JSS ACADEMY OF HIGHER EDUCATION & RESEARCH

(DEEMED TO BE UNIVERSITY) MYSURU

COMPENDIUM ON SDG 14

LIFE BELOW WATER

2020-2021

INTRODUCTION

The SDGs aim to sustainably manage and protect marine and coastal ecosystems from pollution, as well as address the impacts of ocean acidification. Enhancing conservation and the sustainable use of ocean-based resources through international law will also help mitigate some of the challenges facing our oceans. By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism.

The world's oceans – their temperature, chemistry, currents and life – drive global systems that make the Earth habitable for humankind. How we manage this vital resource is essential for humanity as a whole, and to counterbalance the effects of climate change. Over three billion people depend on marine and coastal biodiversity for their livelihoods. However, today we are seeing 30 percent of the world's fish stocks overexploited, reaching below the level at which they can produce sustainable yields.

Oceans also absorb about 30 percent of the carbon dioxide produced by humans, and we are seeing a 26 percent rise in ocean acidification since the beginning of the industrial revolution. Marine pollution, an overwhelming majority of which comes from land-based sources, is reaching alarming levels, with an average of 13,000 pieces of plastic litter to be found on every square kilometre of ocean.

WATER CONSERVATION -RAINWATER HARVESTING AND RETENTION FACILITY IN THE CAMPUS IN SUPPORTING LIFE ON LAND

Biodiversity and Aquatic Ecology Education at JSSAHER

Aquatic ecosystems support a substantial source of the earth's biological diversity. They are an essential reservoir and share an enormous proportion of earth's biological productivity. Both aquatic resources and its biodiversity are interrelated to each other and they perform a myriad of functions and are valuable and essential for the sustainability of biotic communities. Aquatic biodiversity in both freshwater and marine environments are under continuous decline because of overexploitation of species, introduced exotic plant or animal, pollution sources from cities, industries and agricultural zones, loss and changes in ecological niche. Their conservation and management in the form of bio reserve points and bioregional management and worldwide monitoring are needed for the protection of the aquatic biodiversity. JSSAHER provides information to students on biodiversity in aquatic habitats and their resources, in marine and fresh water ecosystems, their importance conservation and restoration mechanisms.

B.Sc Environmental Sciences

https://www.jssuni.edu.in/jssaher/faculty-of-natural-sciences/ug-environmental-science.html

The Bachelor of Science in Environmental Science degree program (the "EVS Program") is an interdisciplinary degree program in Environmental Science focused on the study of the environment, and solutions to the environmental problems through the application of scientific methods and techniques. An environmental sciences program in JSS Academy of Higher Education & Research is designed to give a broad perspective on the environment. The curriculum in many of these programs provides the students with a foundation in Chemistry, Life Sciences, as well as earth and health sciences. In addition to Lecture based coursework, many programs also examine environmental issues through seminars and group projects.

The Department focuses research in the areas of Environmental Chemistry, Environmental Genetics, Environmental Toxicology, Environmental Engineering, ***Remote Sensing and Geographical Information Systems, Environmental Management and Environmental Microbiology, Bioresource Technology, Biodiversity and Aquatic Ecology.***

Undergraduate environmental science degree programs serve as great preparation for a variety of interesting and fulfilling careers. These careers range from geology to forestry, community outreach to research, and ***environmental***

management to eco tourism. These skills are increasingly in demand by the employers, as there is a growing awareness of environmental issues related to the effect of the industries. As a graduate of environmental science program, the student will have expertise to combat many of these issues.

B.Sc. Environmental Science programme is foundational environmental degree, enabling students to learn the science behind the Earth's amazing complexity and its environmental processes, and to help prepare you to take a role in improving the future of our planet. Our staff includes research experts and environmental practitioners who will share with you their practical and theoretical insights so that you emerge from your degree with an understanding of how to measure, evaluate, and make decisions about environmental issues. The student will have the opportunity to learn sophisticated laboratory techniques and data analysis, such as the utilization of Geographical Information Systems. You will have the opportunity to work and learn in inspiring places where you will gain practical field experience. Our programme encourages pursuing student's interests and shaping their ambitions.

The core mission is to impart knowledge with quality teaching and research with a special focus on contemporary national needs. Our vision is to grow into an institution of national importance, with international standing and internationally recognized centre of excellence and research in Environmental sciences.

The program is tailored based on the current environmental issues and policies governing them. The program covers the following core modules which provide an overall basis for various topics in environmental sciences.

- Introduction to Environmental Sciences
- Environmental Studies
- Ecosystem Dynamics
- Components of Biodiversity & Conservation
- Natural RESOURCES
- Environmental Microbiology
- Environmental Chemistry
- ***Environmental Pollution***
- ***Environmental Monitoring & Techniques***
- ***Environmental Management***
- ***Eco-Restoration & Development***

The program also provides for electives concerning specific areas in environmental studies and gives opportunities for the students to link biotechnology, Tissue Culture, Vermiculture Technology, Industrial Biotechnology Etc. with the Core Subjects.

SEMESTER I PAPER 1: PRINCIPLES OF ENVIRONMENTAL SCIENCES 4 CREDITS

- Unit I: Definition, scope and interdisciplinary nature of environmental science, environmental factors: structure, composition of Atmosphere, Lithosphere, Biosphere and Hydrosphere.
- Unit II: Biogeochemical Cycles of major environmental elements and significance: Carbon, Nitrogen, Phosphate, Sulphate, Hydrogen, Oxygen, Mode of energy transmission.
- ***Unit III: Ecology: Definition, subdivision, ecosystem- Terrestrial, Aquatic, Grass, flow of energy, food chain, food web, tropic level, ecological pyramid, eco-tone, edge effect***
- Unit IV: Biomes and Habitat: Classification of biomes – Tundra, Taiga, Grassland, Desert, Evergreen and deciduous forests, Tropical rain forests and their characteristics, flora and fauna; Classification of Aquatic Habitats – Fresh water pond, Wetlands, Beels, Rivers – their characteristics, flora and fauna; Marine Habitats – Pelagic, Benthic, Intertidal Estuarine; Mangroves – their characteristics, flora and fauna
- Unit V: Conservative biology: Biodiversity conservation, Wildlife management, Ex-situ and insitu Conservation, Protected area networks in India, important projects, Role of local community in conservation, national conservation policies: National Forest policy, biodiversity Act, Wildlife protection Act. Concept of Endangered, endemic and extinct species, Red data

B.Pharm -Pharmacognosy & Natural Products Research

BP 405 T.PHARMACOGNOSY I (Theory) 45 Hours

Course Content:
UNIT-I 10 Hours Cultivation, Collection, Processing and storage of crude drugs: Factors influencing cultivation of medicinal plants. Pest management and natural pest control agents. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants Conservation of medicinal plants

UNIT-II 10 Hours Quality control of crude drugs: Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods and properties. Introduction to Pharmacognosy: Definition, history, scope and development of Pharmacognosy Classification of drugs: Alphabetical, morphological, taxonomical, chemical and pharmacological classification of drugs

UNIT III 10 Hours Pharmacognosy in various systems of medicine Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, unani, siddha, chinese Introduction to secondary metabolites Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins and Volatile oil 106 Study of biological source, chemical nature and uses of crude drugs containing Following drugs Secondary metabolites Glycosides –Senna, Arjuna, Digitalis

UNIT IV 08 Hours Study of biological source, chemical nature and uses of crude drugs containing following drugs Secondary metabolites Flavonoids – Tea, Ruta Saponins – Liquorice, Dioscorea Alkaloids-Vinca, Rauwolfia, Bellodonna, Opium Tannins – Catechu, Pterocarpus Terpenoids - Mentha, , Clove, Nutmeg Resins: Benzoin, Guggul, Ginger, Asafoetida UNIT-V 07 Hours Study of biological source, chemical nature and uses of crude drugs containing following drugs Primary metabolites: Carbohydrates: Acacia, Agar, Tragacanth, Honey Proteins: Gelatin Lipids: Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax

UNIT VI Marine Pharmacognosy Novel medicinal agents from marine sources.

PHARM D & M.PHARM -PHARMACOGNOSY & PHYTOCHEMISTRY

https://www.jssuni.edu.in/JSSWeb/UDData/Docs/Pharmacy-Pharm-D.pdf

Therapeutic application of herbal drugs, poisonous plants, herbal-drug interaction, edible vaccines, ***marine Pharmacognosy.*** Marine natural product chemistry. Include examples of marine antineoplastic agents, marine toxins, and other ***pharmaceutically relevant marine natural products from various marine organisms***.

Marine Natural Products

- ***General methods of isolation and purification***
- ***Study of Marine toxins***
- ***Recent advances in research in marine drugs***
- ***Problems faced in research on marine drugs such as taxonomical identification***
- ***Chemical screening and their solution***

RESEARCH PUBLICATION RELATED TO SDG 14- LIFE BELOW WATER

Recent Scenario of Impact of Xenobiotics on Marine Fish: An Overview

Pharmacognosy Journal, 2020,12,6s,1797-1800.
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Jagadeep Chandra S,Chandana GL,Naganagouda V Kote,Sharath Chandra SP

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Abstract:
Xenobiotics from chemicals to plastics have seriously interfered with the biological process of living system. Their impact on aquatic ecosystem, fish in precise is studied with significant interest. However, studies on impact of xenobiotics on marine fish are limited. This literature review integrates and summarizes the impact of xenobiotics on marine fish. The review tries to understand the impact of macro and micro litters, microplastic, metals like mercury and nanoparticles. Finally, we conclude with the ways to regulate the presence and distribution of these xenobiotics in marine environment.

Keywords: Fish, Litters, Marine, Xenobiotics

Diketopiperazine derivative from marine actinomycetes Nocardiopsis sp. SCA30 with antimicrobial activity against MRSA

Saket Siddharth [1], Jamuna Bai Aswathanarayan [2], Mahadevaswamy G Kuruburu [3], Subba Rao V Madhunapantula [3], Ravishankar Rai Vittal [4]

Abstract

Actinobacteria isolated from marine sources are a potential source of novel natural products. In this study, we report isolation, biological activity and characterization of secondary metabolites from strain Nocardiopsis sp. SCA30, isolated from marine sediments of Havelock Islands, Andaman and Nicobar, India. The ethyl acetate extracts of the isolate on screening for biological activity demonstrated antibacterial potency and antiproliferative activity. The extracts showed anticancer activity in a panel of cell lines, including HCT 15, HT 29, MCF 7 and MDA-MB 468, at concentrations ranging from 62.5 to 1000 μg/ml. A dose-dependent reduction in cell viability was observed in all the tested cell lines. The extract at 15 μg/ml and 30 μg/ml inhibited growth of methicillin-resistant Staphylococcus aureus ATCC NR-46071 and NR-46171 with MIC's of 15.62 and 7.81 μg/ml, respectively. LC-MS and NMR studies revealed that the antibacterial and anticancer compound isolated from Nocardiopsis sp. SCA30 is 1-acetyl-4-4(hydroxyphenyl)piperazine.

Keywords: Actinomycetes; Anti-cancer; Antimicrobial; Diketopiperazine; Methicillin-resistant Staphlyococcus aureus; Nocardiopsis; PKS.

Groundwater pollution sensitivity model for part of Cauvery basin between Mettur dam and Erode town using remote sensing and GIS.

M. Ravikumar, D. Nagaraju, +5 authors Krishna Rao

Published 2010

Engineering

International journal of Geomatics and Geosciences

Information about vulnerability of groundwater to contamination is essential to facilitate groundwater planning and management. The vulnerability of shallow groundwater to contamination in and around part of Cauvery basin between Mettur dam and Erode town, Tamil Nadu, India, is evaluated using the “LGRSIDWQ” method within a Geographic Information System (GIS). “LGRSIDWQ” parameters are calculated from geological, soil and elevation contour maps and groundwater level data of the study area and thematic maps are prepared. Finally, the maps are integrated through the “LGRSIDWQ” model within the GIS to demarcate vulnerable zones. In the present study, “LGRSIDWQ” indices for both generic industrialmunicipal and pesticide pollutants are derived and vulnerability maps for both classes are prepared. The result of the study shows that 50 percent of the area is highly vulnerable to industrial and municipal pollutants and more than 81 percent of the area is highly vulnerable to industrial waste pollutants.

Sawant Sushant Anil, JSS Academy of Higher Education & Research

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Review Article

Recent Scenario of Impact of Xenobiotics on Marine Fish: An Overview

Jagadeep Chandra S[1], Chandana GL[2], Naganagouda V Kote[3], Sharath Chandra SP[4,*]

ABSTRACT

Xenobiotics from chemicals to plastics have seriously interfered with the biological process of living system. Their impact on aquatic ecosystem, fish in precise is studied with significant interest. However, studies on impact of xenobiotics on marine fish are limited. This literature review integrates and summarizes the impact of xenobiotics on marine fish. The review tries to understand the impact of macro and micro litters, microplastic, metals like mercury and nanoparticles. Finally, we conclude with the ways to regulate the presence and distribution of these xenobiotics in marine environment.

Key words: Fish; Litters; Marine; Xenobiotics.

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INTRODUCTION

Xenobiotics or foreign bodies are difficult to contain given their ubiquity all over the world.[1] Numerous xenobiotics include chemicals like herbicides, pesticides, metals and their derivatives, pharmaceuticals including antibiotics and many more. Both short and long period exposure to these xenobiotics can cause irreversible damage to living being, with several reports supporting the claim[2,3]. Xenobiotics enter the living system and undertake four stages: absorption, distribution, metabolism and elimination[4]. Standard xenobiotic metabolism follows continuous biotransformation like oxidation, reduction/hydrolysis of the main molecule to produce reactive groups (-NH_2, -COOH-OH) followed by conjugation of hydrophilic molecules (glutathione, sulfate, glucuronic acid) to raise the hydrophilicity of xenobiotics culminating in intestinal excretion[5].

There are also findings where xenobiotics induce carcinogenesis by gene mutation[6]. The effect of xenobiotic pollution in aquatic ecosystem is well documented[7] and pattern of their impact on fish/aquatic animals falls under three major categories behavioral, neurophysiological and reproductive[8]. The above effects are usually interconnected[9], as neurological modifications affect the behavior patterns in the fish; while changes in behavior affect reproductive system[10]. In this review, we have attempted to discuss the recent scenario of xenobiotic and marine fish interaction and provide a literature overview of biological modifications observed in different marine fish species upon external and internal contact with xenobiotics.

OBSERVATIONS

Ingestion of marine litters

Ingestion of litter by different species of marine fish has been reported[11,12]. Approximately 700 species of marine organisms have known to ingest marine litter[13]. Plastics (micro and macro) form the major part (92%) of litter ingested by the marine organisms[14]. Plastics are also manufactured as very tiny particles such as micro-beads, plastic nanoparticles, etc. These tiny particles are easily ingested by marine fish impacting the marine food webs, which directly affects the human consumers[15].

A study[16] reported information on the presence of marine liter in the stomachs of fish species in diverse marine habitats for the Adriatic and North eastern Ionian macro region. The occurrence of macro litter was studied in 614 specimens belonging to 11 species, on the other hand 230 specimens related to 7 species was studies for micro species. The findings underline the presence of litter in the stomach of the fish *Citharus linguatula*. The presence of macro litter in the guts was less than 3 % in North eastern Ionian and North Adriatic but approximately in the North Adriatic (Slovenian sea). The ingested micro and macro litter varied depending on the zones. The research concluded that marine fish was affected by macro litter ingestion.

Microplastic ingestion

Microplastics are ingested by living organisms due to their small size and abundance. Microplastics have been extensively researched for their impact on living organisms including human beings. In marine environment such as ocean and sea microplastics can easily enter the marine organisms due to their very tiny size (< 5mm). There are several reports which suggest ingestion of these microplastics by marine organisms, fish in precise[17,18]. But most of the studies have been reported in the laboratory conditions[19]. A study[20] in the important fishing zone such as Northwestern African upwelling system has been reported to show the presence of microplastic particles in the digestive tract of *Scomber colias* (Atlantic chub mackerel). The study revealed out of the gastrointestinal tract examined 120 fish, 78. 3 % were found have microplastics, 74.2 % showed fibres, 17.5 % had plastic fragments and 16.7 % had

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paint. The study revealed the microplastic contamination in marine fish *Scomber colias*.

Mercury accumulation

The release of mercury from anthropogenic and natural sources like incineration and coal combustion reach the aquatic ecosystem by atmospheric deposition[21] and results in significant repercussions to invertebrates and vertebrates[22]. Mercury is classified into three types of chemicals, elemental, inorganic and organic. Inorganic mercury is the one mostly released to the environment[23]. Many models have been developed to identify the zonal variance of mercury and understand the main culprits[24]. This is the main reason to identify and study the pattern and distribution of mercury in aquatic environment. As the most important source of entry of mercury in humans and animals is the consumption of fish[25], it is important understand the presence and abundance of mercury in aquatic environment. It also helps to understand the magnitude of mercury pollution reaching the main consumers, human beings[26]. A study[27] analyzed the total mercury accumulation in the gut and bodies of 13 species of marine fish. They also reported the mercury concentration in water, sediment, fodder materials and fish prey to depict the bio-accumulation dynamics. Marine fish demonstrated high level of mercury accumulation in comparison to fresh water fish. According to the study[27] mercury content increased in accordance to the trophic level of the consumer. Total mercury levels in marine fish (samples from coastal waters and market) displayed more than the legal limits.

Impact of nano-ZnO on *Mugilogobius chulae*

Aquatic toxicity due to nanoparticles has been studied extensively in recent years. However, the studies on the marine fish toxicity and distribution are very limited. A study[28] reported the impact of zinc oxide nanoparticles on marine fish *Mugilogobius chulae*. The research team also reported the relative difference in zinc oxide nanoparticles dissolution and dispersal of the same in seawater as well as freshwater. The impact of zinc oxide nanoparticles on hatching, mortality, embryonic development, deformity and histopathology was reported[29,30]. The results indicated that zinc oxide nanoparticles showed higher solubility in seawater than freshwater. The zinc oxide nanoparticles also remarkably inhibited hatching. The LC_{50} on the fifth day was found to be 45.40 mg/L with significant spike in the mortality rate. Though exposure to Zn^{2+} showed hatching inhibition and higher lethality, but its impact was less than the zinc oxide nanoparticles at the similar doses[31-33]. Zinc oxide nanoparticles caused spinal bending, hypoplasia, odema and other deformities in *Mugilogobius chulae* larvae and embryos. Histopathological studies exhibited hepatocyte and enterocyte enlargement, vacuolar degeneration, and morphological abnormalities of the fish. The study underlines the impact of zinc oxide nanoparticles on marine fish.

CONCLUSION

The study of the literature on impact of xenobiotics on marine fish shows serious consequences. The entry of different chemicals and their mode of entry are to be given importance by the concerned authorities to avoid more accumulation and distribution. The xenobiotics in marine fish not only impact the aquatic organisms but also human health. So, regulations which govern the presence and release of chemicals are the key to regulate marine pollution due to xenobiotics.

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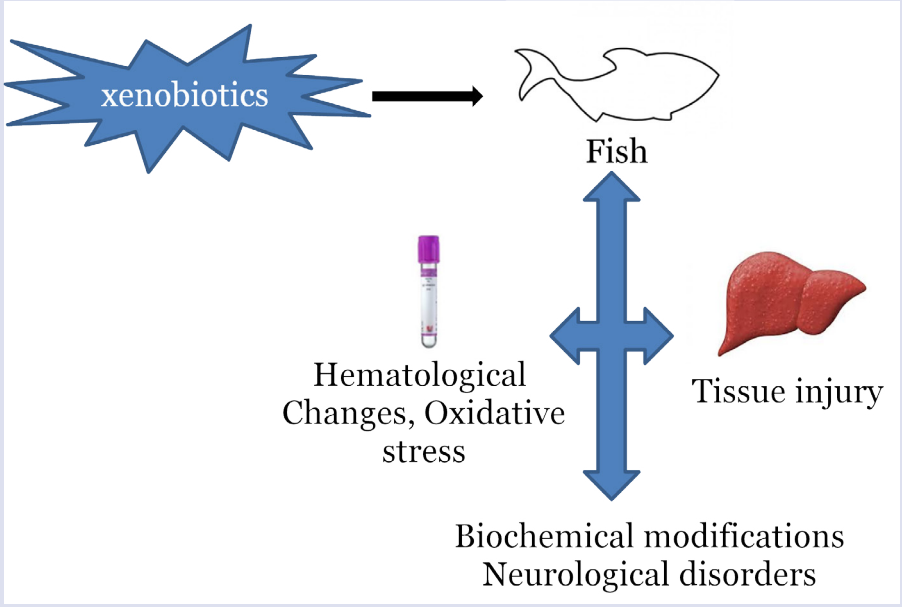
GRAPHICAL ABSTRACT



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