, for example, the first step towards gratitude of traditional medicine came with the adoption of the Indian Medicine Central Council Act in 1970, with a mandate to standardize training, establish accredited research institutions and monitor standards for guidance and practice in this type of medicine.

In 2003 the Indian Government established the AYUSH (Ayurveda, Yoga, Unani, Siddha and Homeopathy) Department, which main task is to developed AYUSH educational standards and research, quality regulation and consistency of various drugs used in traditional medicine, and raising public knowledge about its relevance. Today, Ayurveda is practiced along with modern medicine in around 3,000 hospitals and 20,000 dispensaries. It also has its own dedicated health care and research centers, and is trained in about 400 undergraduate and postgraduate colleges.

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## Alternative System of Medicine: A Holistic Approach to Cure Human Being

---

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### Introduction

Substitutive medicine is used in consign of conventional medicine. An example of the Substitutive therapy is using a nutraceutical diet to defeat cancer instead of undergoing rigorous surgery, energy ray treatment, or drug therapy that has been suggested by a conventional doctor. Alternative medicine is now become prominent among different existing systems<sup>1</sup>.

This term is collectively used to cover all forms of medicine except allopath. In 1973, the Medical Faculty of the University of Rome organized the first World Congress of Alternative Medicines, and the provisional program contained no less than 135 different therapies. Substitutive medical systems are made up on whole systems of assumption and performing art. All these systems have been developed as part of conventional medical trend generally widely used in United States. Homeopathic medicine and naturopathic medicine are nurtured in Western world; in contrast traditional Chinese medicine and Ayurveda have been developed in non-Western world

Day by day the use of alternative medicine in increased immensely. Interest of peoples is increasing continuous today. Marvelous increasing interest of the American public in alternative medical care, the American Congress, in October 1991, directed the National Institutes of Health (NIH), which is the leading therapeutic study institution in the nation, to generate a workplace to "investigate and validate unconventional medical practices." In 1993, that workplace was retiled as "Office of Alternative

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Ravindra Soni *Editors*

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# Bioremediation of Environmental Pollutants

Emerging Trends and Strategies

 Springer

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# Chapter 1

## Waste Management: Challenges and Opportunities



Neha Badola and Jaspal Singh Chauhan

### 1.1 Introduction

'Waste' includes all those substance or materials which is discarded by a holder. The generation of waste is always corresponding to the different activities that take place under urbanization, economic development, and population growth (Kaza et al. 2018; Bhatt et al. 2020). Changing life style in large cities has enhanced the demand of products that release a large amount of waste. For example, with the advent of mobile phones, a large amount of electronic waste has been invaded our earth. Not only the cities but also the rural areas are encroached by the huge mountains of garbage. Solid waste is one of the crucial issues that the world is facing today. Useless and undesirable waste arising by various human and animal activities is termed as solid waste. Alam and Ahmade (2013) stated the characteristics of solid waste as Corrosive, Reactive, Ignitable, and Toxic, yet these characteristics differ from waste to waste. Solid waste has the potential to cause negative impacts on human and animal health and can also significantly affect economic development of a Nation. Proper disposal of discarded waste is a critical challenge in many countries throughout the globe. Unscientific disposal and treatment of solid waste has already covered much of our land and oceans. Presently, the availability of space required to discharge solid waste is an urgent matter of concern. The problem of solid waste has started since many decades. During the earlier time, the large amount of generated solid waste was either organic or consist of metals, glass, and other particles. Most of such waste was biodegraded and mixed into the soil or reused and recycled. But with increasing population, the products like plastic which is non-biodegradable was introduced as a substitute for many things and hence today from micro to mega-size products, the application of plastic is almost seen. Plastic waste is mostly

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1



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# Nano-biotechnology for Waste Water Treatment

Theory and Practices

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## Chapter 4

# Application of Plant-Based Nanoparticles in Wastewater Decontamination



Sudhir Kumar and Jaspal Singh Chauhan

**Abstract** Wastewater treatment is an important challenge of this century as it safeguards the health of our environment and living being. Wastewater is always regarded as a significant source of environmental pollution due to its potential to harm both living and non-living beings. Many physical, biological, and chemical modes of treatment are implied to comply with the standards of wastewater discharge, given by competent national agencies for protecting the environment. Researchers from all over the world have recently become more interested in the synthesis of plant nanoparticles and their application for wastewater decontamination since it is an environmentally benign, cost-effective, and efficient technology. Parts and extracts of various plants are being explored for the synthesis of nanoparticles. Green synthesized nanoparticles are highly efficient for recycling and removal of toxic contaminants from wastewaters and make it reusable in different aspects. However, synthesis, regeneration, and reusability are the major obstacles that must be addressed before the technology transferred from laboratory to commercial applications. In this chapter, we focused on the different approaches of plant-based nanoparticle synthesis and their applications in wastewater treatment. Further, important challenges in the field of plant-based nanoparticles in the wastewater treatment are also discussed.

**Keywords** Plant-based nanoparticles · Metal ion reduction · Wastewater treatment · Protein based nanoparticles

---

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89





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# Preparation of Phytopharmaceuticals for the Management of Disorders

*The Development of Nutraceuticals and Traditional Medicine*





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## Nutraceuticals and their impact on human health

Anand Prakash Maurya<sup>a</sup>, Jaspal Chauhan<sup>b</sup>, Dinesh Kumar Yadav<sup>c</sup>, Reena Gangwar<sup>d</sup>, and Vineet Kumar Maurya<sup>d</sup>

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### Abbreviations

DSHEA	Dietary Supplement Health and Education Act
FDA	Food and Drug Administration, USA
FSSAI	Food Safety and Standards Authority of India
GMOs	genetically modified organisms
GOS	galactooligosaccharides
LAB	lactic acid bacteria
MUFA	monounsaturated fatty acids
PEG	percutaneous endoscopic gastric tubes
PUFA	polyunsaturated fatty acids

### 11.1 Introduction

Food and medicines are two important requirements for healthy life. Food can be defined as *an edible material, consumed to satisfy gastric appetite of a living being, which besides satisfying the appetite, provides nutrition for growth, development and general health of the body*, while medicine could be defined as *a crude or purified substance of natural or synthetic origin, that can cure structural of physiological abnormality of a diseased living organism*. The purpose of consuming both food and medicine is entirely different, and one can't serve the purpose of the other, but

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# The Role of Photosynthetic Microbes in Agriculture and Industry



Keshawanand Tripathi  
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## Nanoemulsions of Plant-Based Bioactive Compounds

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#### ABSTRACT

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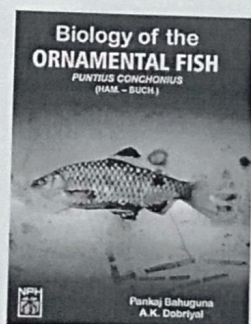
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**3.4.5** Number of books and chapters in edited volumes published per teacher during the last five years:

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Dangwal, M., **Dangwal, L.R.** & Singh, T. 2017. Some Economical Important Phytoplanktons of Tehri Dam Reservoir, Uttarakhand. In: Semwal, V.P. (Ed.), *Conservation of Aquatic Biodiversity and Emerging Trends of Freshwater Environment*. Transmedia Publication, Srinagar Garhwal. pp. 92–96. ISBN: 978-81-904778-2-8.

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Fish Biotechnology and Emerging Trends in Fresh Water Environments  
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## Some Economical Important Phytoplanktons of Tehri Dam Reservoir, Uttarakhand

**Mukta Dangwal<sup>1</sup>, L.R. Dangwal<sup>2</sup> and Tajinder Singh<sup>3</sup>**

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<sup>2</sup>Herbarium and Plant Systematic Lab., Department of Botany, H.N.B. Garhwal University, SRT Campus, Badshahithaul, Tehri Garhwal, Uttarakhand

### Abstract

Uttarakhand Himalaya has variable tectonomorphic features. The villages are scattered within rugged topography of the area. They are fully depends on the natural resources of the area. Spring water is one of the important natural resource for their livelihood. Phytoplankton's play an important role in the maintasining aquatic ecosystem of the district. Some economical important phytoplankton's of the reservoir are *Anabaeana*, *Polycystis*, *Spirulina*, *Bitryococcus*, *Cladophora*, *Microspora*, *Scenedesmus*, and *Triboneama*, etc.

### Introduction

Phytoplankton is a free- floating, wandering type of plants that are generally found in the water. It is a component of the plankton's community. Most of the phytoplanktons are too small to be able to be seen with the human eye alone unless there are incredibly large numbers of it floating together. If this occurs, a human will typically see phytoplanktons are greenish in color. This is nominally due to the effects of photosynthesis or phytoplankton photosynthetic organisms swimming or suspended in the water column, and important as the basis for aquatic food webs. Phytoplankton, also known as microalgae, are similar to terrestrial plants in that they contain chlorophyll and require sunlight in order to live and grow. Most phytoplankton is buoyant and floats in the upper part of the water bodies, where sunlight penetrates the water. They have also requires inorganic nutrients such as nitrates, phosphates, and sulfur which they convert into proteins, fats, and carbohydrates. The two main classes of phytoplankton are dinoflagellates and diatoms. In a balanced ecosystem, these planktons provide food for a wide range of sea creatures including whales, shrimp, snails, and jellyfish. When too many nutrients are available, phytoplankton may grow out of control and form harmful algal blooms (HABs). These blooms can produce extremely



Srivastava, A., Madhukar, V. K., **Dangwal, L.R.** & Srivastava, S.K. 2018. Conservation of wild threatened ornamental plants through horticultural practices in Western Himalaya, India. In: Agnihotri, P. & Khuraijam, J. S. (Eds.), *Angiosperm Systematics: Recent trends and emerging issues (Felicitation volume in honour of Dr. Tariq Husain)*. M/s Bishen Singh Mahendra Pal Singh, Dehradun, India. pp. 405-414. ISBN: 978-81-211-0981-9

## 22 CHAPTER

### Conservation of Wild Threatened Ornamental Plants Through Horticultural Practices in Western Himalaya, India

Amber Srivastava<sup>1</sup>, Virendra Kumar Madhukar<sup>2</sup>,  
**L.R. Dangwal<sup>3</sup>** & \*S.K. Srivastava<sup>4</sup>

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#### Abstract

The Western Himalaya is one of the biodiversity hotspots of India. Several native and endemic plants have become threatened due to various factors like over-exploitation, habitat loss, low regeneration potential, anthropogenic activities, over-grazing, climate change etc. Among these threatened plants, there are some native species which are having high ornamental potential and they represent themselves as a signature species of the ecosystem. Thus, the present study has been carried out on the horticultural potential of some selected threatened wild ornamental species of Western Himalaya that can be used to sustain livelihood of local peoples. This study also focuses on the conservation status, threats, conservation and propagation techniques of ten selected threatened plant species endemic to Western Himalaya.

**Keywords:** Wild ornamentals, threatened, endemic, horticulture, Western Himalaya.

#### Introduction

The Western Himalaya is one of the biodiversity hotspots of India and supports over 4,500 species of angiosperms reported from the three states *viz.*, Jammu & Kashmir, Himachal Pradesh and Uttarakhand (Singh & Thadani, 2011). Several plant species have become threatened due to various factors like overexploitation, habitat loss, low regeneration potential, anthropogenic

Dangwal, L.R. & Singh, T. 2018. Ethno-botanical study of some forest medicinal plants used by Gujjar Tribe of District Rajouri (J&K), India. In: Rahi, J. (Ed.), *The Gujars Vol. 4*. J&K Academy of Art, Culture and Languages, Srinagar. pp. 255–261.

The Gujars Vol. 4

Compiled by Dr. Javaid Rahi

255

## **Ethno-Botanical Study of Some Forest Medicinal Plants Used by Gujjar Tribe of District Rajouri (J&K), India**

L.R. Dangwal

Tajinder Singh

### **Introduction**

District Rajouri is one of the important hilly district of Jammu and Kashmir state with an altitude ranging from 470-6000m asl, covering an area of 2630 sq km. It lies between 32° 58' and 33° 35' North latitude and 74° 10' East longitude, located in western part of Jammu division and foot hill of Pir Panjal range. The Gujjar tribes contribute the major segment of the population of the study area and lives neighbouring the forests for their own purposes (Schultes 1962; Gaur 2008; Gaur et al. 1992; Abudal et al. 2008). The primary occupation of the Gujjar tribes is rearing of cattle and migrate from one place to another in different altitudinal zones upto 4000m asl. in the study area for better grazing as well as other opportunities.

Live stock population has been an important resource of the Gujjar tribe. Therefore, the cattle and their own healthcare has been a major concern to various societies. Ethno-medicinal as well as medicinal practices are community based indigenous knowledge which has been transferred from generation to generation. About 70% of the world population continues to rely on their

Uniyal, P. & Dangwal, L.R. 2020. Plant growth analysis in *Ricinus communis* L. (Family Euphorbiaceae) grown in temperate region in Tehri Garhwal. In: Negi U.S. & Petwal, K.C. (Eds.), *Promoting the Advancement of Applied Sciences*. ABS Books, Delhi, India. pp. 177-188. ISBN: 9789387229440.

# 11

## Plant Growth Analysis In *Ricinus Communis* L. (Family Euphorbiaceae) Grown in Temperate Region in Tehri Garhwal

Priyanka Uniyal\*  
Dr. L.R. Dangwal\*\*

### Introduction

The family Euphorbiaceae is commonly known as the spurge family. It comprises of 228 genera and 6547 species worldwide (The Plant List, 2013), and 70 genera and 410 species in India (efloraindia.nic.in). *Ricinus* is a monotypic genus in the family comprising of only one species, *Ricinus communis* L. It comes under the subfamily Acalyphoideae. The species is widely distributed in the tropical and sub-tropical regions around the world, and is probably indigenous to the SW Mediterranean Basin, Eastern Africa and India (Phillips & Rix, 1999). This plant is commonly known as 'Arandi' or 'Castor bean

---

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## Chapter 7

# *Ex-situ* Conservation of Threatened Plants of India at Botanical Survey of India, Dehradun

*Amber Srivastava<sup>1</sup>, S.K. Srivastava<sup>1</sup> and L.R. Dangwal<sup>2</sup>*

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Badshahithaul, New Tehri – 249 199

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### Abstract

*The chapter deals with the conservation strategies applied for the ex-situ conservation of the Red listed plants of India in the botanical garden of Botanical Survey of India, Dehradun. The propagating material of the species are collected from the wild habitats and propagated in the nursery. The species are provided with possible specific habitat requirement to study the growth pattern and survival percentage in ex-situ condition.*

*Keywords: Ex-situ, Conservation, Threatened, Endangered, Propagation.*

### Introduction

India is one of the 19-mega diverse countries of the world and stand fourth in Asia besides harbors a unique combination of biological resources in its diverse habitats and ecosystem. Of the total floral diversity of the world, 11.4 percent is present in the Indian sub-continent. In the present state of our knowledge India



Dangwal, L.R. & Uniyal, P. 2022. Some important medicinal plants used in protecting human skin from Sun damage. In: Semwal, V.P. (Ed.), *Climate Change and Conservation of Biodiversity and Natural Resources in the Himalayan Environment*. M/s Bishen Singh Mahindra Pal Singh, Dehradun, India. pp. 461–466. ISBN: 978-93- 92570-346.

## 39 CHAPTER

### Some Important Medicinal Plants Used in Protecting Human Skin From Sun Damage

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Herbarium and Plant Systematic Laboratory, Department of Botany, H.N.B. Garhwal University (SRT Campus), Badshahithaul, Tehri Garhwal, Uttarakhand  
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#### Abstract

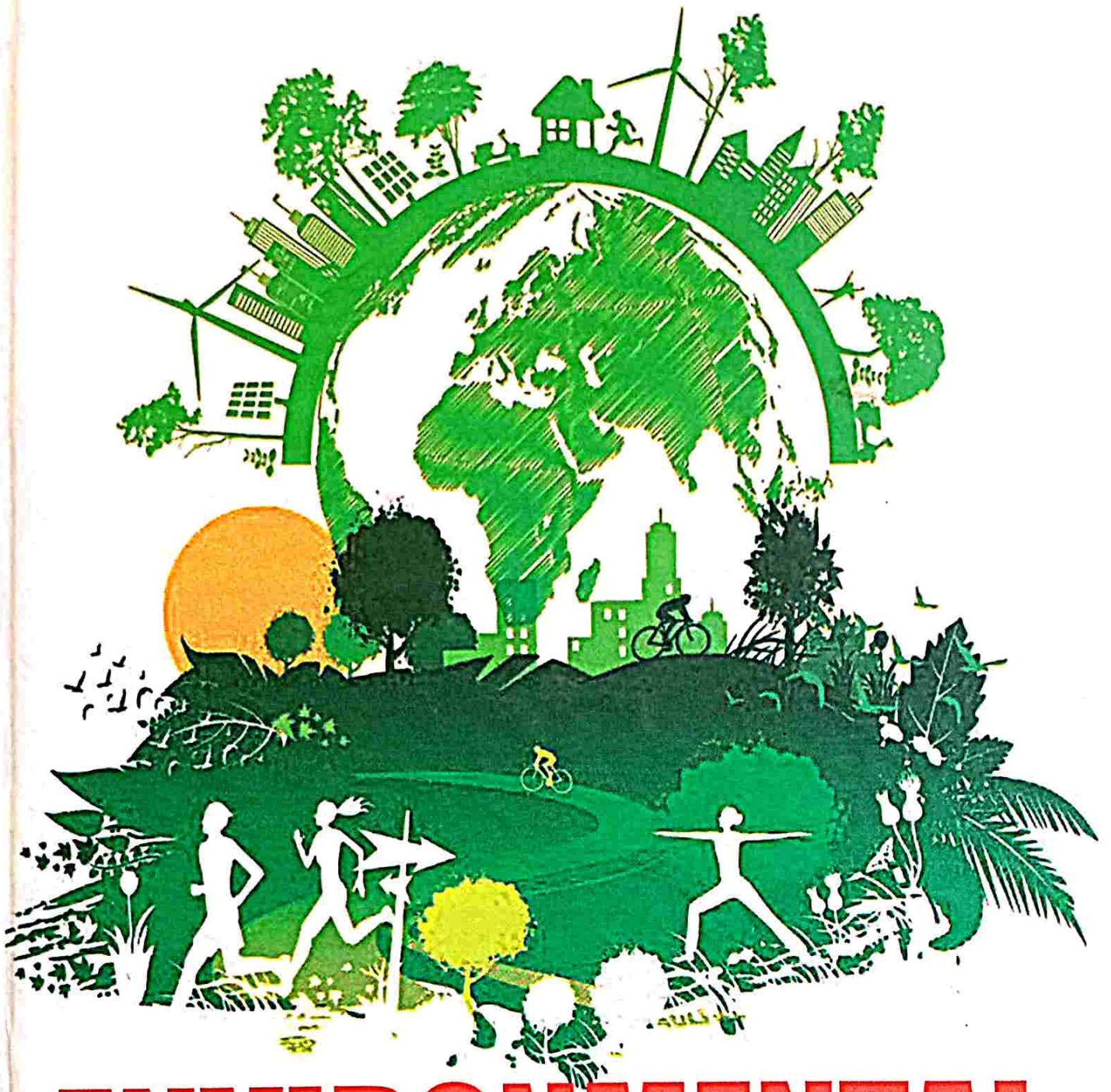
Due to the depletion of stratospheric ozone layer in the atmosphere, there is an increment in the UV levels across the world. Long and high-dose exposure to UV-A and UV-B reaching the earth's surface is responsible for causing many skin problems like tanning, inflammation, sunburns, premature ageing, uneven skin tone and spots etc., which in severe case may lead to life-threatening skin cancer. Efforts have been made to collect information about some local medicinal plants that can be used for preventing and curing skin damage due to exposure to the Sun. The present study have been carried out in 6 villages, namely Dharsal, Sondkoti, Ranichauri, Sursingdhar, Dikholgaun, and Saabli, in and near Badshahithaul, Tehri Garhwal, Uttarakhand. In total, 10 plant species have been enumerated which belongs to 9 families and 10 different genera. These plant species are *Aloe indica*, *Brassica juncea*, *Cannabis sativa*, *Citrus limon*, *Mentha longifolia*, *Ocimum basilicum*, *Piper nigrum*, *Prunus armeniaca*, *Solanum tuberosum* and *Ricinus communis*.

**Keywords:** Sun Damage Protection, Sunscreen, Medicinal Plants, Skin Problems, Traditional Knowledge

#### Introduction

It is a well-known fact that the Sun is the ultimate source of energy on earth. It helps to drive the physical and biological processes on the planet. In general, solar electromagnetic radiation falling on earth ranges between the high-energy ultraviolet radiations to low-energy Infrared Radiations (100-10<sup>6</sup> nm). Ultraviolet radiation can be sub-divided into three ranges: UV-A (315-400 nm), UV-B (280-315 nm) and UV-C (100-280 nm). The ozone layer allows UV-A to easily pass through it. But it attenuates the UV-B rays passing through, and completely blocks the UV-C to pass through it. UV-A is known to cause only minor skin problems like tanning, premature wrinkling and spots etc., but UV-B tends to cause major skin problems like sunburns, erythema, skin cancer etc. in humans (Amaro-Ortiz et al., 2014). Due to the depletion





# **ENVIRONMENTAL HEALTH**

**Human Welfare in Present Scenario**

SUNIL KUMAR  
SHASHI K. SOLANKI

J. V. S. RAUTHAN  
N. PEMOLA DEVI



✓ Biodiversity of Insects in the Sal Forest of Manduwala Region, Dehradun, Uttarakhand	78
<i>Kumari Asha, Zahier Khan and R. S. Fartyal</i>	
A Review on Some Hepatotoxic and Hepatoprotective Herbs of India	86
<i>Sunil Kumar, Rifhat Aara and Shoma Devi</i>	
An innovative way to control immature mosquitoes through quantified water feeding efficiency of dragonfly nymph - <i>Bradinopyga geminata</i> (Rambur 1842)	105
<i>Ritwik Mondal, N. Pemola Devi and R.K. Jauhari</i>	
Alteration in Haematological parameters of <i>Labeo dero</i> exposed to different pH Water Environment	113
<i>Manveer Kandari, J.V.S. Rauthan</i>	
Study on Effect of Pyrethroid (Cyfluthrin) on Haematological Parameters of Male Albinorot	123
<i>Kapil Shiwach</i>	
Heavy Metal Toxicity and Its Imelioration by $\alpha$ - Tocopherol in <i>Rattus rattus albino</i> .	129
<i>Dharmendra Kumar</i>	
Studies Concerning the Biometrics, Haematology and Biochemistry of meat in freshwater fish <i>Labeo rohita</i> (Hamilton) from Pilli Reservoir	135
<i>J.V.S. Rauthan, Geeta Rauthan and Shepali Chalotra</i>	
Harmful Effects of Plastic on Environment Bioplastic- The Future Prospects.	142
<i>Savita Rani and Resha</i>	
Comparative Study Upon the Qualitative and Quantitative Analysis of Metal Ions of Various Water Samples of Kashmir Valley	152
<i>M. M. S. Jassal, M. Amin Mir, and S. V. Tyagi</i>	
Study on container breeding mosquitoes with special reference to <i>Aedes (Stegomyia) aegypti</i> and <i>Aedes albopictus</i> in District Dehradun, Uttarakhand	163
<i>S. Singh and Vandna</i>	



# Biodiversity of Insects in the Sal Forest of Manduwala Region, Dehradun, Uttarakhand

*Kumari Asha, Zahier Khan and R. S. Fartyal*

The study was performed to explore the diversity of insects in the Sal forest of Manduwala village of district Dehradun, Uttarakhand, India. The study was conducted during short term research work, from January to June 2013 within the area approximately 6 hectares. The different methods viz. insect net, light trap and hand picking were used to collect different insects. Total 129 insects belonging to different orders viz. Lepidoptera, Hymenoptera, Orthoptera, Coleoptera, Odonata, Dictyoptera, Diptera, Hemiptera and Isoptera, with 57 species were collected from the Sal (*Shorea robusta*) forest. Among all orders, Lepidoptera was most dominated with 16 species, followed by Coleoptera with 13 species, Hymenoptera with 11 species, Orthoptera with 10 species, Diptera and Odonata with 2 species each, Hemiptera, Dictyoptera and Isoptera with 1 species each. Isoptera order ranked first with the large population of individual and percentage (60 and 46.51%). The order followed by Lepidoptera (19 and 14.65%), Coleoptera (17 and 13.17%), Hymenoptera (13 and 10.07%), Orthoptera (10 and 7.75%), Odonata (3 and 2.3%), Dictyoptera (3 and 2.3%), Hemiptera (2 and 1.5%) and Diptera (2 and 1.5%). The diversity index was calculated by Shannon-wiener expression. In the present study, diversity has been calculated, which is 1.129.

**Keywords:** *Biodiversity, Insects, Species, Manduwala, Dehradun*

## Introduction

Biodiversity found on Earth today consists of many millions of distinct biological species, the product of four billion years of evolution. The biodiversity that exist on this planet today is the outcome of an evolutionary process, which is continuing for over 3-5 billion years involving speciation, selection, migration and extinction. Biodiversity, comprising the variability of gene, species and ecosystem, is essential for maintaining the basic process on which life depends and is a key to sustainable development. Insects are the major components of the biodiversity and are extremely diverse and important to ecosystems (Wiggins, 1983; Finnamore, 1996a). They have permeated the diverse and essential natural processes that sustain biological systems,

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## **Environmental Health : Human Welfare in Present Scenario**

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# **Environmental Health**

## **Human Welfare in Present Scenario**

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<b>Ground Water Contamination : A Risk on Health</b>	<b>169</b>
<i>Shahla Rahman Khan and Rahila Rahman Khan</i>	
<b>On a new trematode, <i>Neopodocotyle songi</i> n.sp. (Digenea) from a fresh water fish, <i>Puntius sarana</i> (Ham) at river Song, Raiwala (Dehradun)</b>	<b>175</b>
<i>M.M. Juwantha</i>	
<b>Effect of Different Herbicides on Nitrogen Fixation and Soil Repiration by Different Strains of <i>Azospirillum</i></b>	<b>184</b>
<i>Vandna Krishna</i>	
<b>Heavy Metals Toxicity in Groundwater of Aligarh City: An Overview</b>	<b>189</b>
<i>Archana Bansal</i>	
<b>Herbal Mosquito Repellent: <i>Ocimum Sanctum</i>.</b>	<b>196</b>
<i>Archana Singh</i>	
✓ <b>Study on Invasive Fruit Pests <i>Drosophila Suzukii</i> Indicus &amp; <i>Zaprionus</i> Indian US and Possible Managment Strategies in Garhwal Region, Uttarakhand</b>	<b>199</b>
<i>Rajendra Singh Fartyal, Manisha Sarswat</i>	
<b>Effect of Toxicity of Micronutrients on Plant Parasitic Nematodes</b>	<b>211</b>
<i>Resha and Savita Rani</i>	
<b>Diversity of Arbuscular Mycorrhizal Fungi in The Rhizosphere of <i>Solanum tuberosum</i>.</b>	<b>220</b>
<i>Archana Srivastav, Naina Srivastav</i>	
<b>Morphological and Taxonomical descriptions of <i>Cheilomenes sexmaculata</i> (Fabr.) (Coleoptera: Coccinellidae) reported from different study sites of district Dehradun (Uttarakhand)</b>	<b>225</b>
<i>Pushpendra K. Sharma</i>	
<b>Influence of Blue Green Algae as Biofertilizers on dry matter Yield of Sunflower Plants</b>	<b>231</b>
<i>Anup Kumar Mishra</i>	
<b>Impact of Pesticides on Human Health and Environment</b>	<b>240</b>
<i>Neelam Panwar</i>	



# Study on Invasive Fruit Pests *Drosophila suzukii* <sup>Indicus</sup> & *Zaprionus indianus* <sup>Indicus</sup> ~~Indian~~ US and Possible Management Strategies in Garhwal Region, Uttarakhand

Rajendra Singh Fartyal\*, Manisha Sarswat\*\*

The pest risk assessment reports from different countries throughout the world have identified *Drosophila suzukii* and *Zaprionus indianus* as serious fruit pests. However, no reports are currently available from India, especially from biodiversity rich Uttarakhand state. The present study provides first record of *Drosophila suzukii indicus* Parshad & Paika and *Zaprionus indianus* Gupta (Diptera Drosophilidae) as invasive fruit pests from Garhwal region of Uttarakhand. Different life stages of these flies were observed in Sweet orange (*Citrus sinensis*) and Guava (*Psidium guajava*). The female *Drosophila suzukii indicus*, widely known as spotted wing *Drosophila* with its serrated ovipositor lays eggs inside unwounded ripening fruits, while *Zaprionus indianus* females are unable to lay eggs through the skin of fruits and need injuries or wounds to lay their eggs. These species spread rapidly and economic losses are severe, thus becoming a pest of great concern. Nonetheless, several knowledge lacunae still exist about these species from this region and no efficient monitoring tools have yet been developed. Here, we provide the description of these pests, their biology, life cycle, extent of infestation along with review of some effective pest management strategies being adopted against these species throughout the world like apple cider vinegar traps, Balsamic vinegar, soy sauce, balsamic honey vinegar, Insect Bait, rice vinegar, seasoned rice vinegar etc. We aim to highlight possible research approach which could be useful in devising future management plans and monitoring techniques towards expanding challenge that *D. suzukii* and *Z. indianus* may pose to fruit production in Uttarakhand.

**Keywords:** *Drosophila*, *Invasive pest*, *Integrated Pest Management*, *Citrus fruits*, *Uttarakhand*

## Introduction

Flies of the genus *Drosophila* are primary consumers of microorganisms, yeasts, and bacteria associated with the early stages of plant decay (Carson, 1971). For this reason, they are generally not considered as pests. Part of the interaction of

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## Contents

<b>1</b>	<b>Sex Hormones and Their Role in Gonad Development and Reproductive Cycle of Fishes . . . . .</b>	<b>1</b>
	Prem Kumar, P. Behera, L. Christina, and M. Kailasam	
<b>2</b>	<b>Vitellogenesis and Their Endocrine Control in Fishes . . . . .</b>	<b>23</b>
	Gyandeep Gupta, Munish Kumar, Susmita Rani, and Banani Mohanta	
<b>3</b>	<b>Estrogenic Regulation of Reproduction in Teleosts . . . . .</b>	<b>35</b>
	Sherly Tomy	
<b>4</b>	<b>Steroids and Its Receptors in Fish Reproduction . . . . .</b>	<b>53</b>
	Partha Sarathi Tripathy, Janmejay Parhi, and Sagar Chandra Mandal	
<b>5</b>	<b>Hormonal Influence on Induced Maturation and Spawning in Striped Murrel, <i>Channa striata</i> . . . . .</b>	<b>63</b>
	Rajesh Kumar, Dushyant Kumar Damle, and Bindu R. Pillai	
<b>6</b>	<b>Reproductive and Breeding Biology of Snowtrout <i>Schizothorax niger</i> . . . . .</b>	<b>77</b>
	Kawkabul Saba, Faisal Rashid, Adnan Amin, Farooz Bhat, Tasaduq Hussain, and Oyas Ahmad Asimi	
<b>7</b>	<b>Reproductive and Breeding Biology of Tuna <i>Euthynnus affinis</i> . . . .</b>	<b>93</b>
	Kawkabul Saba, Faisal Rashid, Adnan Amin, and Tariq Hussain Bhat	
<b>8</b>	<b>Zebrafish (<i>Danio rerio</i>): A Versatile Model for Reproductive Biology . . . . .</b>	<b>105</b>
	Younis Ahmad Hajam, Raksha Rani, Preeti Sharma, Rajesh Kumar, and Sushant Kumar Verma	
<b>9</b>	<b>Sex Determination in Teleost Fish . . . . .</b>	<b>121</b>
	Indrashis Bhattacharya and Deepak Modi	
<b>10</b>	<b>The Involvement of Gonadotropin-Inhibitory Hormone (GnIH) in Fish Reproduction . . . . .</b>	<b>139</b>
	Pravesh Kumar	



<b>11</b>	<b>Gene Regulation on Spermiation of Catfish . . . . .</b>	<b>161</b>
	Samar Jyoti Chutia, Garima Bora, Rupam Jyoti Nath, B. S. Yashwanth, Deepak Agarwal, Kaustubh Bhagawati, and Dipak Kumar Sarma	
<b>12</b>	<b>Ghrelin and Its Role in Reproductive Physiology of Fish . . . . .</b>	<b>171</b>
	Showkat Ahmad Dar, Sameer-ul-Salam Mattoo, and Prem Prakash Srivastava	
<b>13</b>	<b>Melatonin and Seasonal Reproduction in Teleosts . . . . .</b>	<b>181</b>
	Mehak Hafeez and Irfan Ahmad	
<b>14</b>	<b>Emerging Role of Small Non-coding (MicroRNAs) During Regulation of Endocrine Function in Fishes . . . . .</b>	<b>193</b>
	Kiran D. Rasal, Sangita Dixit, Manohar Vasam, and Jitendra Kumar Sundaray	
<b>15</b>	<b>Roles of Bioinformatics in Reproductive Science . . . . .</b>	<b>203</b>
	Imran Zafar, Madiha Saba, Mehar Ali Raza, Mohd Ashraf Rather, Rehab A. Rayan, Maryam Fatima, Qurat ul Ain, and Reham Medhat Ishneiwa	
<b>16</b>	<b>Modulation of Hypothalamic-Pituitary-Gonadal (HPG) Axis by Phytotherapy Using Different Delivery Approaches . . . . .</b>	<b>229</b>
	Ishfaq Nazir Mir and Irfan Ahmad Bhat	
<b>17</b>	<b>Functional Role of Dietary Supplements on Reproductive Physiology of Fishes . . . . .</b>	<b>243</b>
	Soibam Khogen Singh, Sampa Baidya, Pronob Das, and Pradyut Biswas	
<b>18</b>	<b>Endocrine Disruption in Freshwater Fish from Contaminants of Emerging Concern . . . . .</b>	<b>259</b>
	Ankur Jamwal and Kamran Shekh	
<b>19</b>	<b>Hormonally Active Agents: A Menace for Oogenesis and Fertility in Teleosts . . . . .</b>	<b>283</b>
	Subhasri Biswas, Soumyajyoti Ghosh, Urmi Mukherjee, Anwesha Samanta, Sriparna Das, and Sudipta Maitra	
<b>20</b>	<b>Anthropogenic Exposure and Its Impact on Reproductive System of Fishes . . . . .</b>	<b>323</b>
	Iqbal Ansari, Deblina Maiti, Muniyan Sundararajan, and Mohd Suhail Ashar	
<b>21</b>	<b>Effect of Climate Change on Endocrine Regulation of Fish Reproduction . . . . .</b>	<b>335</b>
	Abhilipsa Biswal, P. P. Srivastava, and Tapas Paul	



# Sex Determination in Teleost Fish

9

Indrashis Bhattacharya and Deepak Modi

## Abstract

Sex determination (SD) is the fundamental developmental process crucial for the survival of biological species. Fishes are the only class of vertebrates which show a larger plasticity in gonadal development and are represented by both gonochoristic (one sex at a time) and hermaphrodite (more than one sex) species. In teleosts, SD is either regulated by the genetic mode (GSD), where male and female have different sets of alleles that specify their reproductive fate and morphology, or determined by environmental variables (ESD) such as temperature, pH, salinity, or social conditions. Male-restricted master regulators like *Dmy*, *Gsdf*, *Amhy*, *SdY*, *Sox3*, and *Dmrt1* or female-specific *Foxl2* and *Foxl3* have been well documented in different teleost species till date. However, the critical balance between the turnover rates of testosterone (T) to either estrogen ( $E_2$ ) or 11-ketotestosterone (11-KT) regulated by either aromatase enzyme (coded by *Cyp19a1a*) or 11 $\beta$ -hydroxylase enzyme (coded by *Cyp11b*) and 11 $\beta$ -hydroxysteroid dehydrogenase enzyme (coded by *Hsd11b2*), respectively, finally determines the sexual development and gonadal output. This chapter precisely discusses various SD mechanisms like the environmental conditions including social cue, endocrine factors, and genetic regulatory network(s) that collectively determine the gonadal fate and function in teleosts.

## Keywords

Sex determination · Sexual development · Gonadal development · Teleosts

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# Emerging Issues in Climate Smart Livestock Production

## Biological Tools and Techniques



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9. *Potential implications of gonadotropin-releasing hormone (GnRH) analogues in assisted reproductive technology* discusses GnRH agonists–antagonists in female and male livestock, rodents and GnRH analogues and future directions.
10. *Oxidative stress in modulation of immune function in livestock* highlights the role of free radicals in evoking immune responses, implication of oxidative stress on immune responses in dairy cattle, immunological reflex in poultry birds on redox burden, impact of stress on the goat immune system and sequential effects of oxido–reductive stress in piglets.
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16. *Targeted genome editing by CRISPR/Cas9 for livestock improvement* deals with genome editors, journey of the CRISPR/Cas9 system from its discovery to development as a genome editing tool, CRISPR/Cas9 system components, mechanism of action, application of CRISPR/Cas9 in





# Chapter Nine - Potential implications of gonadotropin-releasing hormone analogues in assisted reproductive technology

Joseph R.D. Fernandes<sup>a,\*</sup>, Maitreyi Das<sup>b,\*</sup>, Kavya Chandra<sup>a</sup>, Indrashis Bhattacharya<sup>c</sup>,  
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## Abstract

The gonadotropin-releasing hormone (GnRH) is a hypothalamic decapeptide that acts as the key regulator in vertebrate reproduction. An in-depth understanding of the GnRH structure and function potentially alleviates the fertility management of economically essential animals. Analogues of GnRH with a wide range of variable potencies and half-lives can be designed and synthesized employing recombinant DNA technology. These agonists generally activate the GnRH-receptor (GnRH-R), whereas the antagonist blocks the GnRH-receptor (GnRH-R), thereby engaging them to facilitate a desired outcome. Both agonists and antagonists of GnRH are commercially used on a large scale for regulating the fertility of the cattle herd, thereby increasing farm productivity. Treatment of GnRH agonists in rodents showed success in experimental in vitro fertilization. The long-term use of GnRH agonists in the livestock industry shows a significant increase in the annual yield. This chapter aims to briefly discuss the multiple roles of GnRH analogues in regulating the fertility and productivity of farm mammals and laboratory rodents.

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## CONTENTS

1. **BIOASSESSING PERTURBATIONS IN ECOSYSTEM STRUCTURE OF HIMALAYAN GANGA-HEADWATER-RIVER SERIALY IMPOUNDED FOR HYDROPOWER**  
*Nautiyal, P., Sharma, N., and Bartwal, T.* 1-74
  
2. **ASSESSMENT OF DETERGENT INDUCED ECO - TOXICOLOGICAL IMPAIRMENTS IN FISH**  
*Trivedi, A.* 75-84
  
3. **GENOTOXIC EFFECTS OF COPPER SULPHATE (CuSO<sub>4</sub>.5H<sub>2</sub>O) IN FISHES: A REVIEW**  
*Yadav, K. K. and Trivedi, S. P.* 85-93
  
4. **PROBLEMS AND PROSPECTS OF RURAL DEVELOPMENT BY AQUACULTURE IN BIHAR, INDIA**  
*Singh, A. K.* 95-104
  
5. **EVALUATION OF IDEAL MEDIAN LETHAL CONCENTRATION (LC<sub>50</sub>) OF A BIOFERTILIZER IN AN INDIAN AIR-BREATHING FISH, *CHANNA GACHUA* (HAM.)**  
*Pandit, D. N. and Kumari, S.* 105-120
  
6. **PHYTOPLANKTON DIVERSITY OF A TROPICAL RESERVOIR IN CAUVERY RIVER SYSTEM**  
*Jesna P. K.<sup>1</sup>, Sibina Mol S.<sup>1</sup>, Ramya V. L.<sup>1</sup>, Saha, A., Panikkar, P., Sarkar U. K. and Das B. K.* 121-125
  
7. **MONTHLY VARIATION AND INTERRELATIONSHIP OF PHYSICOCHEMICAL CHARACTERISTICS OF A PERENNIAL POND AT SANJAY GANDHI ZOOLOGICAL PARK IN PATNA, BIHAR, INDIA**  
*Singh, P. P., Saroj, K. S. and Kumari J.* 127-134

8. **EFFECTS OF AIR POLLUTION ON HUMAN HEALTH**  
*Goswami, M., Mansotra, D. K., Sharma, S., Pant, G., and Joshi, P. C.* 135-144
9. **IMPACT OF WATER POLLUTION AND HEAVY METAL BIOACCUMULATION IN *LABEO ROHITA* FROM RAMGANGA, MORADABAD UP, INDIA**  
*Rahman, Q. and Azeem, I.* 145-149
10. **INVESTIGATION OF PROTEIN, ASCORBIC ACID, DNA AND RNA IN DIFFERENT TISSUES OF *LAMELLIDENS MARGINALLIS* FROM GIRNA RESERVOIR IN NASIK DISTRICT, INDIA**  
*Rahane B. and Bhalla R.* 151-160
11. **SYNTHESIS OF PVA ENCAPSULATED AGNP AND ITS EFFICACY AGAINST ANTIBIOTIC RESISTANT FISH PATHOGENIC BACTERIA, *AEROMONAS HYDROPHILLA***  
*Sarkar, D. J., Das, B. K., Basu, S., Mohanty, D. and Behera, B. K.* 161-167
12. **EFFECT OF CADMIUM TOXICITY ON BIOCHEMISTRY OF GUPPY FISH**  
*Khan, S.* 169-175
13. **STUDIES ON CHRONIC TOXICITY OF SUBLETHAL CONCENTRATION OF ZINC SULPHATE ON HAEMATOLOGICAL PARAMETERS IN INDIAN CAT FISH *HETEROPNEUSTES FOSSILIS* (BLOCH)**  
*Kumari, S.* 177-182
14. **STUDIES ON PERIPIHYTON DIVERSITY IN FEW PONDS OF GAYA DISTRICT**  
*Tabassum, S. A. and Khan, A. A.* 183-189

15. **BIOASSESSMENT OF HYDROPOWER  
IMPACTED ALAKNANDA RIVER:  
APPLICABILITY OF DIATOM BASED  
INDICES AND ECOLOGICAL VALUES**  
*Bartwal, T., Sharma, N. and Nautiyal, P.* 191-198
  
16. **EVALUATION OF CHANGES IN BLOOD  
CHOLESTEROL, PROTEIN AND CALCIUM  
IN CIRRHINUS MRIGALA EXPOSED TO CRUDE  
TOXIN OF MICROCYSTIS AERUGINOSA**  
*Srivastava, M.* 199-207
  
17. **PLANKTON DISTRIBUTION AND DIVERSITY  
OF KARAPUZHA RESERVOIR IN KERALA,  
INDIA**  
*Panikkar, P., Khan, M. F., Ramya V.L., Jesna P.K. and  
Das, B. K.* 209-215
  
18. **STUDIES IN RELATION TO HALIPEGUS  
MEHRANISES (HEMIURDAE : TREMATODE)  
INFECTION IN THE FROG RANA  
CYANOPHIYSIS IN ARA, BIHAR, INDIA**  
*Verma, B. and Kumari, P.* 217-221
  
19. **BACTERIOPHAGE GRCS DEMONSTRATE  
ANTIBACTERIAL ACTIVITY AGAINST  
MASTITIS ASSOCIATED STAPHYLOCOCCUS  
AUREUS ISOLATES**  
*Katragadda, D. S. and Sunagar, R.* 223-230
  
20. **STUDIES ON THE ACCUMULATION OF  
HEAVY METALS IN WATER AND TISSUE  
OF LABEO BOGA COLLECTED FROM  
RIVER TAWI**  
*Sharma, M., Gandotra, R. and Jangral, S.* 231-240
  
21. **METACID INDUCED ACUTE TOXIC EFFECTS  
ON CERTAIN BLOOD PARAMETERS IN  
MYSTUS VITTATUS (BLOCH.)**  
*Prasad, R. K.* 241-245



- 22. TOXIC EFFECT OF SUBLETHAL  
CONCENTRATION OF METASYTOX ON  
HAEMATOLOGY OF FRESH WATER FISH,  
*MYSTUS TENGARA* (HAM.)**

*Kumari, S. and Singh, S. K.*

247-251

- 23. BRYOZOA AND SPONGE: A PERIPHYTIC  
ASSOCIATION**

*Nimbalkar, N. D. and Mokashe, S. S.*

253-258

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# **BIOASSESSING PERTURBATIONS IN ECOSYSTEM STRUCTURE OF HIMALAYAN GANGA-HEADWATER- RIVER SERIALY IMPOUNDED FOR HYDROPOWER**

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## **ABSTRACT**

Hydroelectric projects alter the natural hydrology. Perturbations in the Alaknanda river ecosystem (Ganga headwaters) due to Vishnuprayag and Srinagar HEP occur in key environmental variables (WT, CV, DO) and benthic assemblages of diatoms (Cpe-Ap) and macroinvertebrates (B-3T) in ca. 200 km stretch. These were also reflected through bio-assessment, especially pH, saprobity, trophic state and moisture categories through use of diatoms (Van Dam ecological values) and organic pollution through use of macroinvertebrate based index (BMWP) for both HEP's. The dam-free ca. 90 km stretch tends to improve occasionally in September or June due to floods that enhance flows.

**KEYWORDS:** Himalaya, HEP, river-regulation, Alaknanda, Benthic, Assemblages, *C. laevis*, Baetidae

## **INTRODUCTION**

Assessing impacts from non-point sources, such as contaminants and nutrients from agricultural and urban areas, has been of increasing concern (Rott *et al.*, 1998). Three components, chemical, physical and biological integrity of the surface water are often used to evaluate stream health (Karr, 1981; 1989; Karr *et al.*, 1986; Butcher *et al.*, 2003).

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## CONTENTS

1. **BIOASSESSING PERTURBATIONS IN ECOSYSTEM STRUCTURE OF HIMALAYAN GANGA-HEADWATER-RIVER SERIALY IMPOUNDED FOR HYDROPOWER**  
*Nautiyal, P., Sharma, N., and Bartwal, T.* 1-74
  
2. **ASSESSMENT OF DETERGENT INDUCED ECO - TOXICOLOGICAL IMPAIRMENTS IN FISH**  
*Trivedi, A.* 75-84
  
3. **GENOTOXIC EFFECTS OF COPPER SULPHATE (CuSO<sub>4</sub>.5H<sub>2</sub>O) IN FISHES: A REVIEW**  
*Yadav, K. K. and Trivedi, S. P.* 85-93
  
4. **PROBLEMS AND PROSPECTS OF RURAL DEVELOPMENT BY AQUACULTURE IN BIHAR, INDIA**  
*Singh, A. K.* 95-104
  
5. **EVALUATION OF IDEAL MEDIAN LETHAL CONCENTRATION (LC<sub>50</sub>) OF A BIOFERTILIZER IN AN INDIAN AIR-BREATHING FISH, *CHANNA GACHUA* (HAM.)**  
*Pandit, D. N. and Kumari, S.* 105-120
  
6. **PHYTOPLANKTON DIVERSITY OF A TROPICAL RESERVOIR IN CAUVERY RIVER SYSTEM**  
*Jesna P. K.<sup>1</sup>, Sibina Mol S.<sup>1</sup>, Ramya V. L.<sup>1</sup>, Saha, A., Panikkar, P., Sarkar U. K. and Das B. K.* 121-125
  
7. **MONTHLY VARIATION AND INTERRELATIONSHIP OF PHYSICOCHEMICAL CHARACTERISTICS OF A PERENNIAL POND AT SANJAY GANDHI ZOOLOGICAL PARK IN PATNA, BIHAR, INDIA**  
*Singh, P. P., Saroj, K. S. and Kumari J.* 127-134

8. **EFFECTS OF AIR POLLUTION ON HUMAN HEALTH**  
*Goswami, M., Mansotra, D. K., Sharma, S., Pant, G., and Joshi, P. C.* 135-144
9. **IMPACT OF WATER POLLUTION AND HEAVY METAL BIOACCUMULATION IN *LABEO ROHITA* FROM RAMGANGA, MORADABAD UP, INDIA**  
*Rahman, Q. and Azeem, I.* 145-149
10. **INVESTIGATION OF PROTEIN, ASCORBIC ACID, DNA AND RNA IN DIFFERENT TISSUES OF *LAMELLIDENS MARGINALLIS* FROM GIRNA RESERVOIR IN NASIK DISTRICT, INDIA**  
*Rahane B. and Bhalla R.* 151-160
11. **SYNTHESIS OF PVA ENCAPSULATED AGNP AND ITS EFFICACY AGAINST ANTIBIOTIC RESISTANT FISH PATHOGENIC BACTERIA, *AEROMONAS HYDROPHILLA***  
*Sarkar, D. J., Das, B. K., Basu, S., Mohanty, D. and Behera, B. K.* 161-167
12. **EFFECT OF CADMIUM TOXICITY ON BIOCHEMISTRY OF GUPPY FISH**  
*Khan, S.* 169-175
13. **STUDIES ON CHRONIC TOXICITY OF SUBLETHAL CONCENTRATION OF ZINC SULPHATE ON HAEMATOLOGICAL PARAMETERS IN INDIAN CAT FISH *HETEROPNEUSTES FOSSILIS* (BLOCH)**  
*Kumari, S.* 177-182
14. **STUDIES ON PERIPIHYTON DIVERSITY IN FEW PONDS OF GAYA DISTRICT**  
*Tabassum, S. A. and Khan, A. A.* 183-189



15. **BIOASSESSMENT OF HYDROPOWER  
IMPACTED ALAKNANDA RIVER:  
APPLICABILITY OF DIATOM BASED  
INDICES AND ECOLOGICAL VALUES**  
*Bartwal, T., Sharma, N. and Nautiyal, P.* 191-198
  
16. **EVALUATION OF CHANGES IN BLOOD  
CHOLESTEROL, PROTEIN AND CALCIUM  
IN CIRRHINUS MRIGALA EXPOSED TO CRUDE  
TOXIN OF MICROCYSTIS AERUGINOSA**  
*Srivastava, M.* 199-207
  
17. **PLANKTON DISTRIBUTION AND DIVERSITY  
OF KARAPUZHA RESERVOIR IN KERALA,  
INDIA**  
*Panikkar, P., Khan, M. F., Ramya V.L., Jesna P.K. and  
Das, B. K.* 209-215
  
18. **STUDIES IN RELATION TO HALIPEGUS  
MEHRANISES (HEMIURDAE : TREMATODE)  
INFECTION IN THE FROG RANA  
CYANOPHIYSIS IN ARA, BIHAR, INDIA**  
*Verma, B. and Kumari, P.* 217-221
  
19. **BACTERIOPHAGE GRCS DEMONSTRATE  
ANTIBACTERIAL ACTIVITY AGAINST  
MASTITIS ASSOCIATED STAPHYLOCOCCUS  
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### **ABSTRACT**

Diatom indices based bio-assessment was carried out for the Alaknanda River, impacted by multiple hydroelectric projects (HEP). Diatoms were collected from 8 locations at monthly intervals to generate species count for computing indices and van Dam values (OMNIDIA version 6.08). The indices show that the pollution aggravates in HEP areas. Pollution was low in Vishnuprayag HEP and high in Srinagar HEP (S5) as also evidenced by van Dam values. Water quality improves in the dam-free section (S4). The indices (IBD, IPS, IDS/E and TDI) and van Dam ecological values were suitable for assessing impacts of hydropower on water quality of the Himalayan Rivers.

**KEYWORDS:** HEP; Alaknanda; Diatom indices; Van Dam; Organic pollution

### **INTRODUCTION**

Diatoms are the excellent indicator of water quality and ecological status of the surface water because they give quick response to change in the water quality. Diatom indices have been used to assess the eutrophication, organic pollution and human disturbance (Descy and Coste, 1991; Prygeil and Coste, 1993; Kelly and Whitton, 1995; Watanabe *et al.*, 1986; Fore and



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# Food and Agricultural Byproducts as Important Source of Valuable Nutraceuticals

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# Chapter 1

## The Role of Nutraceuticals as Food and Medicine, Types and Sources



**Abhay Prakash Mishra, Neeti Srivastav, Anita Singh, Manisha Nigam, Raffaele Pezzani, Chukwuebuka Egbuna , Chukwuemelie Zedech Uche, and Johra Khan**

### 1.1 Introduction

The term “nutraceuticals” is not new, as it has been adopted many years back. An attempt was made in United States for creating a functional component through fortification by adding iodine to salt in order to prevent goitre. If we talk in the terms

---

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# Medicinal Plants of the Asteraceae Family

Traditional Uses, Phytochemistry and  
Pharmacological Activities

 Springer

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## Chapter 10

# *Dolomiaea costus* (Falc.) Kasana and A. K. Pandey: Ethnomedicinal Uses, Bioactive Chemical Constituents, and Pharmacological Activities



Abhay Prakash Mishra, Manisha Nigam, Hari Prasad Devkota,  
and Motlalepula Gilbert Matsabisa

**Abstract** *Dolomiaea costus* (Syn. *Saussurea costus*), commonly known as the costus, Indian costus, kut, or putschuk, is a species of thistle native to South Asia and a member of the *Dolomiaea* genus. Studies conducted on *Dolomiaea* species around the globe have demonstrated the existence of bioactive secondary metabolites including polyphenols, flavonoids, lignans, sesquiterpenoids, and lactones. The goal of this chapter is to compile all the scientific data on *D. costus*' traditional usage, bioactive chemical components, and pharmacological properties. In summation, our investigation shows that *D. costus* has a wide variety of bioactive substances contributing its anti-inflammatory, antibacterial, antioxidant, and anticancer activities. To provide greater scientific support for their traditional applications, more in vivo and clinical research for mechanism-based pharmacological evaluation should be conducted in the future.

**Keywords** *Saussurea* · *Aucklandia costus* · Sesquiterpene lactones · Costunolide · Santamarine · Anticancer · Clinical studies

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# Preparation of Phytopharmaceuticals for the Management of Disorders

*The Development of Nutraceuticals and Traditional Medicine*



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# Phytomedicine: Scope and current highlights

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## Abbreviations

AD	Anno domini
AIDS	acquired immune deficiency syndrome
BC	Before Christ
DNA	deoxyribonucleic acid
EF	elongation factor
HPLC	high-performance liquid chromatography
IPRs	intellectual property rights
NMR	nuclear magnetic resonance
NPAAAs	nonprotein amino acids
SH	sulfhydryl group
WHO	World Health Organization

## 3.1 Introduction

---

The practice of herbal medicine is as old as human civilization as evident from various sources comprising written documents, conserved monuments, and traditional knowledge sometimes as wonderful verbal memories. Along with contemporary medicine, such traditional herbal medicines have sustained their popularity for historical and cultural reasons. Cognizance of the practice of medicinal plants is an outcome of the several ages of tussles against ailments that resulted in the exploration of drugs in plants, an easier and natural source.

The initial acknowledgment about the tradition of herbal rehabilitations originates from China (2800 BC), although Indian subcontinent has been a gigantic source of medicinal herbs used in conventional medical cures [1, 2]. Phytomedicine play a prominent role in Ayurveda



Hari Prasad Devkota  
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## Chapter 10

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Chapter 5

**Vehicle-Generated Heavy Metal Pollution in an Urban Environment and Its Distribution into Various Environmental Components**



Vidhu Gupta

**Abstract** Pollution caused by vehicles and its rapidly growing number is a serious concern all over the world. Vehicular pollution is primarily known for emitting various kinds of organic and inorganic gaseous pollutants in to the atmosphere, but recent studies show that vehicles are one of the chief sources of creating heavy metal pollution in an urban environment via processes like exhaust of diesel and petrol, corrosion of metallic parts, engine wear, tyre and brake pad wear and road surface degradation due to vehicular movement. Studies show that apart from fuel burning, tyre and brake wear particles lead the contribution of heavy metals into an urban environment. Due to easy availability and low cost, two wheelers dominate the road traffic and become a major source of air pollution in most of the developing countries. Heavy metals emitted in ambient air ultimately get deposited on other environmental component like hydrosphere and lithosphere which ultimately affect flora and fauna living in it. Some heavy metals are able to create toxicity at low level of exposure, and metals like nickel, cadmium and chromium are able to produce carcinogenicity in humans. Meteorological and geographical conditions of an area play a major role in distribution and deposition of heavy metals. There is an urgent need to make an effective environmental management plan for urban areas which include promotion of new technologies, adaption of biofuels, green belt development and public participation.

**Keywords** Vehicular pollution · Heavy metal · Tyre and brake pad · Meteorological · Management plan

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113

## Large scale cultivation and commercialization opportunities and constraints of *Allium stracheyi* Baker – An endangered Medicinal Plant of Western Himalaya, India

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### ABSTRACT

The Himalaya is a known home for diverse flora and fauna with medicinal properties. For millennia, Himalayan plants are used to treat simple cough to fatal snake bites. Traditional ethno-botanical knowledge (TEK) is an important tool to treat various ailments. Food as medicine is a very essential component to maintain healthy life and extend our life span. Pharmaceutical industries are utilizing about 95% of medicinal plants from the wild populations of Indian Himalayan region. Uttarakhand, one of the herbal state of Himalaya is known as a treasure house of medicinal and aromatic plants (MAPs) because of its distinct ecology and geography. *Allium stracheyi* Baker one of the important MAP belonging to the family Alliaceae locally known as Jambu is an endangered red listed species indigenous to Nanda Devi Biosphere Region (NDBR) with deficient information. Therefore, the study was carried out to present a comprehensive overview on the importance of *A. stracheyi* in the Indian Himalayan economy and TEK of tribes, with special emphasis on availability, cultivation and uses. The dominant Bhotiya tribes cultivated *A. stracheyi* during summer season. They have peculiar and specific ethno-botanical knowledge (TEK) on medicinal plant propagation and environmental management. *A. stracheyi* leaves, flowers, bulbs and the whole plant are largely used as medicine, spices, condiments, vegetables and ornaments. The total production and monetary equivalent was reported maximum for *A. stracheyi* due to large cultivation. The intense knowledge of *A. stracheyi* has provided much understanding on the importance of medicinal plants and the necessity to conserve them. Wide opportunities are available to explore different cultivation methods and conservation strategies of *A. stracheyi*. Also policy constraints on the cultivation and commercialization of *A. stracheyi* has been focused in this study.

**Key words :** *Allium stracheyi*, Ethnobotanicals, Western Himalaya, Bhotiya tribe, Socio-economy, Policy recommendation

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## Chapter 4

# Long-Term Tracking of Multiple Benefits of Participatory Forest Restoration in Marginal Cultural Landscapes in Himalaya



Krishna G. Saxena, Kottapalli S. Rao, and Rakesh K. Maikhuri

**Abstract** The literature is abound with references to the potential of indigenous and local knowledge (ILK) for sustainable landscape management, but empirical on-the-ground efforts that demonstrate this potential are still lacking. To identify interventions for improving the effectiveness and efficiency of forest restoration, participatory trials were set out in the Indian Himalaya, where per capita degraded land far exceeds per capita cropped/healthy forest land. Treatments were designed based on pooled indigenous and scientific knowledge taking into account farm-forest-livelihood interactions in cultural landscapes. The multipurpose tree-bamboo-medicinal herb mixed restoration plantation reached a state of economic benefit/cost ratio  $>1$  in the eighth year and recovered 30–50% of flowering plant species and carbon stock in intact forest. The communities maintained but did not expand restoration in the absence of policies addressing their genuine needs and aspirations. Transformative change for sustainable restoration would include (1) nesting restoration in participatory, long-term, adaptive and integrated landscape development programmes, (2) formally involving communities in planning, monitoring, bioprospecting, and financial management, (3) assuring long-term funding but limited to the inputs unaffordable for local people, (4) stimulating the inquisitive minds of local people by enriching ILK and cultural heritage, (5) convincing policymakers to provide the scientific rationale behind policy stands, to support the regular interactions of communities with researchers, traders, and industrialists, to commit to genuine payment for ecosystem services in unambiguous terms at multiple spatial (household, village and village cluster) and temporal (short, medium and long-term) scales, and to

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61



## Enhancing Livelihood Options Through Appropriate Technological Interventions for Sustainable Development of Central Himalayan Rural Landscape

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### Abstract

Pilgrimage tourism was the major source of income and employment of the people of Kedar valley for generations but after devastating flash floods on June 16<sup>th</sup> & 17<sup>th</sup>, 2013 almost all livelihood options were totally collapsed. In-depth field observations carried out by researchers of GBPIHED after disaster and discussion held with local inhabitants revealed that a minimum of 10-15 years may require in bringing pilgrimage tourism in its original conditions. It has created the situation of food insecurity and poverty and left the affected people hopeless. So, the major issues, concerns and challenges before the government and its line departments and R&D institutions is to design and develop a comprehensive reconstruction/re-building plan for the disaster affected areas/villages for their sustainable development. Based on the detail investigation and assessment of bioresources potential and cost-benefit analysis of various production systems and articulated needs of the disaster affected area/village communities, Garhwal Unit of GBPIHED has recommended priority interventions and technology package for livelihood enhancement. Therefore, appropriate strategic framework and specific policies need to be developed to support the implementation of suitable programme/activities in accordance to the priority needs of the people inhabited in disaster affected areas of Kedar valley in particular and other parts of Uttarakhand in general.

**Keywords:** Flash Flood; Kedarnath Valley; Reconstruction of Affected Areas; Potential Bioresources; Livelihood Enhancement

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## PHYTO-SOCIOLOGICAL CHARACTERISTICS OF PLANT SPECIES IN KEDARNATH WILDLIFE SANCTUARY IN WESTERN HIMALAYA

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### ABSTRACT

The present study emphasizes upon the phytosociological and indigenous knowledge of native plants at three forest sites at Kedarnath Wildlife Sanctuary (KWLS) of District Rudrapur, Uttarakhand. This study is mainly focused on population studies and traditional uses of plants of the area which are utilised by local people. For each species the information was collected through a questionnaire based survey which emphasized the information regarding scientific names, local name, family name, plant part used and medicinal importance of the plant. A total of 29 species which belong to 16 families were studied in the KWLS area. The dominant tree species was *Neolitsea pallen* with high density ranging between 350 ind./ha. and 555 ind./ha. while the dominant shrub species was *Viburnum mullaha* with the highest density ranging between 405 ind./ha. and 765 ind./ha. across the study area.

**Keywords:** Phytosociology, Wild edible plants, *Viburnum mullaha*, Conservation and Kedarnath Wildlife Sanctuary (KWLS)

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### INTRODUCTION

The Indian Himalayan region has total geographical area of about 530,795 km<sup>2</sup> representing 16.16% of the total area of India (Singh 2006). The area is considered very rich in endemic species. The Himalayas cover 18% of the Indian subcontinent and are abode of about 8000 species of angiosperms, of which 1748 species are being used medicinally (Kala 2005). Medicinal plants form a high percentage of non-timber forest products (NTFPs) collected from the Himalayas (Ghimire *et al.*, 2005). A completed record of many plant species used by human beings during the past shows their importance in health, economy, shelter, clothing, food and other living necessity for humans (Rizwana *et al.*, 2006). Over last two decades, the species area relations, environmental gradient and natural features, distribution pattern of the specific taxa and bio-geographic region are considered the best criteria for declaring importance of area in relation to biodiversity richness its and management across the world (Miller *et al.*, 1986). One of the most critical issues on the national and global agenda is need to conserve biodiversity for future generations while trying to understand and document the indigenous knowledge of resource management practices (Farooquee *et al.*, 2004). The concern of biodiversity conservation has highlighted the importance to describe vegetation at regional and small scale (Brown *et al.*, 1988). The modern concept of ethnobotany deals with

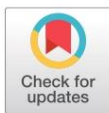
the relationship between a given society and environment in general and the plant world in particular (Aumeruddy 1996). Thus, ethnobotany is a multi-disciplinary science of botany, ecology as well as anthropology. However, there is limited information available about the species composition, variation and ecology of many forest communities in Himalaya in general (Maikhuri *et al.*, 1998; Dhar *et al.*, 1999) and targeting on ethno botanically important species in particular.

The Kedarnath Wildlife Sanctuary, one of the largest protected areas in Western Himalaya, is not only rich in floristic composition and panoramic view but also harbors high diversity of medicinal plants. The local inhabitants have significant and variable reservoir of primitive knowledge about the usage of the plants. They use the folk medicines through different ways, depending on plant species, specific method of preparation, doses and pattern of application (Bhandari 2003). Due to the heavy exploitation, a few species like *Taxus baccata*, *Cypripedium cordigerum*, *Dactylorhiza hatagirea*, *Aconitum heterophyllum* and *Picrorhiza kurroa* etc have witnessed rapid decline during recent decades (Singh 2008). Above 2800 m oak-conifer association occurs where, *Q. semercarpifolia*, *Abies pindrow*, *Rhododendron arboreum*, *Taxus wallichiana* and species of *Viburnum* are the dominant forms (Bhandari *et al.*, 2000). Several studies have been carried out on the use of the medicinal plants in the Indian Himalayan

RESEARCH ARTICLE

# Vegetation dynamics and soil nutrient availability in a temperate forest along altitudinal gradient of Nanda Devi Biosphere Reserve, Western Himalaya, India

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**Data Availability Statement:** All relevant data are within the paper and its [Supporting Information](#) files.

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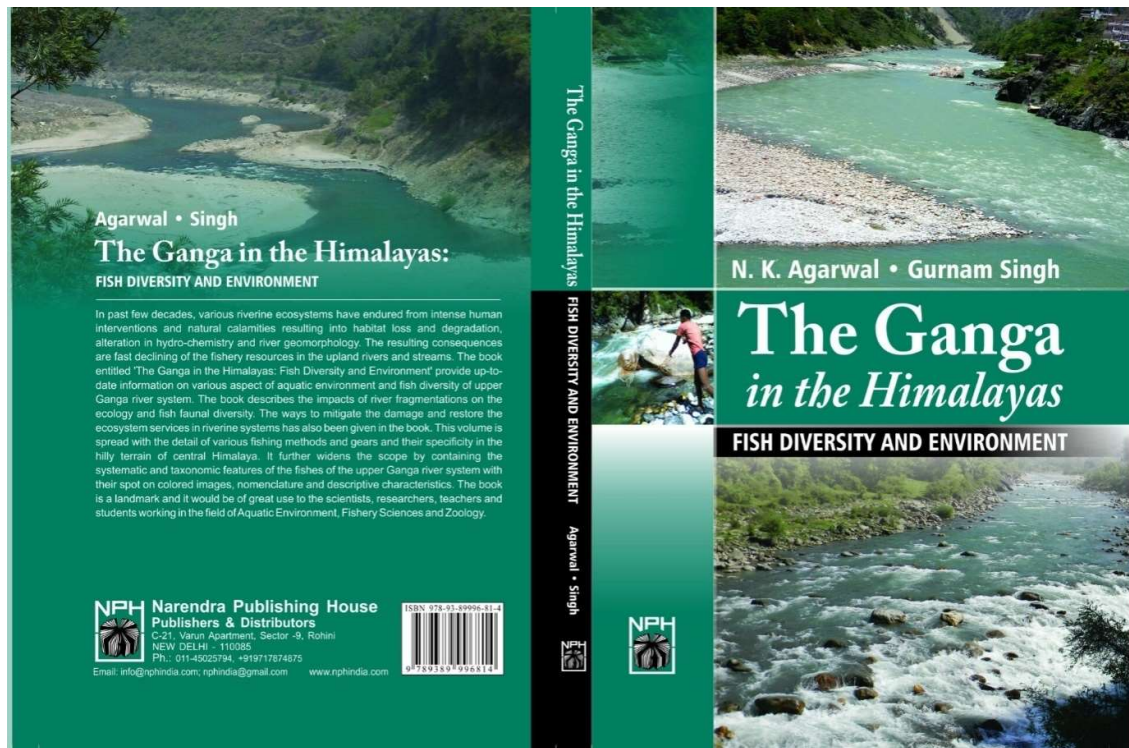
## Abstract

This study examined forest structure, composition, and regeneration patterns of two sites, Tolma-Lata-Raini (TLR) and Bhyundar-Ghangaria (BG). Both sites are located within the temperate zone along the altitudinal gradient between 2,800 to 3,400 m asl of Nanda Devi Biosphere Reserve (NDBR) in the Western Himalayan Region of India. We recorded a total of 223 species of vascular plants (Angiosperm, Gymnosperm, and Pteridophytes) within the study area. Of the recorded species, plants within the family Rosaceae were dominant (17.69%), followed by Asteraceae (14.97%) and Ranunculaceae (12.93%). *Betula utilis* had the highest tree density (724 and 324 individuals ha<sup>-1</sup>) and species cover (44% and 36%) at both TLR and BG sites, followed by *Pinus wallichiana* (24%) and *Cedrus deodara* (15%), respectively. In BG site, 56% of tree species showed fair regeneration (i.e., seedling density > sapling density ≤ adult density), 22% good (i.e., seedling density > sapling density > adult tree density), 11% exhibited poor (i.e., species survived only in the sapling stage but not in the seedling stage), and the remaining (11%) indicated no regeneration. Comparatively, at TLR site, 40% of the tree species showed fair regeneration, 40% good, and the remaining 20% showed no regeneration. Across the two sites, species richness and diversity significantly decreased as the altitudinal gradient increased. Vegetation structure and soil properties also revealed differences between the southern and northern aspects. The baseline information generated in this study is helpful in designing effective conservation and management measures for these ecologically sensitive and important ecosystems. To effectively monitor changes in vegetation structure, species composition, and regeneration, we suggest that permanent vegetation plots with meteorological stations be established across the region for long-term monitoring of forest dynamics in response to the changing climate and anthropogenic pressures.

## Annexure: Documentary Proof for Book & Book Chapters

### Book Published

Agarwal, N. K. And Singh, G  
**The Ganga in the Himalayas: Fish Diversity and Environment**  
Narendra Publishing House, New Delhi (India)





2. Smita Dangwal, Dinesh K Sharma, J.S. Chauhan (2022). *Laudakia tuberculata* Gray, 1827 (Kashmir Rock Agama) in the Garhwal Himalaya: Distribution, Habitat Preference, Morphometry and Breeding Biology. Climate Change and Conservation of Biodiversity and Natural Resources in the Himalayan Environment *Edited by*: Dr. Vijay Prakash Semwal  
*Published by* : Messrs Bishen Singh Mahendra Pal Singh, Dehra Dun, India.

## 23 CHAPTER

### ***Laudakia tuberculata* Gray, 1827 (Kashmir Rock Agama) in the Garhwal Himalaya: Distribution, Habitat Preference, Morphometry and Breeding Biology**

**Smita Dangwal<sup>1\*</sup>, Dinesh K Sharma<sup>2</sup> and J.S. Chauhan<sup>3</sup>**

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#### **Abstract**

The genus *Laudakia* belongs to the family Agamidae of order Squamata. Agamidae has 52 genera and more than 350 species. The first member of the Genus *Laudakia* was described as *Lacerta stellio* by Linnaeus in 1758. The agamid genus *Laudakia* Gray, 1845 consists of 20 species complexes of rock-dwelling lizards distributed throughout the old world and inhabit various habitats within arid, tropical, and subtropical regions. In the North-West Himalayan region, four common species of *Laudakia* viz. *L. himalayana* (Steindachner 1867) (Himalayan Agama), *L. tuberculata* (Gray 1827) (Kashmir rock Agama), *L. agrorensis* (Stoliczka, 1872) (Agor Agama), and *L. dayana* (Stoliczka, 1871) has been recorded. *L. himalayana* was recorded between 2300-3430 m at higher elevation regions. *Laudakia tuberculata* has been reported with an altitudinal range extending up to 3650 m in Himachal Pradesh. This species was recorded between 150-3,600 m.asl from Uttarakhand. According to our study *L. tuberculata* was recorded at an altitudinal range of 350 to 2200 m asl. *L. agrorensis* is reported to found between 700 to 1300 m asl in Northern Punjab (old Punjab which included lower elevated areas of Himachal Pradesh). *L. dayana* up to 3000 m asl in Ladakh and upper Shimla. Most of the species of *Laudakia* are known for their very specific microhabitat preferences and are mainly found in crevices along the river beds and under or above rocks. They are ectothermic and colonize in the habitats with poor food availability. They feed on insects, their larval forms, ants, earthworms, spiders, beetles, large invertebrates and also on flowers and leaves of some plants, hence omnivorous. The present study deals the ecology of *Laudakia tuberculata* (Gray, 1827) in the Tehri district of Uttarakhand in the Indian Himalayan Region.

**Keywords:** *Laudakia*, *Agama*, Distribution, Morphometry, Microhabitat.

#### **Introduction**

*Laudakia tuberculata* (Gray, 1827) belongs to the family Agamidae (Agamid lizards) which comprises more than 350 species in 52 genera (Khan & Mahmood, 2004).

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7. Harpal Singh, Gurnam Singh, Amritpal Singh and N.K. Agarwal (2022). Impact of Tehri Hydropower Project on Water Quality of River Bhilangana, Central Himalaya, India. Climate Change and Conservation of Biodiversity and Natural Resources in the Himalayan Environment *Edited by* : Dr. Vijay Prakash Semwal *Published by* : Bishen Singh Mahendra Pal Singh, Dehra Dun, India

## 29 CHAPTER

### **Impact of Tehri Hydropower Project on Water Quality of River Bhilangana, Central Himalaya, India**

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#### **Abstract**

Hydropower is an important renewable energy resource and plays a vital role in reducing the world's dependence on fossil fuels. There are many more benefits of dam construction particularly in fulfilling the increasing demands of energy, irrigation and drinking water. But recent studies have shown that many dams altered aquatic ecology and river hydrology upstream and downstream, affecting water quality and quantity. They have created novel and artificial types of aquatic environment for the life span of the dam. This manuscript reviews the impacts of Tehri Hydropower project on water Quality of river Bhilangana constructed at the confluence of Bhagirathi and Bhilangana river at Central Himalaya, Uttarakhand. We investigated the changes in various physicochemical parameters from the three sampling sites identified on different fragments of Bhilangana river. Monthly samples for water quality were collected and analysed from downstream site S-3, Impounded site S-2 and compared with Natural upstream site S-1. In the impounded site (S-2) the water quality parameters like Water temperature, Transparency, pH, Nitrate, Phosphate recorded high while Turbidity, Water velocity, DO, Free CO<sub>2</sub> and alkalinity recorded low compared to Natural Upstream S-1 site. Considerable change in downstream water quality were also recorded in comparison to natural upstream site S-1

**Keywords:** River fragmentation, Physicochemical Parameters, Tehri Dam

#### **Introduction**

The rivers are the most precious ecosystem on earth. The characteristics of river ecosystems such as slope, nature of substratum, physico-chemical properties of water like temperature, color, alkalinity, pH, dissolved oxygen, flow velocity, turbidity, thickness of water column, depth of light penetration, atmospheric temperature,

9. Gurnam Singh, Harpal Singh, B. L. Thapliyal, Ravindra Singh and N.K. Agarwal (2022). Fish Diversity and Physico-Chemical Features of Kharmola Stream- a Spring-fed Tributary of River Bhagirathi in Garhwal Himalaya. Climate Change and Conservation of Biodiversity and Natural Resources in the Himalayan Environment. Edited by: Dr. Vijay Prakash Semwal. Bishen Singh Mahendrapal Singh. Dehradun (India).

## 12

### CHAPTER

## Fish Diversity and Physico-Chemical Features of Kharmola Stream- a Spring-fed Tributary of River Bhagirathi in Garhwal Himalaya

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### Abstract

The Kharmola stream is an important spring-fed tributary of river Bhagirathi joining at Kharmola bridge near Dharasu in Uttarkashi district (Uttarakhand), India. The present study has reported twelve fish species belonging to seven genera, three families and two orders. Cyprinidae family was the dominating family followed by Cobitidae and Sisoridae family, respectively. In the fish catch, schizothoracine group was dominating over other species. *Schizothorax* and *Schizothoracichthys* species were followed by mahseer (*Tor putitora*), lesser barils and some loaches. The relative abundance of almost 70% species was recorded as common, and ~30% were recorded as rare. The habitat features and hydrological parameters along the stream significantly influenced the species richness and their assemblage structure. Morphological features of fishes also have a significant role in their distribution. Species having unique adhesive structure were found frequently from the fast-flowing waters while other species without such adhesive structures were found from slow-moving water. Stream features are significant for providing breeding and feeding ground to the early stages of the fishes of this stream as well as Bhagirathi river. Stream serves critical habitat for the mahseer and snowtrout species. Conservation status of fish fauna was determined which revealed that out of twelve fish species, two species was under the endangered category, four species were under the vulnerable category, three species were categorised as lower risk near threatened. Status of three species was not assessed due to data deficient.

**Keywords:** Critical Habitat, Fish Diversity, Habitat Preference, Kharmola Stream, Physico-Chemical Features, Species richness

10. R. Singh, P. Bachhwan (2022). Fecundity of a hill stream fish *Noemacheilus botia* (Ham.) from Garhwal Himalaya. *Climate Change and Conservation of Biodiversity and Natural Resources in the Himalayan Environment*. Edited by: Dr. Vijay Prakash Semwal. Bishen Singh Mahendrapal Singh. Dehradun (India).

# 45

## CHAPTER

### **Fecundity of a Hillstream Fish *Noemacheilus botia* (Ham.) From Garhwal Himalaya**

**Ravindra Singh and Prashansa Bachhwan**

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Mature specimens of *Noemacheilus botia* collected from the Khoh river, a parental tributary of the river Ramganga were examined for fecundity. The fecundity varied from a minimum of 447 in fish measuring 51 mm to 1631 in the fish 80 mm. Body weight varied from  $2.253 \pm 0.179$  gm to  $5.300 \pm 0.00$  gm and consequently, the fecundity varied from  $581 \pm 185.15$  to  $1631 \pm 0.00$ . The relationship between fecundity and total length and weight of fish, fecundity and length, weight and volume of ovary, fish length-ovary weight, and fish weight-ovary weight were found to be of linear form.

**Keywords:** Fecundity; *Noemacheilus botia*; fish length; fish weight; ovary weight.

#### **Introduction**

The estimation of fecundity is an important aspect as it provides prior information regarding number of eggs that are likely to be received for hatching process and further management of nursery etc. Fecundity varies from species to species, depending on their age, length, weight, environmental conditions etc. In any environment, the success or failure of a species largely depends on its spawning potential. The fecundity is referred as the reproductive capacity of fish. Hence, it was considered desirable to study the fecundity of *Noemacheilus botia*, an important food-fish found in Khoh river the parental tributary of the river Ramganga.

#### **Materials and Methods**

For the purpose of fecundity only twenty ripe specimens were considered. The low number of mature fish for the estimation of fecundity is justified because it is a very rare and low population fish. The morphometric measurements of fish and related parameters (ovary length and ovary weight) were computed. For the estimation of fecundity, the ovary was taken out of preservative and properly washed in distilled water. The moisture was removed from ovary after putting it on the filter paper. The





## **Bacterial Diversity of Important Freshwater Ecosystems in Uttarakhand**

**A. Kumar; N. Rawat; A. Rawat; GK Joshi\***

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### **ABSTRACT**

Survival of various ecosystems directly or indirectly depends on freshwater as an important natural resource. Rivers are known for their unidirectional current with a relatively high, average flow velocity. The microorganisms are the key elements in the food chain of an aquatic system by providing nutritional sources to the next higher level. In addition, they have a prime role in the chain of biochemical reactions for accomplishing recycling of elements. Bacterial diversity is important because most of them are beneficial and responsible for important environmental processes such as decomposition, nutrient cycling and breakdown of environmental toxins. They are also the most metabolically diverse group that obtain energy from oxidizing organic carbon, parasitism, chemoautotrophy and photoautotrophy. The present paper describes the studies on bacterial diversity of rivers and lakes in Uttarakhand.

**Keywords:** Bacterial diversity, Uttarakhand, *Corynebacterium*, Alaknanda.

### **Introduction**

Uttarakhand is one of the northern states of India which shares international boundary with Tibet, China and Nepal. The state lies within 28° 43' N to 31° 27' N (Latitude) and 77° 34' E to 81° 02' E (Longitude) with total area of 53,483 Km<sup>2</sup>. Uttarakhand is regarded as a leading sacred destination for pilgrims from India and around the world. The state is also known for its unique culture and beautiful landscapes which attract millions of tourists every year. Uttarakhand mountains are important not just because

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Foreword by: Dr. Rajiv Pandey, Scientist, ICFRE, Dehradun

# Recent Advancements in Science with Special Reference to **HIMALAYA**

**Dr. Alok Sagar Gautam**



## About the Book

Himalaya, a mountain series are enriched with natural capital such as biodiversity, water bodies, fertile soil, quality air and serene environment. The present book will surely attract the readers because of its interdisciplinary nature which covers several fields of science i.e. atmospheric science, material science, computer science, remote sensing, environmental science, mathematical science, health and agricultural science, etc. The results discussed in the chapters were experimentally performed using the latest technology to get some impactful results. The chapters in the book shows a high impact over the society as it covers the hot and burning topic such as atmospheric and environmental science which deals with the factors responsible for the climate change and our environment. As we all know, learning is a never ending process to explore new horizons in science and technology, therefore this book somewhere reflects the above lines and is a small step towards recent Advancements in Sciences with Special reference to Himalaya.

## About the Editor

**Dr. Alok Sagar Gautam** is an outstanding researcher, mentor and academician of National and International repute holds Post Graduate (M.Sc.), and Doctoral Degree (Ph.D) in the field of Atmospheric Physics and Space Science, associated as Assistant Professor of Department of Physics, Hemvati Nandan Bahuguna Garhwal University (A Central University), Uttarakhand. Earlier, he worked in Instrumentation & Observational Techniques Division, Indian Institute of Tropical Meteorology, Pune. He took part in South Pole Antarctica Expedition. He has published some very good scientific papers in peer reviewed International/Nationals journals. He has also organized/participated in many scientific International/Nationals conferences, seminars, workshops. As a result of his very good research work, Dr. Gautam has been awarded Junior Associate at International Centre for Theoretical Physics (ICTP) Italy, Young Scientist Award by Uttarakhand State council for Science & Technology (UCOST), Young Scientist of the Year 2018 by International Academy of Science and Research (ISAR) Kolkata and "Promising Indian" by Promising Indian Society New Delhi, Research Excellence Award for best research paper on "First report on Chemical Characteristics of atmospheric pollutants over Garhwal Region Uttarakhand" by Institute of Scholars Bengaluru, Young Scientist Award in Atmospheric and Space Science by Global Environment & Social Association (GESA) New Delhi.



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## Lichens: Natural and Most Sensitive Biomonitorers of Atmospheric Changes

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### Abstract

*Lichens are used for biomonitoring of atmospheric changes as they are sensitive to many types of pollution but they are much suitable to assess damage caused by air pollution. Lichens have property to accumulate air pollutants such as heavy metals and polycyclic aromatic hydrocarbons (PAHs) which are mostly emitted during the burning of fuel by vehicles and emission from industries. Lichens are the natural and most sensitive biomonitorers used to monitor environment in the regions such as terrain forests, at high altitudes having anthropogenic activities, where it is not possible to establish instruments for monitoring pollution. Accumulated contents of polycyclic aromatic hydrocarbons (PAHs) in lichen thallus are measured to calculate the air pollution. It is easy to assess pollution by observing lichens growth and by comparing the data with time because lichens are always grows in clean environment and in polluted environment the growth of lichens are inhibited.*

**Keywords:** Lichens, bio-monitoring, polycyclic aromatic hydrocarbons (PAHs), Western Himalaya.

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## Effects of Salt Stress on the Morphology, Anatomy, and Gene Expression of Crop Plants

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### 6.1 Introduction

Our society and people living around the world need food to survive. Population is projected to increase around 10 billion in the next 50 years and to meet the food demand, around 50% increase in crop yield is needed (Godfray et al. 2010). On one side, population is increasing but the land needed for agriculture is decreasing about 1–2% per year in arid and semiarid zones around the globe due to salinity increase (Khan 2008). Salinity stress will increase globally due to climate change. Due to illogical crop irrigation practices, excessive fertilization, and excessive plowing, etc., salt stress increases every year (Lin et al. 2018). The sessile nature of the plants makes them very susceptible to get exposed and affected by different type of stresses. Tolerance is multidimensional and there is a complex signaling and concerted efforts to integrate all activities in plants (Cheeseman 2013). To feed the population by next century is a major challenge, so the mechanism underlying salt tolerance in halophytes is important since it withstands harsh salinity (Yang et al. 2017). The plants are classified into sensitive ones as “glycophytes” and tolerant ones as “halophytes” as per the salt stress response. Plants termed as glycophytes have retarded growth and even die under 100–200 mM concentration of salt (Flowers and Colmer 2008; Shabala 2013). Plants termed as halophytes can survive high concentrations of salts in their environments with  $\geq 200$  mM NaCl (Flowers 1975). They have important role in restoration of saline soils and ecological protection (Flowers and Colmer 2008).

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# Molecular Aspects of Plant-Pathogen Interaction

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Archana Singh • Indrakant K. Singh  
Editors

# Molecular Aspects of Plant-Pathogen Interaction

 Springer

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# Role of Phytohormones in Plant Defense: Signaling and Cross Talk

7

Vibha Gulyani Checker, Hemant Ritturaj Kushwaha,  
Pragati Kumari, and Saurabh Yadav

## Abstract

Plants, being sessile throughout their life cycle, are vulnerable to various kinds of abiotic and biotic stress conditions. They have evolved sophisticated mechanisms to detect precise environmental change and respond with an optimal response, thereby minimizing damage and conserving resources for growth and development. The response of plants towards these stresses are dynamic and complex. A defense response is initiated via modulation of molecular events, which involves interplay of signaling molecules including phytohormones. Phytohormones are small endogenous, low-molecular-weight molecules, which trigger an effective defense response against both biotic and abiotic stresses. Apart from defense signaling, these phytohormones are also regulators of growth, development, and physiological processes. The phytohormones such as auxins, cytokinins (CKs), gibberellins (GAs), salicylic acid (SA), jasmonic acid (JA), ethylene (ET), abscisic acid (ABA), and brassinosteroids (BRs) respond to stress via synergistic and antagonistic actions often referred to as signaling cross talk. These phytohormones coordinate with each other in a harmonious manner and respond to developmental and environmental cues. All defense response in plants are the result of interplay of many genes and gene families nicely orchestrated in

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# ***Green Nanomaterials for Industrial Applications***

# ***Green Nanomaterials for Industrial Applications***

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# ***Green biosynthesized metallic nanoparticles and future biomedical applications***

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## **1 Introduction**

The most challenging part of medical science is multiple drug resistance and emergence of new diseases. The whole world is now witnessing the devastating effects of coronavirus, which has accounted for the lives of many people affecting developed, underdeveloped, and poor countries. The countries which thought they had excellent medical facilities are showing signs of helplessness. The most powerful countries such as the United States and China are not in a position to control the viral infection. In medical science the patient can be saved if he/she gets the treatment on time and he/she will get the treatment on time if diagnosis and detection of the cause will be done on time. Current medical science is dependent on antibiotics for the treatment of common disease to complex diseases that originated from pathogenic microorganisms. However, the emergence of a drug-resistance microorganism (Chandra et al., 2017) and no discovery of new antibiotics till today makes the lives of human beings more complex. In India, before the introduction of modern medicine, people were using the traditional system of medicine, i.e., Ayurveda, for different ailments.

In India, before the introduction of modern medicine, people were using the traditional system of medicine, i.e., Ayurveda, for different ailments. The Indian subcontinent has a very rich biodiversity of flora and fauna and a treasure of many valuable medicinal plants. The burgeoning increase of new diseases like COVID-19, Dengue fever, Chikungunya, SARS, MERS, Swine flu, etc. is leading the countries to a most dramatic situation in which medical science is proving to be inefficient. The development of Nanotechnology or Nanoscience is proving to be effective technology in combating certain diseases and aiding important contributions in diagnostics, cancer therapy, Diabetes management, dentistry, and other fields of medical sciences (Fig. 1). The nanotechnology field is not new in the Indian subcontinent and

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# Plant-Pest Interactions: From Molecular Mechanisms to Chemical Ecology



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Indrakant K. Singh • Archana Singh  
Editors

# Plant-Pest Interactions: From Molecular Mechanisms to Chemical Ecology

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## Thioredoxins as Molecular Players in Plants, Pests, and Pathogens

Pragati Kumari, Arvind Gupta, and Saurabh Yadav

### Abstract

Throughout their life cycle, plants are exposed to various kinds of biotic and abiotic stress conditions. Plant responds to such stressors through the orchestrated machinery at the molecular level and exerts its defense. Plants have sophisticated mechanisms to sense environmental cues, which guard them to mount a protective response. The antioxidant machinery in the plants comprises enzymatic and non-enzymatic proteins. The enzymatic proteins include glutaredoxins, thioredoxins, and many others. Thioredoxin (Trx) are multifunctional small redox proteins found in every living organism, and various Trxs have been identified in plants. The two reactive cysteine residues are found in the conserved motif of thioredoxins. They play post-translational regulatory role in number of cellular processes such as oxidative stresses and plant pathogen interactions. Trxs are reduced by NADP-thioredoxin reductase (NTR) in the presence of NADPH. In model plant, *Arabidopsis thaliana*, At Trxs are pathogen-inducible and contribute towards plant defense via expression of the defense responsive pathogenesis-related (PR) genes. The most important family of thioredoxin proteins is Trxh, having their role in many versatile processes including defense responses in plants. We present upcoming, prospective roles of thioredoxin proteins of plants, insects as well as pathogens and their role in biological interactions. This chapter would assist plant scientists in further exploring the

Authors Pragati Kumari and Arvind Gupta have equally contributed to this chapter.

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## Chapter 9

# Proteins Involved in Colorectal Cancer: Identification Strategies and Possible Roles



Sudhir Kumar, Divya Goel, Neeraj, and Vineet Kumar Maurya

**Abstract** Colorectal cancer is one of the five types of commonly occurring cancer in the world. Like other cancers, it is also a result of uncontrolled cell divisions. Each disease bears clear proteomic signatures, which if identified properly would assist in its early diagnosis and timely treatment. Comparative proteomics and microarray technologies enable the study of differential proteomics signatures of a disease. Using these two technologies, some proteins like beta-subunit of 14-3-3 proteins (14-3-3 $\beta$ ) and aldehyde dehydrogenase 1 (ALDH1), etc. have been identified as possible biomarkers for detection of colorectal cancer (CRC). Proteomics signature not only provides clue about biomarkers for colon cancer but also indicates drug targets that can be utilized for treatment of cancer. Most common drug targets for cancer are expected to be the proteins involved in cell cycle, protein synthesis, signaling and transport, etc. Tumor antigen p53 (p53), E2F transcription factor 1 (E2F1), ribosomal protein L15 (RPL15), vascular endothelial growth factor (VEGF), G protein-coupled receptor 35 (GPR35), nucleoside diphosphate kinases (NM23), erythroblastic oncogene-B (c-erbB-2), and urokinase-type plasminogen activator (uPA) are some of the proteins which have been explored for their possible roles in colorectal cancer. These proteins along with other crucial proteins are described in the present chapter for their role either as biomarker or drug target for colorectal cancer. Besides “omics,” “data mining technology”-based studies were also explored for their possible role in proteomic profiling of colorectal cancer.

**Keywords** p53 · GPR35 · E2F1 · RPL-15 · CD44 · ATM/ATR · JAK/STAT · Microarray · Data mining

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<b>9</b>	<b>Proteins Involved in Colorectal Cancer: Identification Strategies and Possible Roles</b> . . . . .	<b>179</b>
	Sudhir Kumar, Divya Goel, Neeraj, and Vineet Kumar Maurya	
<b>10</b>	<b>Short-Chain Fatty Acids as Therapeutic Agents in Colon Malignancies</b> . . . . .	<b>195</b>
	Arundhati Mehta, Vivek Kumar Soni, Yashwant Kumar Ratre, Rajat Pratap Singh, Dhananjay Shukla, Naveen Kumar Vishvakarma, Rakesh Kumar Rai, and Navaneet Chaturvedi	
<b>11</b>	<b>Targeting Angiogenesis for Colorectal Cancer Therapy</b> . . . . .	<b>219</b>
	Vaishali Gupta, Taha Bharmal, Vineeta Dixit, Naveen Kumar Vishvakarma, Atul Kumar Tiwari, Dhananjay Shukla, and Shirish Shukla	
<b>12</b>	<b>Anti-Inflammatory Molecular Mechanism and Contribution of Drug Transport Molecules in Colorectal Cancer Cells</b> . . . . .	<b>239</b>
	Dowluru S. V. G. K. Kaladhar and Srinivasan Tantravahi	
<b>13</b>	<b>Emerging Role of Circulating Tumour DNA in Treatment Response Prognosis in Colon Cancer</b> . . . . .	<b>257</b>
	Eveline M. Anto, Anaga Nair, and Jayamurthy Purushothaman	
<b>14</b>	<b>Immuno-modulating Mediators of Colon Cancer as Immuno-therapeutic: Mechanism and Potential</b> . . . . .	<b>271</b>
	Chanchal Kumar, Rajat Pratap Singh, Mrigendra Kumar Dwiwedi, and Ajay Amit	
<b>15</b>	<b>Immune Checkpoint Inhibitors as an Armor for Targeted Immunotherapy of Colorectal Cancer</b> . . . . .	<b>309</b>
	Smita Kapoor and Yogendra S. Padwad	
<b>16</b>	<b>Examining the Role of the MACC1 Gene in Colorectal Cancer Metastasis</b> . . . . .	<b>327</b>
	Aparna S. Narayan, Jayshree Nellore, Valli C. Nachiyar, and Sujatha Peela	
	<b>Index</b> . . . . .	<b>353</b>

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# Colon Cancer Diagnosis and Therapy

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## Chapter 4

# Application of Plant-Based Nanoparticles in Wastewater Decontamination



Sudhir Kumar and Jaspal Singh Chauhan

**Abstract** Wastewater treatment is an important challenge of this century as it safeguards the health of our environment and living being. Wastewater is always regarded as a significant source of environmental pollution due to its potential to harm both living and non-living beings. Many physical, biological, and chemical modes of treatment are implied to comply with the standards of wastewater discharge, given by competent national agencies for protecting the environment. Researchers from all over the world have recently become more interested in the synthesis of plant nanoparticles and their application for wastewater decontamination since it is an environmentally benign, cost-effective, and efficient technology. Parts and extracts of various plants are being explored for the synthesis of nanoparticles. Green synthesized nanoparticles are highly efficient for recycling and removal of toxic contaminants from wastewaters and make it reusable in different aspects. However, synthesis, regeneration, and reusability are the major obstacles that must be addressed before the technology transferred from laboratory to commercial applications. In this chapter, we focused on the different approaches of plant-based nanoparticle synthesis and their applications in wastewater treatment. Further, important challenges in the field of plant-based nanoparticles in the wastewater treatment are also discussed.

**Keywords** Plant-based nanoparticles • Metal ion reduction • Wastewater treatment • Protein based nanoparticles

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89



# Contents

<b>1</b>	<b>Principles and Potentials of Nanobiotechnology</b> .....	<b>1</b>
	Jai Prakash Narain Rai and Shweta Saraswat	
<b>2</b>	<b>Application of Nano-biotechnology in Wastewater Treatment: An Overview</b> .....	<b>41</b>
	Shweta Saraswat	
<b>3</b>	<b>Emerging Nano-Bio Material for Pollutant Removal from Wastewater</b> .....	<b>77</b>
	Dheeraj Rathore, Anoop Singh, Shiv Prasad, Piyush Malaviya, and Surajbhan Sevd	
<b>4</b>	<b>Application of Plant-Based Nanoparticles in Wastewater Decontamination</b> .....	<b>89</b>
	Sudhir Kumar and Jaspal Singh Chauhan	
<b>5</b>	<b>Microbial Synthesis of Nanoparticles for Wastewater Remediation</b> .....	<b>115</b>
	Shailja Singh, Shiv Shankar, and Shikha	
<b>6</b>	<b>Recent Trends in Synthesis and Applicability of GO-Based Nanomaterials in Environmental Remediation</b> .....	<b>151</b>
	Rimmy Singh, Sunil Kumar, and Rachna Bhateria	
<b>7</b>	<b>Nanomaterials for the Removal of Inorganic Contaminants from Industrial Wastewater</b> .....	<b>171</b>
	Rashmi Paliwal and Jai Prakash Narain Rai	
<b>8</b>	<b>Application of Nanobiotechnology for Heavy Metal Remediation</b> .....	<b>191</b>
	Arjita Punetha and Amir Khan	

Jai Prakash Narain Rai · Shweta Saraswat  
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# Nano-biotechnology for Waste Water Treatment

Theory and Practices

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