

Clean Energy Production Technologies
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Bioenergy Research: Basic and Advanced Concepts

 Springer

Chapter 3

Influence of Significant Parameters on Cellulase Production by Solid-State Fermentation



M. Subhosh Chandra, P. Suresh Yadav, Pallaval Veera Bramhachari, and Narasimha Golla

Abstract Cellulases become an area of unique attention in bioremediation methods owing to their capability to breakdown cellulose. Development of cost-effective, high titer of attractive enzymes by fungi is a challenge. The overproduction of dynamic enzymes which cut various β -1,4-glycosidic bonds still wreck a challenge and is the key blockage for the cellulosic biomass transformation. Microbes are an eye-catching topic for production of cellulases because of their enormous prospective for production of cellulase, enzyme intricacy, and severe habitation variability. Microbial cellulolytic enzymes are ideal because of their immense advantages in number of industries. In fact, trend for cellulolytic enzymes is undeniably expanding for their use in bioremediation, pharmaceuticals, pulp and paper, waste management, food processing, and so on. Future research is ensuing into enhanced scientific information in addition to the achievement of summit of the rising demands of cellulase and associated enzymes for production of eco-friendly textiles, detergents, bio-pulping, and bio-alcohols. Furthermore, it is opening novel paths for exploitation of a variety of agricultural residues and pollutants as a basis of renewable energy in lieu of throwing away to cause environmental degradation. In years to come, newest knowledge of outstanding cellulolytic enzymes and acceptance of various biotechnological approaches will undoubtedly bring immense vision in the field of green chemistry. Hence, the present book chapter focused on fungal cellulases in bioremediation and factors affecting cellulases production by solid-state fermentation (SSF).

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Winemaking

Basics and Applied Aspects

V.K. Joshi • Ramesh C. Ray (eds)



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16 Additives, Adjuvants, Packages, Closures and Labels in Oenology

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1. Introduction

Wine production is the process by which yeast converts grape sugar into alcohol and carbon dioxide. But because of wine – the word sounds simple enough – today's winemakers are facing a number of problems beginning from the vineyard to the bottle. Since the past few decades, scientific knowledge of the wine process has become so extensive as to provide many choices to wine makers (Gardner, 2008). To process the products, including wine, several methods are employed to preserve through use of different additives, adjuvants and preservatives. The main reason wine adjuvants and additives are popular is because of their harmlessness (when used correctly) and their ability to improve the sensory qualities (taste, smell, etc.), stability, colour, clarity and age-worthiness of the wine. Common additives are added generally before fermentation. A good rule of thumb to follow is that if the wine needs corrective additives of some kind, then, something has to be wrong with the quality of the grapes, the region (climate), or the process of winemaking. Of course, finding out what additives a winemaker has used is a bit challenging because there is a shroud of secrecy and consumer fear around the topic (Marchal and Jeandet, 2009).

In the wine world, there are many different wine additives, some of which have been used for hundreds of years with no ill effects. The intention of these additives is not to adulterate the wine, but to stabilise it. When it is stable, it is possible for the wine to have a longer shelf life. Many of these are not really additives; instead they glom (with molecular attraction) on to unwanted particles and are removed from the finished wine. Many adjuvants/additives that help to restart a stuck fermentation have been proposed, for example, addition of ammonium does not raise any counter indications with little improvement of the second fermentation. The addition of ammonium sulphate should be limited to 5 g/hl due to the limited use of nitrogen by yeast. The winemaker must react accordingly and, if need be, use additives such as nitrogen, vitamins and yeast hulls whose effectiveness has been clearly established. In addition to the above elemental operations, notably aeration and temperature control must also be standardised. Fresh wine is turbid with very high particle content, consisting of yeast lees and other grape debris. Clarity and stability of wine are the essential qualities required to convince the consumers. Particles in suspension (that form a haze or disperse through the liquid) not only spoil the presentation, but also affect the flavour. Clarity is achieved by gradual settling, followed by racking to eliminate the solids. Wine treatments are determined by its intended purposes. For instance, filtration clarifies but does not stabilise; fining does both and the treatment with gum arabic stabilises wine, but does not clarify it. Efficient packaging is necessary for both kinds of fresh or processed food and it is an essential link between the food producer and the consumer. The basic function of packaging is to identify the product and safe transportation of the product through the distribution system to the consumer. Including the above preserving the farm or processor freshness or preventing physical damage, cost effectiveness is also very important in the designing and packaging process. Packages must be easy and safe to handle, simple to open and use, and pose no problems in their disposal (Paine and Paine, 1992). Traditionally, wines have been packaged in glass bottles, but new developments include packaging in plastic bottles, laminate lined bag-in-box systems, laminated paperboard cartons and metal cans (Markowski, 1989; Buchner et al., 1988; Anelli, 1988). The basic purpose of a closure is mainly to seal the container and

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Bioenergy Research: Commercial Opportunities & Challenges

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Chapter 3 1
Value Added Products from Agriculture, 2
Paper and Food Waste: A Source 3
of Bioenergy Production 4

M. Subhosh Chandra, M. Srinivasulu, P. Suresh Yadav, 5
Bellamkonda Ramesh, Narasimha Golla, and Thummala Chandrasekhar 6

Abstract Solid waste generated from food mainly contains various organic com- 8
pounds such as carbohydrates, lipids, and proteins. These biodegradable wastes 9
mainly released from food, Agricultural, household, and hospitality segments. The 10
waste material produced from food is frequently burned or discarded into open areas, 11
which may also become a source of many severe health and environmental prob- 12
lems. The management of waste material generated from food is done by transform 13
into various value-added products, like phytochemicals, food supplements, bioactive 14
materials, dietary fibers, safe to eat and important oils, bio fertilizers, biofuels, and 15
single-cell proteins (SCP). Every year, enormous amounts of solid waste (sludge) 16
from the wastewater treatment of paper manufactures have been created. They might 17
be dumped into the landfill if they have heavy metals lower than the standard of the 18
Department of Industrial Work and the Ministry of Industry. Now a day, the area of 19
landfills is quite limited whereas solid waste has been accumulated. In the case of 20
waste from agriculture biomass, a few of them are mixed with soil or applied as 21
ingredients of the fertilizer. On the other hand, the value of the wastes is fairly low. 22
Hence, the manufacture of value-added products, such as furniture cardboard, and 23
packaging and the agricultural product from solid wastes could be useful. This 24

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Assessment of heavy metal contamination in soils and groundwater at an industrial area, Bangalore, Karnataka, India**S. Srinivasa Gowd^{1*}, C. Krupavathi¹, R. Maheswararao¹, B. Pradeep Kumar¹,
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Abstract: Much concern over soil pollution of heavy metals because of accelerated industrialization and urbanization has been addressed in recent years. The present research was conducted to examine the dispensation of potentially dangerous elements (PHEs) (Cr, Cu, Ni, Pb, and Zn) concentrations in soils of the Bommasandra Industrial Area on the Varanasi – Kanyakumari National Highway (Longitude 77° 40' to 77° 45' and 12° 45' to 12° 50' N Latitude), south-east of Bangalore City to determine the level of chemical contamination. Geologically, peninsular gneisses, close-pet granites, lateritic hills, and some basic dykes with undulating terrain are beset by the study area. The semi-arid type is the climate of the study area. Two hundred soil samples were collected from the Bommasandra industrial areas and tested for heavy metals using a Philips Magi X PRO-PW 2440 X-ray fluorescence spectrometer. According to the data, the soil in the region is heavily polluted with heavy metals such as Chromium (Cr) ranges from 11.8 to 335 mg/kg (average of 136 mg/kg), Cu from 10 to 221 mg/kg (average of 77 mg/kg), Pb from 0 to 397 mg/kg (average of 21 mg/kg), Ni from 0 to 308 mg/kg (average of 98 mg/kg), and Zn from 11 to 435 mg/kg (average of 78 mg/kg). The distribution and association of heavy metals in soils was explored, as well as potential remedial steps. These findings are significant for the development of appropriate management strategies through the study of various remediation methods to reduce point and non-point pollution sources.

Key words: Heavy metals; Urbanization; Industrialization; Remediation; Bommasandra.

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Landuse and Landcover Analysis using Remote Sensing and GIS to study the Change Impact on Water Resources in Parts of Porumamilla, YSR District, Andhra Pradesh, India

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Abstract: The use of multi-temporal satellite imaging helps to understand landscape dynamism through digital shift detection techniques. Integrated approach based on advanced applications of remote sensing and geographical information systems (GIS) lends itself as an efficient and effective result-oriented method for studying the development and management of water resources. Land use change pattern reveals the rate of change of groundwater recharge. It is necessary to identify the land use change in the past and present accessible land use, and its allocated and potential changes are major rudiments for planning and management. The current study shows the space and time dynamics of land utilization/decoration in the area of Porumamilla, Kadapa District, Andhra Pradesh. Landsat satellite imagery was obtained by earth explorer site for two separate periods of time, including Landsat Themedic Mapper (TM), quantifying changes in the field of research 2008 to 20018 over the 10 years. Methodology for supervised classification was used in ERDAS 2014 for maximum probability technologies. The photographs in the field of research were grouped into five classes: forestry, agriculture and wastelands, built-up, waterbodies. The findings show that over the past decade, land and build-up was increased by 3.48% (12.82 km²) and by 4.03% (14.86 km²), while forestry, woodland and waterways were reduced by 6.81% (25.1 km²) and 3.72% (13.7 km²) and 1.9% (7 km²), respectively.

Key Words: Land use / Land cover, Remote Sensing, GIS, Erdas Imagine, Waterbodies.

CHAPTER 3: Landuse and Landcover Analysis using Remote Sensing and GIS to study the

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Environmental Chemistry for a Sustainable World 68

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Chapter 9 1

Insights on the Biotechnological 2

Applications of Marine Fungal 3

Exopolysaccharides 4

A. M. V. N. Prathyusha, G. Triveni, G. Mohana Sheela, B. Anand Kumar, 5
 G. Bhargava Ram, T. Chandrasekhar, and Pallaval Veera Bramhachari 6

Abstract Microbial exopolysaccharides are the subject of research in many scientific areas, focusing on elucidating structure-function relationships, identifying novel biosynthetic pathways, and unraveling applications based on their distinct properties. Marine fungi signify a relatively untapped bio-resource for novel exopolysaccharides molecules; however, marine fungi are evidenced with great industrial significance during past decades. High molecular diversity, complexity and growth in unique and extreme habitats make the marine fungi produce unusual exopolysaccharides. However, due to their unique rheological properties, marine fungal exopolysaccharides have found several applications in the environment, food, cosmetic and pharmaceutical industries. The current review emphasizes untapped marine fungi focusing on exploring the fungal exopolysaccharides with novel structures and unique functional properties. 7-18

Keywords Marine Fungi · Exopolysaccharides · Industrial applications · Unique functional properties 19-20

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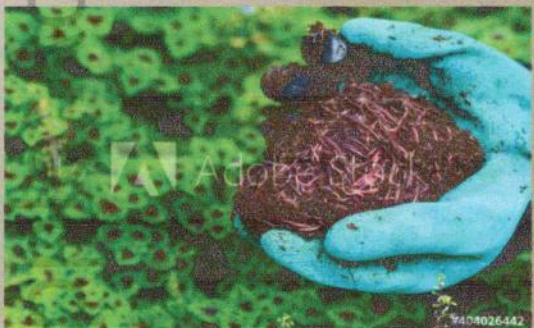
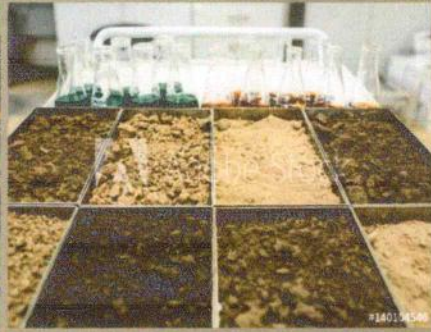
Innovations in Agricultural & Biological Engineering

Bioremediation and Phytoremediation Technologies in Sustainable Soil Management

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Innovations in Agricultural and Biological Engineering

Bioremediation and Phytoremediation Technologies in Sustainable Soil Management, Volume 3 Inventive Techniques, Research Methods, and Case Studies

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Phytoremediation has evolved into an important tool to improve the bioremediation process since it is an innovative green technology that uses a wide variety of plants to remediate radioactive metals, organics, chemicals, and radioactive elements from soil, sediment, surface water, and groundwater environmental pollutants. Together, bioremediation and phytoremediation technologies provide an effective approach to contaminant abatement.

This new book, volume 3 of the four-volume set **Bioremediation and Phytoremediation Technologies in Sustainable Soil Management** identifies and draws a fresh image of existing developments in theoretical and functional implementation systems from recent scientific research studies that take into account different facets of bioremediation. It also discusses the latest technology and prospects of new soil bioremediation technology and analyses their domains, along with their associated challenges and consequences.

Volume 1: Fundamental Aspects and Contaminated Sites begins with an overview of phytoremediation and phytotechnologies and the role of environmental factors. It goes on to introduce soil assessment techniques and offers methods of remediation designed to combat soil and agricultural degradation. Attention is given to specific types of sites and soil pollution, such as soils contaminated by heavy metals; microbial and phytoremediation-based removal of polycyclic aromatic hydrocarbons (PAHs) from coal, crude oil, and gasoline; microbial bioremediation and amelioration of pesticide-contaminated soils; phytoremediation techniques for biomedical waste contaminated sites; as well as bioremediation processes for human waste sites. Biopesticides are also explained in the book as an alternative to conventional pesticides as well as the possibilities for the improvement of modern bio-pesticides.

Volume 2: Microbial Approaches and Recent Trends focuses on new and emerging techniques and approaches to address soil pollution. These include the use of rhizobacteria, archaea, cyanobacteria, and microalgae as biofertilizers and for soil bioremediation efforts. New technologies for assessment of soil bioremediation are explored also. The chapters provide in-depth coverage of the mechanisms, advantages, and disadvantages of the technologies used and highlights the use of different microbial enzymes that are used in the process of bioremediation and phytoremediation to clean up different pollutants without causing damage to the natural environment.

Volume 4: Degradation of Pesticides and Polychlorinated Biphenyls addresses pesticide degradation, PCBs degradation, and genetic interventions. It begins by describing environment pesticide degradation, mechanisms and sustainability, microbes and microbial enzymes, plant microbe interactions,

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• Biology and Culture of Portunid Crabs of World Seas
• Biology and Ecology of Edible Marine Gastropod Molluscs

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"As the Principal Editor for the trending 3-volume set book of *Phytochemistry*, I wish to express my sincere gratitude to the management of AAP for their excellent publishing services. Our publishing experience is

CHAPTER 9

IN VITRO SCREENING OF HEAVY METALS: SEED GERMINATION AND SEEDLING GROWTH OF SORGHUM AND HORSE GRAM

THUMMALA CHANDRASEKHAR, M. KEERTHI KUMARI, and
PALLAVAL VEERA BRAMHACHARI

ABSTRACT

Heavy metal (HM) stress is an important abiotic stress along with drought, salinity, extreme temperature, etc. Specifically, HM pollution causes potential risk for crop yield and in turn for human beings. In the present study, screening of HMs on sorghum (*Sorghum bicolor*) and horse gram (*Macrotyloma uniflorum*) seed germination and seedling growth were carried out. Particularly, screening of non-essential chromium (Cr) on seeds of sorghum including horse gram and essential manganese (Mn) on seeds of sorghum were performed under *in vitro* conditions. In addition, physiological, and biochemical aspects were studied to assess the growth promotion or damage in both Cr and Mn treatments. The percentage of sorghum seed germination was reduced with increasing chromium concentration. In contrast, seed germination was unaffected in horse gram even in a high concentration of chromium. In extent, increasing chromium doses reduces the root and shoot lengths of both sorghum and horse gram seedlings but the impacts were more in an earlier one. High concentrations of essential manganese exhibit a minor reduction in germination of sorghum seeds and root and shoot lengths of seedlings. Total chlorophyll contents were reduced with high concentrations of chromium or manganese in sorghum seedlings. But interestingly minor augmentation of total chlorophyll contents was noticed in horse gram seedlings with increasing doses of chromium. Proline contents were increased in

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164. Our Beloved

Dr. Vijetha M Jillella

Lavender Pink White Yellow

Orange Cosmos

Bunches of Roses hanging...

Flowers fruits all around the
mansion delights

Sign posts mentioning

H.No... and Prof. ...

On a White, Blue classic car

Inscribed Prof. ... our pride

Press of a switch

Effectual angel at the abode

A never fading smile on her brow

In a tidy elegant attire our beloved

Mx ...with 'Maggie' like sons



Peanut (*Arachis hypogaea* L.) Transgenic Plants for Abiotic Stress Tolerance

Chandra Obul Reddy Puli, Chandra Sekhar Akila,
Varakumar Pandit, Sravani Konduru, Suresh Raju Kandi,
and Sudhakar Chinta

Abstract

Groundnut (*Arachis hypogaea* L.) is one of the important legume cash crops of tropical and semi-arid regions, where it provides a major source of edible oil and vegetable proteins. Abiotic and biotic stresses in groundnut negatively influence on survival, biomass production, and total crop yield. Breeding groundnut genotypes for abiotic stress tolerance will likely sustain groundnut production. Traditional approaches such as breeding for abiotic stress tolerance have been slow, due to the rare alleles implicated in abiotic stress tolerance in the existing groundnut germplasm. Hence, engineering for abiotic stress resistance is an important target for increasing groundnut productivity. The chapter focuses on the development of transgenic groundnut plants for abiotic stress tolerance and the constraints associated with it. This review also describes the recent progress in using genetic engineering approaches for the improvement of abiotic stress tolerance in groundnut.

Keywords

Peanut · Abiotic stress · Transgenic plants · In planta transformation · DREB1A · NHX

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Alginate-based hydrogels

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11.1 Introduction

11.1.1 Overview/objective

Alginate is a natural anionic polymer extracted from the brown seaweed, which comprises β -D-mannuronic acid (M) and α -L-glucuronic acid (G) units (Fig. 11.1); these are arranged in a linear manner either by homogeneous (GG/MM) or heterogeneous (GM/MG) units through 1 \rightarrow 4 glycosidic linkages [1] (Fig. 11.2). The genus of brown seaweed includes the *Saccharina japonica*, *Laminaria hyperborean*, *Macrocystis pyrifera*, *Ascophyllum nodosum*, etc. [2]. In addition, alginate can be produced in a laboratory scale by bacteria *Azotobacter vinelandii* and *Pseudomonas* spp. [3]. It was first discovered by Stanford ECC in 1881 [4]; however, the industrial commercialization of this polymer has taken place after 100 years, especially in Europe, the United States, and Japan. The hydroxyl (-OH) and carboxyl (-COOH) functional groups of alginate are responsible for its potential physicochemical properties. Hence it has been widely used in various applications such as drug delivery, tissue engineering (TE), agriculture, food industry, cosmetics, water purification, wound dressings, and electrical devices (Fig. 11.3). In addition, these properties are significantly influenced by alginate production parameters such as molecular weight, acetylation degree, the arrangement of uronate units, and M/G ratio [5].

CHAPTER 6

Polymer Electrolyte Membranes for Fuel Cell and Drug Delivery Applications

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Abstract: Polymer membranes are emerging substrates for industrial applications like power solutions, toxic metal ion removal and drug delivery technologies. Among all types of membranes polymer electrolyte membranes (PEMs) are current interest, due to their physico-chemical interaction with the guest molecules. PEMs are capable to transport or permeate, adsorb and delivery of molecules, ions and other required reagents. This chapter provides basic concepts as well as the progress with regard to PEMs based science and technology of fuel cells and drug delivery.

Key words: Polymer Electrolyte Membranes, Fuel Cell, Drug Delivery

CHAPTER 6: Polymer Electrolyte Membranes for Fuel Cell and Drug Delivery

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Therapeutic Applications of *Nigella Sativa* and its Metal Nanoparticles

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Abstract: *Nigella sativa* is an annual flowering plant belongs to the family Ranunculaceae commonly known as Black seed, Black cumin or Kalonji. It is considered as one of the most miraculous healing medicines existed as a remedy for all diseases specified in varied traditional system of medicine and food. Phytochemically, it is enriched in fixed oil, terpenoids, essential oil, alkaloids etc and few key chemical constituents such as thymol, carvone, thymoquinone, nigellicimine, nigellicine, dithymoquinone and thymohydroquinone. Therapeutic properties of this plant are due to the presence of thymoquinone which is one of major active component and has different beneficial properties. Ample of phytochemical, pharmacological and clinical researches have been executed on this plant which may include antidiabetic, anticancer, immunomodulator, analgesic, antimicrobial, anti-inflammatory, bronchodilator, hepato-protective, renal protective, gastro-protective, and antioxidant properties etc. This plant also been studied for nanoparticle synthesis via green route with varied biological applications. Considering above all these aspects, this plant catches the attention of research analyst to tactic the utility, proficiency and potency of *Nigella sativa* in diverse medicinal sectors.

Key words: *Nigella sativa*, green synthesis, thymoquinone, Kalonji seed.

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Recent Innovations in Natural Gums Based Adsorbents for the Removal of Toxic Metal Ion from Wastewater

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Abstract: Natural gums which are hydrophilic carbohydrate polymers of high molecular weights, generally composed of monosaccharide units joined by glucosidic bonds have been attracting many researchers. These are used in confectionaries, dairy products, beverages, as emulsifier in food products, petroleum and for oil-well-acidizing purpose in the industry. They also have pharmaceutical applications as demulcents, adhesives in pill manufacture and as emulsifying agents. These natural polysaccharides do hold advantages over the synthetic polymers, generally because they are nontoxic, less expensive, and freely available. They are also used for the removal of heavy metals from water. They have great potential in removal of heavy metals due to their bio sorption properties. They are readily available, cheap and eco-friendly. The present chapter focuses on the application of gums particularly in the removal of heavy metals from water.

Key words: Natural Gums, Adsorption, Toxic Metal Ions, Green Technologies

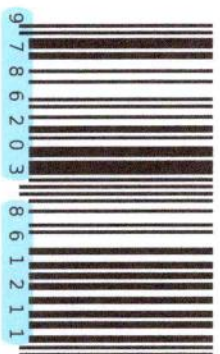
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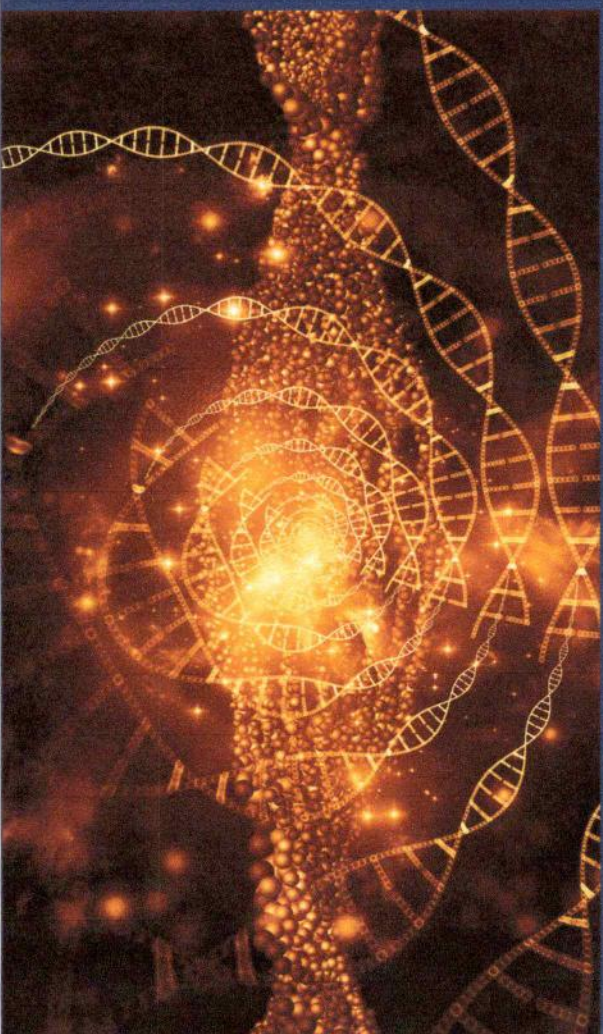
Nitrogen and sulfur heterocycles are recognized as "privileged medicinal scaffolds" because these compounds are found in a wide variety of bioactive natural products and pharmaceuticals. Among them, azoles (1,2 and 1,3-azoles) have been considered as an 'important structural motif' in a huge number of natural products and also in medicinally valuable compounds. Because of their broad based utility, efforts to develop green and sustainable synthetic methodologies for the synthesis of 1,2 and 1,3-azoles are on the ever-increasing trend in synthetic organic chemistry. In the present study, attempts have been made to develop new synthetic routes for the synthesis of benzo-fused 1,2-azoles (indazoles) and 1,3-azoles (benzimidazoles) and nitrogen and sulfur containing 1,3- azoles like thiazoles (i.e. 2-aminothiazoles and hydrazinyl-thiazoles). Further, biological activities (antioxidant, antimicrobial and anti-cancer) of the synthesized hydrazinyl-thiazole compounds have been investigated.



Dr. N.C. Gangi Reddy obtained PhD degree from Sri Venkateswara University, Tirupati, INDIA. Working as an Associate Professor in the Department of Chemistry, Yogi Vemana University, Kadapa. His research interests are i) Design and synthesis of D-A type small organic fluorescent materials and ii) Development of green synthetic methodologies.



Trivikram Reddy, China Gangi Reddy



Gundala Trivikram Reddy
Nallagonda China Gangi Reddy

Synthesis and Biological Evaluation of N and S Based Heterocycles

New Synthetic Approaches to Nitrogen and Sulfur Based Heterocycles and Biological Assessment for Selected Analogs

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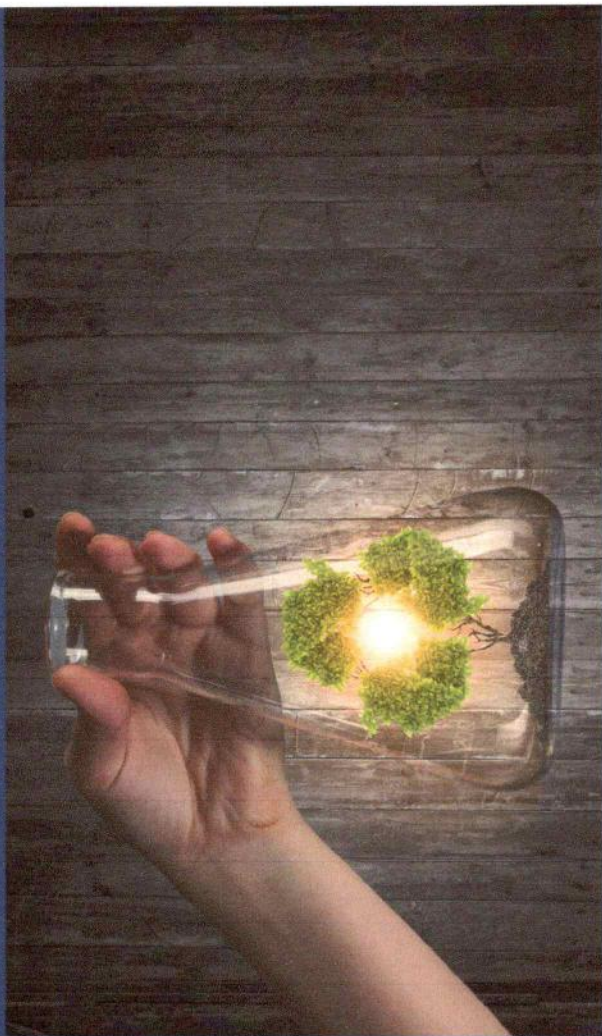
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The carbon-carbon and carbon-heteroatom bond formation reactions are considered as important transformations in synthetic organic chemistry. They are effectively used in the synthesis of natural products and pharmaceutically important compounds. In the present study, attempts have been made to develop green and sustainable synthetic methodologies for the construction of carbon-carbon and carbon-heteroatom bonds.

C-C, C-N, C-O, C-S & C-X bonds construction

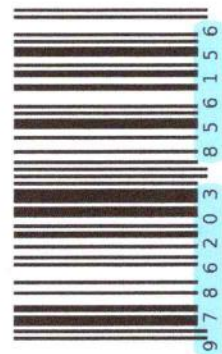


Dr. NC Gangi Reddy obtained a PhD degree from Sri Venkateswara University, Tirupati, India. Working as an Associate Professor at the Department of Chemistry, Yogi Leader University, Kadapa. His research interests are i) Design and synthesis of D-A type small fluorescent materials and ii) Development of green and sustainable synthetic methodologies.

Pinjari Mohammad Khaja Mohinuddin
Nallagonda Chinna Gangi Reddy

Carbon-Carbon and Carbon-Heteroatom Bond Formation Reactions

Development of Green and Sustainable Methodologies for Carbon-Carbon and Carbon-Heteroatom Bond Formations



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Dry-Land Agriculture and Watershed Development in Andhra Pradesh

T. Sudarsana Reddy

Assistant Professor, Department of Economics, Yogi Vemana University, Kadapa.

Abstract

This paper attempts to assess the impact of the WSD programmes covering sample watersheds from two different schemes (IWDP and DPAP) in drought-prone regions of AP with the following objectives: to examine the functioning of the watershed development programme, level of people's involvement in planning and implementation of the programme, and the extent of impact of the programme on the resource conservation, improvement in production and increase in incomes. The analysis is based on the data collected from 21 watersheds spread over 4 Mandals of Kurnool district of Andhra Pradesh.

The analysis indicates that the WSDP has created a positive impact in the watershed villages in terms of soil and moisture conservation and a rise in the water table level by 20 to 23 per cent leading to increase in irrigated area and thereby an increase in crop production. The overall impact of WS is positive on irrigation, environment and livelihoods as it stabilizes production in spite of droughts. It has also been successful in promoting horticulture and animal husbandry activities. These achievements have resulted in reducing seasonal migration by about 75 per cent in IWDP areas and about 47 per cent in DPAP areas. It has also been successful in bringing about fairly good awareness among people regarding the need for WSD activities for promotion of agriculture in fragile ecological zones. Nevertheless, the programme appears to be weak with regard to community organization for maintaining the assets created as well as continuing the programme through UGs (User Groups) and people's involvement.

I. Introduction

India was perhaps the first developing country to formally recognize the danger of soil erosion and land degradation vis-a-vis food security and prosperity of the nation. Bio-mass production system can be practiced on land only if it is available in required quantum and desired quality. All other inputs including irrigation and fertilizers do not help in increasing production if the land is not responsive and continues to be degraded. Soil and Water Conservation Research Centers (SWCRCs) have been established to identify the problems of land resources. These Research Centers demonstrated that an integrated and inter-dependent land management system helps to prevent degradation of resources and enhance production. To achieve the above an

The representatives of WSCs and WSAs should be given adequate training in conducting the stipulated meetings at regular intervals in a systematic and meaningful manner so as to maintain the minute's book and other records required for facilitating / proper monitoring and impact assessment of the programme.

Efforts should be made to strengthen the participation of UGs in the programme in terms of obtaining their consent before taking up works in / their fields and involving them in executing these works. Building up proper awareness and constant persuasion and motivation to make them take active part would ensure further decentralization, effective contribution to WDF and sustainability of the programme.

The SHGs should be effectively linked to the ongoing rural development programmes in order to enable them to mobilize additional resources for strengthening the income generating activities (IGAs) initiated. Linkages with financial institutions like Rashtriya Mahila Kosh could also be built up if these SHGs are federated at the Mandal level or affiliated to the existing United Nations Development Programme (UNDP) women federations.

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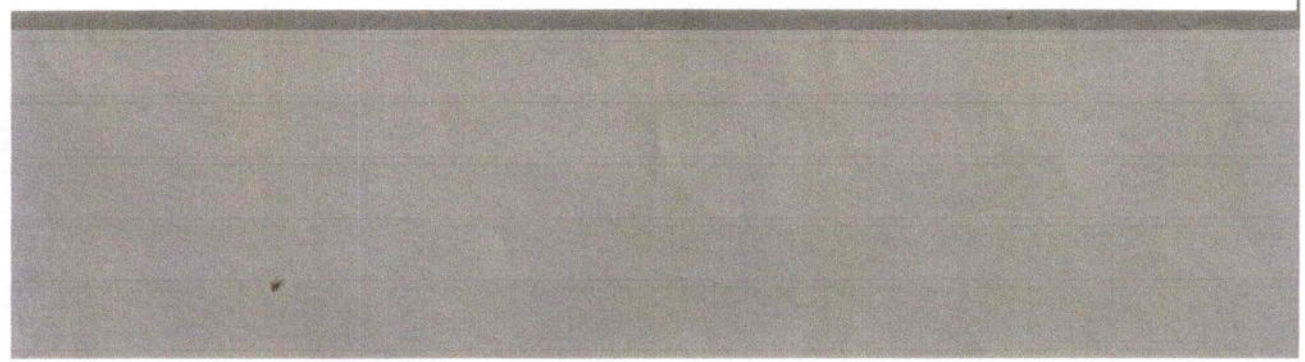
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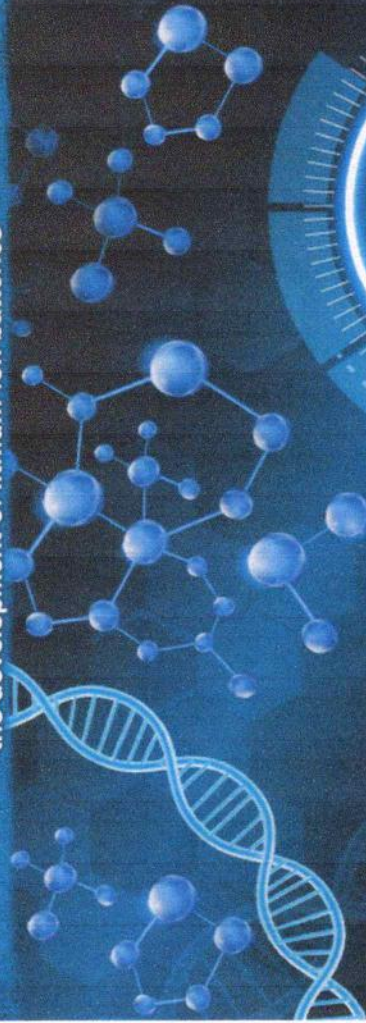
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Nobel Prize in Chemistry



John B. Goodenough (USA, left), M. Stanley Whittingham (UK, centre), and Akira Yoshino (JPN, right) share the Nobel Prize for the development of lithium-ion batteries



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SERVICES MARKETING

— IN EMERGING —

GLOBAL ECONOMY



DR. S. DURGA RAO

A STUDY OF PERCEIVED PRIVACY AND PERCEIVED SECURITY IN ONLINE STORES

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Research scholar, Department of Business management, Yogi Vemana University, Kadapa, A.P¹

Assistant. Professor, Department of Business management, Yogi Vemana University, Kadapa, A.P²

Abstract:

Individuals mostly hesitate to use services offered via Internet due to their suspicions regarding the level of offered (1) protection of their privacy and (2) security of performing online transactions. Privacy is mostly concerned with the identifiable user data and users' rights to have control over their data. On the other hand, security provides the physical, logical, and procedural safeguards that are needed to keep the data private. In the present scenario more companies are offering their products/services over the web, as the number of internet users is growing rapidly and online technologies are improving. Quality of the website, trust, privacy concerns, security concerns are strong reputation efforts in online stores. The internet offers a wide range of benefits for customers but major two critical problems faced by online customers in India. I.e. privacy and security. Privacy is the control over the one's personal data. Security is the attempted access to data by unauthorized users. This paper main objective is to know the perceived privacy and perceived security of online customers in Tirupati.

Privacy cannot be achieved without obtaining security practice. Despite being closely linked in practice, privacy and security are perceived as separate issues by online users. so in this article the relationship between various perceived privacy and perceived security factors are analyzed.

Keywords:perceived privacy, online stores, online shoppers and perceived security.

SERVICES MARKETING

— IN EMERGING —
GLOBAL ECONOMY

Service industry is facing cut-throat competition because of globalization deregulation and privatization. This edited book presents 78 articles on financial services, healthcare services, personnel services, telecommunication services, tourism services etc. and these articles provide appropriate strategies to improve and meet the challenges by the service industry. Researchers also revealed the emerging trends in services marketing and the common issues of services. Academicians and researchers presented their current and on-going studies in this book and practitioners took the opportunity to share their experiences in this forum. These articles in different areas will provide in depth knowledge to students, research scholars, academicians and practitioners who are interested in services marketing.



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B.Sc. (Ag) (A.P. Agricultural University)

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Strategies for Inclusive Growth and Sustainable Economic Development

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Industry 4.0 - Fuzzy Road Ahead or Opportunities Galore for Human Resources

Dr. Y. Subbarayudu

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Abstract

Industry 4.0 (fourth industrial revolution) is an automation and data exchange in industrial technologies, i.e. cyber physical systems, the Internet, cloud computing. An organization would require a successful Smart HR strategy to cope up with the challenges of fourth industrial revolution renovation. Emergent technologies such as Internet-of-Things, Big Data, and artificial intelligence will automate most of the HR processes, resulting in efficient Human Resource. Company strategy should be transferred into day-to-day work and should lead to an employee growth plan for every employee. This paper mainly is focused on fourth industrial revolution and its impact on Human Resources. It is found that implementing new technology to increase its efficiency is natural and no one can stop; the employees essentially should acquire specific skills as per the changing requirements to get the jobs and it is estimated that the robots are not for terminating the employee's jobs but for just doing the repetitive work.

Key Words: Industry 4.0, Revitalize, cyber-physical systems, Automation

Introduction

Technology has been developing at an incremental pace since long and leaving no clues of slowing down ever for the human wants and their demand for sophistication too has been showing a ceaseless growth. The anticipated but unimaginable technological disruptions is not an ending list, some go as - the Google's brain child "the quantum computer's incredible data processing speed, driverless cars and ear buds translating foreign languages. Scientists are developing living solar panels that can be printed on paper, and tech pioneers are setting their sights on even grander goals like enhancing the human brain with implants for possibility of telepathic communication. The advent of new digital industrial technology is yet another priceless advancement leading to faster, flexible, efficient and high quality production at economic prices just by gathering and analyzing the data across the machines. Combination of cyber-physical systems, the Internet of Things and the Internet of Systems make Industry 4.0 possible and the smart factory a reality. As a result of the support of smart machines that keep getting smarter as they get access to more data, our factories will become more efficient and productive and less wasteful. Ultimately, it's the network of these machines that are digitally connected with one another and create and share information that results in the true power of Industry 4.0.

Fourth Industrial revolution has a lot to promise when it comes to revenues, investment, and technological advancements, but employment still remains one of the most mysterious aspects of the new industrial revolution. It's even harder to quantify or estimate the potential employment rates. What kind of new jobs will it introduce? What does a Smart Factory worker needs to have to be able to compete in an ever changing environment such as this? Will such changes lay off many workers? These are the questions to be answered in the technological disruptions.

Literature Review

The Fourth Industrial Revolution is popularly known as Industry 4.0. The first industrial revolution was triggered by water and steam power to move from human labour to mechanical manufacturing. The second industrial revolution built on electric power to create mass production. The third used electronics and information technology to automate manufacturing. The fourth is the current trend of automation and data exchange in manufacturing technologies, Big data and analytics, Autonomous Robots, simulation, Horizontal and vertical system integration, Industrial Internet of things, Cyber security, Cloud computing, Additive manufacturing, and augmented reality are said as the building blocks of industry 4.0.

Industry 4.0 is almost inescapable to think how it'll impact our professional worlds. (HR, VarunBhaskar, HC Leader Services.2017). Managerial leaders and HR executives have faith that

ABOUT THE BOOK

Indian economy is growing nearer to double digit and its contribution to global economic growth is increasing over the years. Many Indian firms are successfully competing with international firms and also producing substitute products to imports. But, the big question is how inclusive and sustainable is India's growth? To move further and become global power, India needs to work towards inclusive growth and sustainable economic development which is possible through Innovation. Innovation in business models; sustainable and equitable agricultural through mechanisation and finding new models of financial support to farmers; encourage youth to start-up new ventures with innovative ideas; train youth with the skills required for industry to grab the opportunity; take measures to increase financial inclusion; provide necessary infrastructure for the use of information and communication technology in business and reform higher education system to provide quality and sustainable education. Focusing on the above issues would help lead India making her mark as the fastest growing economy with the concern of inclusive growth and sustainable economic development. The book is the compendium of selected papers presented in the conference. The papers are useful and contain valuable inputs for researchers, executives, and policy makers.

EDITOR'S PROFILE



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Gulzar Ahmad Nayik
Amir Gull *Editors*

Antioxidants in Vegetables and Nuts - Properties and Health Benefits


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Deepu Pandita , Anu Pandita, Ramachandra Reddy Pamuru,
and Gulzar Ahmad Nayik

Abstract

Beta vulgaris subsp. *vulgaris* L is a root vegetable from Chenopodiaceae family. *Beta vulgaris* L. ssp. *vulgaris* positions among the 10 most potent antioxidant vegetables due to presence of betalains, phenolic acids, saponins, alkaloids, steroids/triterpenes, catechins, and flavonoids. The antioxidant activity of beetroot acts as defense against the oxidative damage caused by ROS or free radicals in the cell which may alter cell metabolism, cause DNA damage, and structural and functional impairment of lipids and proteins. Beetroot makes an outstanding dietary supplement being abundant not only in nutrients, minerals and vitamins, vitamin B complex, and folic acid but also has plethora of unique bioactive compounds bestowed with a number of medicinal and therapeutic properties. Several parts of beetroot possess medicinal properties as analgesic, hepatoprotective, antioxidant, antimicrobial, anti-inflammatory, antimigraine, antihypertension, antiviral, antihyperglycemic, anti-progestogenic, antiallergic, antithrombotic, anti-tumorigenic, and prevents neurodegeneration and hepatic damage.

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SUSTAINABLE AGRICULTURE IN INDIA

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Regional Disparities in the Development of Irrigation in Andhra Pradesh

P. Kalandar¹, Dr. T. Sudarsana Reddy²

Research Scholar, Department of Economics, Y.V. University, Kadapa

Assistant Professor, Department of Economics, Y.V. University, Kadapa

Abstract

Andhra Pradesh (AP) is one of the largest states in India with agriculture as the major source of income for about 60 % of its population depends on agriculture and related activities. AP is comprises into three distinct regions namely, Coastal Andhra, Rayalaseema and Telangana. The Gross Domestic Product (GDP) of Rayalaseema region at 1999-2000 prices was lower, (21.7%) compared to Coastal Andhra (43.3%) and Telangana (35.1%) regions. During 2007-08, contribution of the Rayalaseema region to the State Gross Domestic Product (SGDP,) at constant prices, of 1999-2000 was only 16 % while other two regions contributed more than 40 % in the same year. Moreover, Gross District Domestic Product (GDDP) contribution is also low in Rayalaseema, indicating the relative backwardness of this region. The paper has examined the prevailing regional disparities of AP in terms of availability of irrigation facilities in the three regions. The paper has also made an attempt to analyse the impact of Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) on irrigation facilities as this programme entails water resource management works. The study finds low Irrigation Intensity (II) in Rayalaseema region when compared to the other two regions, While it has recorded substantial increase in Telangana region (17.2% in 1955-56 to 45 % in 2012-13) during the last 57 years period, it has only increased 11.4 % in Rayalaseema during this period. The assured irrigation through canal dominates the Coastal Andhra but it is very low in Rayalaseema. On the whole, while area under total wells has increased in Telangana, it has decreased in Rayalaseema. The later has less irrigated area compared to the other two regions. This might be one of the reasons why districts of Rayalaseema are left out of growth process and not able to catch up with other two regions. MGNREGA would have a remarkable impact on rural water management through promotion of irrigation and thus can play a significant role in providing water security in these backward areas.

Section I: Introduction

This paper deals with access to the irrigation facilities available for cultivation across the three regions of Andhra Pradesh (AP). It examines the regional disparities and differential access to irrigation in Coastal Andhra, Rayalaseema and Telangana regions. Rayalaseema comprises four districts i.e. Kurnool, Kadapa, Anantapur and Chittoor. Among these four districts, Anantapur

through water management works and improve irrigation facility so as to develop the agricultural sector of the region.

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6. It is the ratio of gross irrigated area (GIA) to GCA across regions.

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A Study on Growth and Instability of Oil Seed Crops in Rayalaseema Region

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Abstract

The present study examines the trends in area, production and yield of oil seed crops, namely, groundnut and sunflower. The present study confined to Rayalaseema region of A.P. only. Rayalaseema region formed with four districts namely Anantapur, Chittoor, Kadapa and Kurnool. We consider the aggregate data for our study. To study the trends of the selected crops we estimate linear functions for area, production and yield. Crop diversification gives good yields along with crop rotation in this Rayalaseema region. There is a need to provide water facility for huge productivity of groundnut and sunflower and other oil seed crops. The farmers should be a warped and provided new methods of agriculture for oil seed crops to full the targets of productivity.

Key words: Oil seed crops, Crops Diversification, Rayalaseema.

Introduction

Agriculture as a primary industry plays a significant role in the process of the economic development of a country. In the early stages agriculture is the major contributor to national income and it provides employment to a majority of people. At later stages of a fairly high level of economic progress, the importance of agriculture gradually declines. About 65 to 70 percent of our people depend on agriculture for their live hood. In the name of New Economic Reforms (1991) a structural change took place at the national as well as state level. However, during the post-economic reform period the issues were to raise the productivity, increase the cultivable area of pulses and oil seed crops, effective utilization of irrigation facility and development of rural market for the improvement of the agriculture to achieve agriculture a growth of not less than 4 per cent. Now it is around 2 per cent and is declining. The output index of all crops increased at 3.4 per cent per year in the 1980s as well as in the early 1990s. The growth rate of GDP from agriculture declined from 4.2 per cent in the 1980s to 3.7 percent per annum in the 1991s.

Review of Literature

Naidu et al., (1994)¹ points out the trends in area, production and productivity of major crops in Andhra Pradesh. They found that the time series analysis from 1980-81 to 1989-90

the crop because the production and productivity is not attractive. To attract the farmers for favorable trends, the government may provide price incentives, provide good marketing facilities adequate fertilizers and pesticides may be provided at subsidized rate.

Measures to improve productivity

1. Moving surplus water into the tanks that ensures farmers can continue crop paddy.
2. The overall growth pattern of paddy yield indicated a downward trend, so improving technologies are to be introduced in these districts.
3. Incentives for groundnut can be increased to move the farmers' attitude towards groundnut cultivation.
4. An understanding of the long run price elasticities facilitates the formulation of an appropriate agricultural price policy for growth and stability.
5. To improve the productivity of sugarcane modern hybrid methods in agriculture to be introduced.

Conclusion

Though the region is rainfed, by transforming the water from surplus tanks to scarcity tanks, farmers can be enabled to increase the productivity of commercial crops in this region. For this awareness among farmers and government proper implementation of policies and review and revision is needed from time to time.

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Agriculture Development in Andhrapradesh

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Agriculture is the life line of the economy of Andhrapradesh. Andhra Pradesh mirrors India in the agriculture sector. It has all the types of soil obtaining elsewhere in the country. It has all the crops being cultivated in the rest of the country. Contributing over third of states GSDP and provides lively hood to about 70% of the population. In order to achieve property wellbeing and high quality of life for the people. The vision of Andhra Pradesh the first state in the country to develop it is a build prosperous democratic, egalitarian and cohesive society. Andhrapradesh with its strength in agriculture and food production has tremendous potential to emerge as a major power house. Agriculture performance is the key economic growth and poverty alleviation so it is the dominant activity in rural areas. The working group on the food and agro industry of the ministers councils or trade and industry calls for move a from green to food revolution through a sustained development in agriculture and larger investment in technology and skills. Andhrapradesh is one of the leading agriculture in the state and the future of its agriculture sector is closed inter-linked with several factors in the policy climate at the state, national and international levels. Agriculture is the main occupation of about 62 per cent of the people in Andhra Pradesh. Rice is a major food crop and staple food of the State contributing about 77 per cent of the food grain production. Other important crops are jowar, bajra, maize, ragi, small millets, pulses, castor, tobacco, cotton and sugarcane. The new Andhra Pradesh government has announced a new farmer support scheme, christened YSR Rythu Bharosa that will be implemented from October 15 in the state, offering investment support of Rs 12,500 per ann.

Andhra Pradesh (AP) is one of the largest states in India, with agriculture providing the major source of income for about 60 per cent of the population even though it contributes only 19 per cent state GDP. In the last 40 years, annual growth rate of agriculture is 2.88 per cent as against targeted growth of about 4 per cent per annum. This paper analyses the sources of crop sub-sector growth in pre-liberalization period (from 1970-1989) and post-liberalization period (from 1990-2009). The growth rate in value of production in pre-liberalization period is lower (2.4% per annum) than post-liberalization period (2.7% per annum) per annum. Even though contribution of both yield and crop diversification to growth in value of production is higher, the negative contribution of real prices is the main reason for slower growth in pre-liberalization period. While positive contribution of prices along with yield and diversification in the post-liberalization period contributed for higher growth rate. In the post-liberalization period, regions are specializing based on their resource endowment (coastal Andhra in paddy, Telangana in

It can be observed from table 2 and figure 2 that the MSP for sugarcane varied from Rs. 26 per quintal in 1991-92 to Rs. 275 per quintal in 2019-2020. Cotton had lowest price at Rs. 840 per quintal in 1991-92 and highest at Rs. 5550 per quintal in the year 2019-2020. The MSP for Groundnut ranged between Rs. 645 per quintal in 1991-92 to Rs. 5090 per quintal in 2019-2020. The jute price was lowest at Rs. 375 per quintal in 1991-92 and highest at Rs. 3950 per quintal in 2019-2020. It was above Rs. 1000 per quintal for 14 years and less than Rs. 1000 per quintal for 15 years during the study period. The Minimum Support Price for sunflower in India varied from Rs. 670 per quintal in 1991-92 to Rs. 5650 per quintal in 2019-2020. In case of mustard, the MSP ranged between Rs. 670 per quintal in 1991-92 to Rs. 4200 per quintal in 2018-2019. Moreover, it was above Rs. 1000 per quintal for 21 years and less than Rs. 1000 per quintal for 7 years during the study period. It is quite interesting to note that the Minimum Support Price for mustard continuously increased during the study period.

Minimum Support Price for Paddy in India

Minimum Support Price is the price at which government purchases agricultural crops from the farmers whatsoever may be the general price for the agricultural crops. MSP has become the main tool to keep the market prices from plunging below the cost of agricultural production. The details of MSP for paddy crop during the post-reform period in India (1991-92 to 2019-2020) are given in Table 3.

Watershed Approach to Rainfed Agriculture: A Study of Anantapuram District of Andhra Pradesh

Dr.G. Parvathi

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Abstract

In the 1980s and 1990s, agricultural scientists and planners aimed to promote rain fed agriculture through watershed programme. Watershed Management programme is a holistic concept which tries to integrate several components like soil and water conservation, forestry development, agriculture, horticulture, livestock development etc. 86.8 per cent of cropped area in Anantapuram District of Andhra Pradesh is rainfed and is prone to frequent monsoon failures leading to drought. In fact the district is the second lowest rainfall district in the nation after Jaisalmer, Rajasthan. Watershed approach is adopted to manage the rainfed or dry land agriculture in the district by implementing various schemes like Joint Forest Management (JFM), National Watershed Development Project for Rainfed Areas (NWDPR), Employment Assurance Scheme (EAS), Andhra Pradesh Rural livelihood Programme (APRLP), Andhra Pradesh Hazard Mitigation Programme (APHM), Desert Development Programme (DDP), Hariyali Programme, and Integrated Watershed Management Programme (IWMP). The present paper attempts to study the Watershed approach to manage the rainfed or dry land agriculture in Anantapuram district, its need, success rate and constraints in implementation.

Key Words: Watershed Management programme, Rainfed Agriculture, Dry land agriculture, National Watershed Development Project for Rainfed Areas (NWDPR)

Introduction

Anantapuram district is one of the four districts of Rayalaseema region and the largest among the 13 districts of Andhra Pradesh with a geographical area of 19,197 sq.km. The district is economically backward and chronically drought affected. The district is classified as desert-prone, by the Government of India. On average once in every 7ve years, the district experiences drought conditions. In 2006, Anantapuram was one of the thirty-one districts identified by the Government of India as being prone to agriculture-related suicides. The suicides are reported from the entire district except few mandals viz., Hindupur, Lepakshi and Chilamattur, irrespective of whether the mandal is falling in command area or non command areas, low or high ground water development.

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Sustainable Agriculture in India: It's Role and Prospects

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Introduction

Agriculture has always been called the backbone of Indian economy, supporting the livelihoods of the majority of the population. Although India has a significant presence internationally in terms of production of key cereals, pulses, fruits, vegetables and animal products, at the same time, productivity is fairly low. Despite a conducive policy environment and strong demand pull for the sector, key challenges plaguing the sector involve smaller holding size, dismal primary and secondary processing infrastructure, a convoluted supply chain with multiple levels and intermediaries, and limited last mile delivery of services, to name a few.

The role of agricultural sector in Indian economy can be seen through its contribution to Gross Domestic Product and employment. The sustainable agriculture development of any country depends upon the judicious mix of their available natural resources. In spite of fast growth in various sectors, agriculture remains the backbone of the Indian economy. Sustainable agriculture is the system of raising crops for greater human utility through utilization of resources with better efficiency without disturbing, misbalancing or polluting the environment.

Being the largest private sector 'agriculture' enjoys a very important position in Indian economy. As it is having link from various sectors like production, processing and marketing; agriculture continuously dominate to change in the India. Sustainable development in the agriculture sector aims to increase the productivity, efficiency and level of employment and further aims to protect and preserve the natural resources by the over utilization. It also provides mechanism to reduce the soil degradation through multiple cropping systems and through the deforestation and much other reason.

The Government of India therefore set up a panel on doubling farmers' income by the year 2022. Agricultural reforms such as reducing cost of cultivation, enhancing productivity, improving profitability, encouraging organic farming are in the pipeline. Doubling the farmers' income in a given timeframe is a huge task as Indian agricultural is also beset with several problems such as climate change, soil degradation and lowering of water level at some areas, increasing cost of agricultural inputs and growing numbers of small and marginal farmers with growth of population.

In such a situation where overcoming the ongoing farming problems is also an issue, enhancing agricultural productivity and improving the farmers' income is a double challenge. It cannot be achieved without reaching up to the level of every farmer analyzing how do he/she is doing

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A Study on Possible Areas of Agripreneurial Development

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Abstract

Agriculture is the backbone of Indian economy. The three pillars of Indian economy are agricultural sector, industrial sector, service sector. The development of the three sectors leads to the overall development of the nation. Agripreneurship is one of the most important inputs in the economic development of a country and of regions within the country. Agripreneurship has a great scope for entrepreneurship in agriculture and its potentiality can be gained only by effective management of agri elements an individual with the capacity of risk bearing and keen for latest knowledge with regard to agriculture sector can prove to be a right agripreneurs. The sector like agriculture has a great potential for contributing national income of the country. On the other hand, it provides direct employment and income to the large and vulnerable section of the society. There are so many areas and sub-areas in agriculture. Within each area, enormous number of commodities is available. Based on the needs, agro-climatic conditions and available resources, agripreneurs can adopt some commodities and flourish on it. The allied sectors like sericulture, dairy farming, bee-keeping, mushroom cultivation, fisheries, etc., have a great potential for agripreneurial development. The present study aims to identify the possible areas of agripreneurial development. The study is primarily based the secondary data. The data was collected through the sources like journals, publications, news papers, magazines etc.

Introduction

Agriculture is the backbone of Indian economy. The three pillars of Indian economy are agricultural sector, industrial sector, service sector. The development of the three sectors leads to the overall development of the nation. Agripreneurship is one of the most important inputs in the economic development of a country and of regions within the country. Entrepreneurship in agriculture is popularly known as Agripreneurship. Agripreneur uses the scant resources in the most efficient manner thereby increasing profits and decreasing costs. The significance of agripreneurship is being realized more and more. This has seen efforts from the government as well as from the NGOs for the promotion and development of the same. Besides, the agripreneurs should also identify the industries related to Vegetable production and marketing, Vermi composting, Veterinary clinics, and Pickle, papad units.etc. This will lead to regional as well as individual growth. Such type of entrepreneurial business ventures can maximize the farmers disposable income at large and can make the farmers financially more independent.

- **Poultry**

Egg and meat consumption have shown a steady rise over the years. This provides a very good opportunity for the budding entrepreneurs to take up poultry business. Poultry farming provides reasonable diversification.

Conclusion

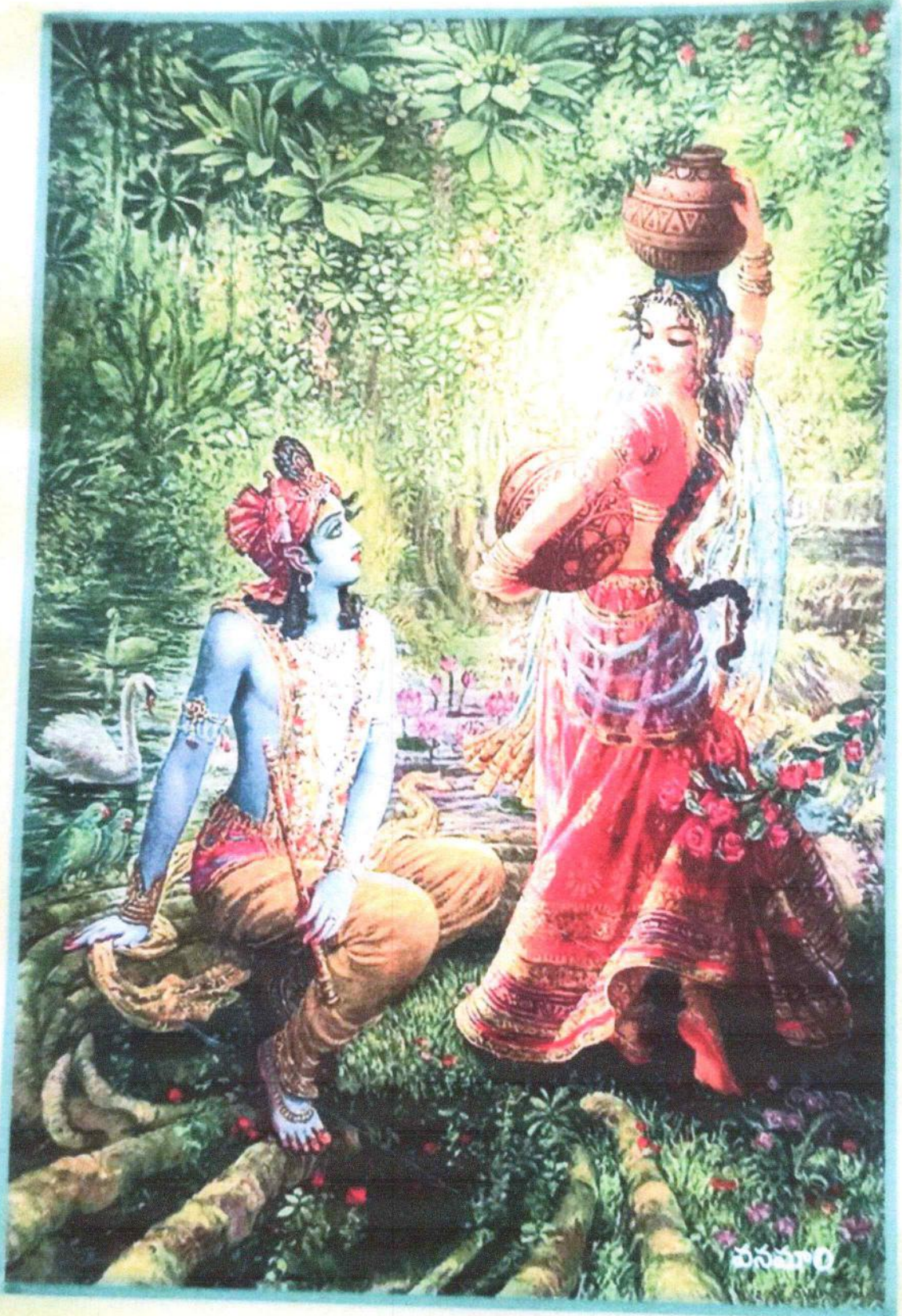
Agripreneurship shares many characteristic features of entrepreneurship, but also has its discrete features due to the specific context of the agricultural sector. It is clear that there are so many areas for agripreneurial development like sericulture, dairy farming, bee-keeping, mushroom cultivation, fisheries, etc., and it helps to reduce the unemployment in agricultural sector. Agripreneurship has a great scope for entrepreneurship in agriculture and its potentiality can be gained only by effective management of agri elements an individual with the capacity of risk bearing and keen for latest knowledge with regard to agriculture sector can prove to be a right agripreneurs. The sector like agriculture has a great potential for contributing national income of the country. On the other hand, it provides direct employment and income to the large and vulnerable section of the society.

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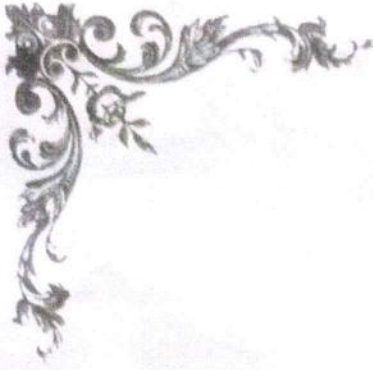
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SUSTAINABLE AGRICULTURE IN INDIA

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Globalization and Indian Agriculture

Dr.S.Venkata Subba Reddy

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Abstract

Globalization refers to integrate the domestic market with world market in the field of trade of goods and services, technology and labour etc. The term globalization has come into common practice since the 1980s, reflecting in the technological advances that have made it easier and quicker to complete international transactions flows, both trade and financial. Globalization means an explanation of market from local level to worldwide. It aims at the integration of the Domestic Economy with the Global Economy and the optimum utilization of growth potential. The process of globalization has revolutionized World Agriculture and allied sectors directed to improve the efficiency productivity and cost competitiveness. Globalization has brought in new opportunities to developing countries. Greater access to developed country markets and technology transfer hold out promise improved productivity and higher living standards. Post liberalization, Indian agriculture sector face new challenges in the form of competition from highly subsidized agriculture of developed countries. This prompts the need for making Indian agriculture successful and profitable by improving the conditions of small and marginal farmers, countering then negative effects of Green Revolution, developing and promoting organic farming, and diversifying cropping pattern from cereals to high value crops. Agriculture sector plays key role in economic development of the country. Agriculture in India is the means of livelihood of more or less two thirds of the work force in the country. It has always been INDIA'S most important and desired economic sector. Therefore, present study analyses the impact of globalization on Indian agriculture.

Introduction

Globalization refers to integrate the domestic market with world market in the field of trade of goods and services, technology and labour etc. The term globalization has come into common practice since the 1980s, reflecting in the technological advances that have made it easier and quicker to complete international transactions flows, both trade and financial. Globalization has opened up new and tremendous opportunities for worldwide developers. Under the influence of the process of globalization, India in 1991 introduced economic policy changes and integrated its economy to the international economy. Globalization in India arrived just before the end of the cold war. India introduced changes in industrial and trade policies to improve its efficiency, productivity and competitiveness of its economy. Globalization means an explanation of market

agriculture came to 58 per cent whereas the share of agriculture in the GDP went down drastically to 24 per cent and further to 22 per cent in 2006-07. This has resulted in a lowering the per capita income of the farmers and increasing the rural indebtedness. (Malik 2013)

Conclusion

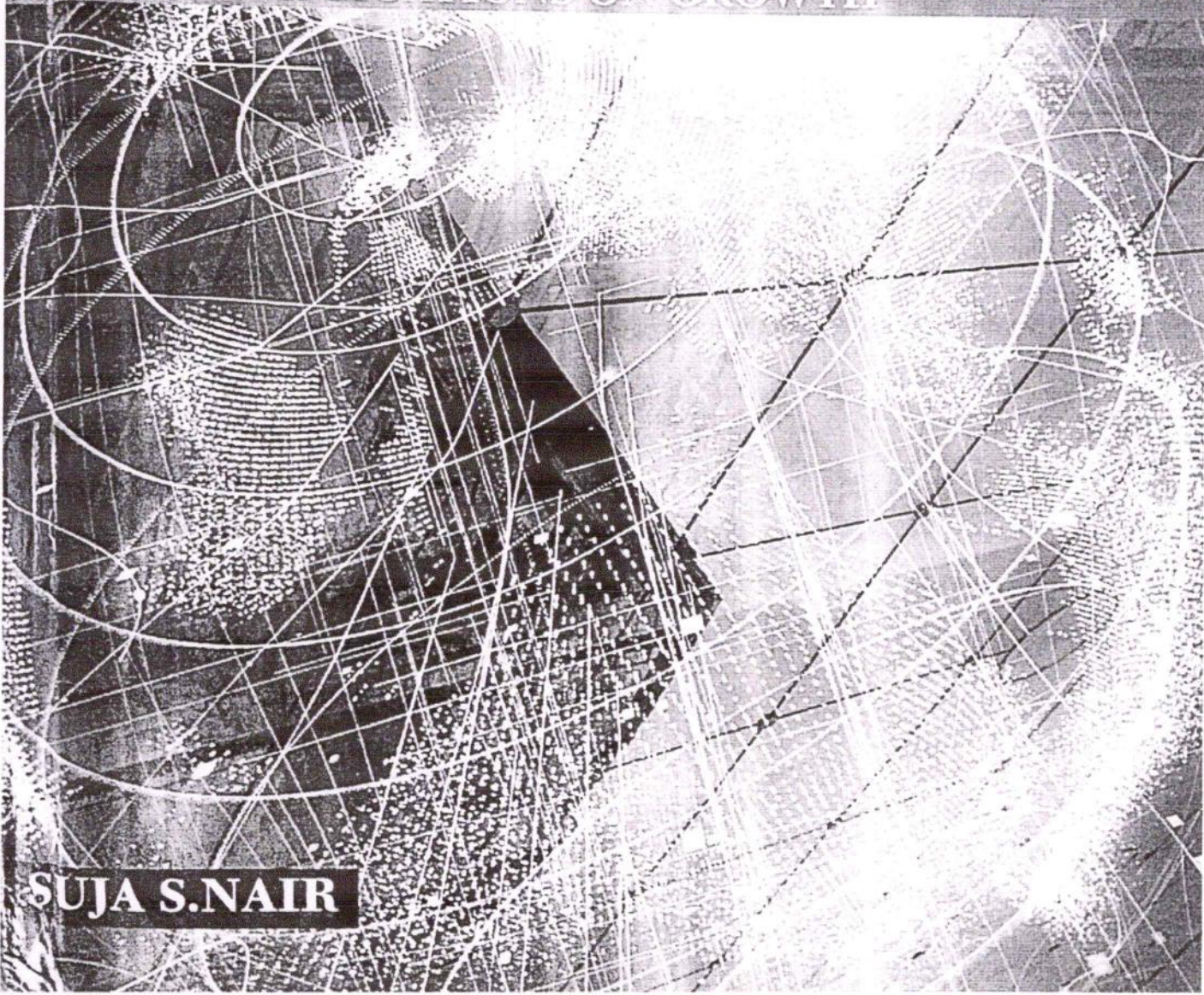
An overview of Indian agricultural sector indicates that globalization did not yield the desired results in India. It has marginally contributing in minimizing poverty, and removing social inequalities. The desired objectives of this process have not been achieved in India. As far agricultural sector is concerned we have seen mixed results in the country. It is clear with the study that agriculture plays key role in the economy. Agriculture employees 60% of Indian population, yet its contribution varies only from 15 to 20% of the GDP. The globalization process in the economy offers an opportunity to correct the 'anti agriculture' bias in Indian Trade Policies that have been in existence since 1950s. With this, the hidden 'implicit taxation' on agriculture sector would get an opportunity to respond favorably to these signals. India, which has significant technical skills in the field of agriculture, must develop self-reliance in technology. Moreover, there is no need for the country of function as the purveyors of Multi-National corporation technologies with their patent rights. Agriculture can move on to a higher growth trajectory, if supply side bottlenecks are freed, and a protective cover is accorded to the poor, at least for some time. If this happens, agriculture can propel growth in other sectors too on a sustainable basis, while promoting intersectoral and interpersonal linkages. After adoption of globalization in 1991 Indian agriculture growth rate increased but at present the economic condition of the farmers is not satisfactory because input cost is high and output cost is low. Cutoff of subsidies is hindering growth of agricultural sector.

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IMPACT OF GLOBALIZATION ON MSME'S

PROSPECTS, CHALLENGES AND POLICY
IMPLICATIONS ON GROWTH



SUJA S. NAIR

**IMPACT OF GLOBALIZATION
ON MSME'S—
PROSPECTS, CHALLENGES AND
POLICY IMPLICATIONS ON GROWTH**

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A Study of Mudra Schemes in Credit Growth of Micro, Small and Medium Enterprises Sector in India

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ABSTRACT

For long, Small Scale Industries, and in present scenario, the Micro Small Medium Enterprises (MSME) plays a prominent role in the growth of the Indian Economy. This sector performs a direct impact on the growth of the overall economy. Not only plays a significant and complementary role in the industrialisation of the economy but also contributes enormously to the socio-economic development of the country. As per the Fourth All India Census of the Micro, Small and Medium Enterprises, the total number of enterprises of the MSME sector is 361.76 lakh. Out of which 15.64 lakh are registered enterprises while the remaining 346.12 lakh are in the unregistered segment. According to the Ministry of Micro, Small and Medium Enterprises, GOI, the employment in this sector has increased to 80.52 million in 2006-07 from 7.50 million in 1981-82. The data further reveals that, there are 117 million people employed in 51.06 million enterprises across the country. The SME sector in India has been changing over time, mostly through changes in Govt. policies time to time. After Globalisation, the growth in production almost doubled from 8.9 per cent to 16.6 per cent, employment grew by 10.2 per cent, in the case of exports the growth rate slightly increased to 7.64 per cent. During this period, productivity multiplied by almost four times and grew at the rate of 6.45 per cent. This sector contributed 33 per cent of industrial GVA and 31 per cent of Industrial Gross Domestic Product at constant prices base year 2011-12 during the year 2016-17. Since 2014, Govt. of India has introduced various reform measures to boost the overall growth in MSME Sector and launch of MUDRA Scheme is one of the key initiatives among them. This scheme has been initially formed as a wholly owned subsidiary of Small Industries Development Bank of India with 100 per cent capital being contributed by it. At present, the authorized capital of MUDRA is 1000 crores and paid up capital is 750 crore, fully subscribed by

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Role of Crop Insurance in Climate Change Mitigation and Adaptation A Case of Kadapa YSR District of Andhra Pradesh

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Introduction

Climate change is a global environmental challenge that is threatening sustainable development around the world. It is a continuing long-term process manifesting itself with gradual increase in temperature, greater variability in rainfall, rise in sea level and increased frequency, intensity and duration of extreme weather events, such as drought, flood, cyclone and storm surge (IPCC, 2007). India being located in the low latitude region of South Asia is extremely vulnerable to climate change because of its tropical climate, monsoon rain, long coast line, greater dependence on agriculture, high incidence of poverty, low irrigation coverage and inadequate resources and technology to combat climate change. Agriculture is the dominant sector in Indian economy. Agriculture contributes 22 percent of GDP, provides 58 percent of employment, sustains 69 percent of population, produces all the food and nutritional requirements of the nation, important raw materials for some major industries, and accounts for about 14 percent of exports. However, agricultural production is beset with various risk factors due to occurrence of natural calamities like flood, drought, cyclone and storm surge, infestation of plant diseases and pest attack, technology failure, irregularity in input supply etc. (Mamata Swain, 2014).

In the last fifty years, there have been about 15 major droughts in India, due to which the productivity in those years was adversely affected. Crop failures have spurred suicides by many farmers even in recent the past (Naveen Kalra. P.K. et al). In India agriculture is diversified and prone to a variety of risks. Most of the farmers are small and marginal. In most areas, agriculture is rain fed, leading to a greater degree of yield variability and risk. Crop Insurance, which aims at addressing yield risk-though necessary for a vast majority of farmers-is subject to structural, design and financial problems. Conspicuously, it is a potentially more effective risk-shifting mechanism tool.

Dandekar(1976) clearly states that the crop insurance is a vital technique to protect the farmers from crop loss. He suggested introducing individual crop insurance in Indian agriculture.

The area approach crop insurance eliminates the moral hazard problem and reduces effectiveness of adverse selection problem and also the administrative cost. Further, Dandekar

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**EXPONENTIAL TRANSITION OF MANAGEMENT
PRACTICES AND IMPLICATIONS FOR SECTORIAL
PROSPERITY**

**DR. N. SANTOSH RANGANATH
&
PROF. KOPPALA VENUGOPAL**



EXPONENTIAL TRANSITION OF MANAGEMENT PRACTICES AND IMPLICATIONS FOR SECTORIAL PROSPERITY

DR. N. SANTOSH RANGANATH & PROF. KOPPALA VENUGOPAL

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CHANGING ROLE OF HR DURING COVID-19 PANDEMIC

Shaik Abdul Mazed

Research Scholar (Part-Time), Yogi Vemana University, YSR Kadapa and Assistant Professor, Dr. B R Ambedkar Institute of Management and Technology, Baghlingampally, Hyderabad

Dr. P. Saritha

Assistant Professor and Research Supervisor, Department of Business Management, Yogi Vemana University, YSR Kadapa

Abstract: COVID-19 pandemic has disturbed organizations and made HR personnel to think differently by considering new normal norms like social distancing, new work conditions that they may never have envisioned. To stop the spread of the coronavirus, organizations have changed to a Work from Home Model (WFHM), Remote Connections (RC) at a rate and scale, monitored and controlled by email and video conferencing. Sum and substance, HR Managers role has become more crucial and need to accomplish troublesome work under these unprecedented conditions. HR is worried about employee's wellbeing and prosperity during the pandemic; they are under the strain of handling the deskwork and giving comfort to the large number of laborer's simultaneously. HR has consistently been the front liner for workers and the HR's job in observing and keeping up has gotten significantly. Traditional HR is being supplanted with a comprehensive methodology utilizing trend setting innovations and being human driven too. HR managers are literally doing war with the difficulties of reclassifying their techniques on administration, ability, assorted variety while assessing their operational adequacy. The world stands up to different emergencies and COVID-19 being the greatest one right now which has hit the entire world and its economy. In this scenario, this research paper emphasized on role and challenges of HR during the pandemic.

Key Words: COVID-19, Organizations, HR Personnel, Work from Home (WFM), Administration, Remote Connections (RC)

I. INTRODUCTION

As the Coronavirus receipts done the Worldwide, similarly, can HR bests assistance businesses achieve the disaster. Willpower or to resolve the unintentional tactics of handling professional overlays the method and techniques for convalescing incorporation of humanoid and digital workforces? These remain supreme periods, maddening aeras and uncharted topography for all of us. COVID-19 has engaged the universally by whirlwind and elated out a new typical as to in what way organizations accomplish the professional. Organizations universally remain embarking upon swift issues of possession staffs safe, approving optimum operation of staff, and perpetuation the stamina of professional processes. However, of the case, companies unanimously are going out of their ways and accountability their greatest to approve amalgamated circulations and dependably advance efficacy even throughout these bizarre circumstances.

Today, HR is no lengthier working behind padlocked doors and is a critical part of driving the company's accomplishment. During these unparalleled times, the role of HR leaders converts all the more imperative and they are predictable to respond rapidly and lengthily, bearing in mind proximately, short-term, and long-term implications of this universal calamity. Therefore, there is burden on HR from the standpoint that it takes into interpretation the following:

Table-1: Role of HR from Standpoint

The demand-supply disruption, productivity or Profitability challenges
Being able to deal with the new paradigm of recruitment freezes
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Sadhan Kumar Ghosh *Editor*

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Temporal Changes of Solid Waste at Limestone Quarries in and Around Yerraguntla, YSR District, A.P., using Google Earth Images



Y. Sudarshan Reddy, B. Suvarna, M. Prasad, V. Sunitha
and M. Ramakrishna Reddy

Abstract In limestone mining and cement industry, solid and liquid wastes are generated in every day and every stage of the operations and are required to mitigate properly. Different types of waste generated from both the industries are cement and limestone quarry. Due to environmental impact and public health and safety, proper efforts must be made to decrease waste generation and hence efficient disposal practices have to be followed. Hence, this study aims at a better understanding of spatial and temporal changes of unplanned dumping sites from 2006 to 2018. Google Earth mapping is one of the most advanced methods for identification of rock-solid waste clearly for collecting on satellite image data. This paper is centered on application of Google Images in assessing the temporal changes of solid waste at limestone quarries in and around Yerraguntla. Time series multi-date Google Earth imageries of 2006–2018 are used to demarcate the evolutionary changes in limestone waste disposal management and to understand the spatial and temporal changes that happened due to the changes by expanding the rock waste dump around Yerraguntla village, YSR district, A.P. Results revealed that the solid waste management in the study area is very poor which need to be properly monitored so as to mitigate the present and future environmental threats.

Keywords Temporal changes · Solid waste · Limestone quarries · Google Earth · Yerraguntla

1 Introduction

Waste is defined as the discarded and discharged material generated during every stage of life causing adverse health and environmental impact (Bringi 2007). Environmental contamination and waste management are the major concerns to earth scientist and form other related fields of science all over the world both in developing

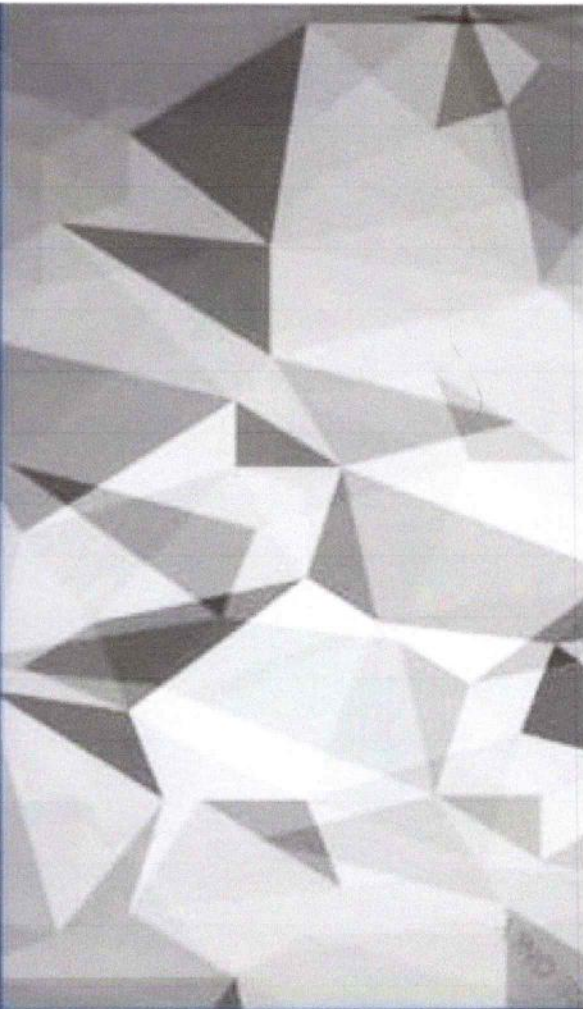
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In this book, an attempt is made to analyze the heat and mass transfer effects on a laminar two-dimensional steady/unsteady convective flow of a viscous incompressible and radiating Newtonian/non-Newtonian fluid past a stretching/wedge/stretching sheet/thin liquid film bounded by a porous/non-porous medium, by taking viscous dissipation, uniform/non-uniform heat source/sink, activation energy and binary chemical reaction, aligned/non-aligned magnetic strength into account. The approximate solutions are obtained by using Runge-Kutta with the shooting method. A parametric study is carried out to illustrate the behavior of the velocity, temperature, concentration, skin friction, Nusselt number and Sherwood number for variations in the various thermophysical and hydrodynamical parameters and are represented in figures and tables.

Numerical Studies of MHD

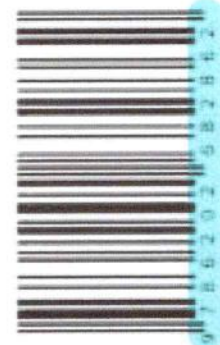


Dr. S. Suneetha is working as an Assistant Professor (Senior) in the Department of Applied Mathematics, Yogi Bema University, Kadapa, Andhra Pradesh, India. She has 45 publications in National and International journals. Her current interest areas are Convective flows in Nanofluids, Hybrid Nanofluids, Entropy Generation, Radiation, etc.

Sangapatnam Suneetha
Ketineni Subbarayudu

Numerical Studies of MHD Convective Fluid Flows in Various Geometries

Suneetha, Subbarayudu



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In this book, an attempt is made to assess the everyday memory performance among older men and women, its relationship with Socio-demographic and Psychological variables, and also to see the efficacy of the intervention on a selected sample of older subjects. Everyday memory refers to memory operations that routinely occur in one's daily environment. The hallmark of everyday memory and associated research, then, is that it involves the performance of tasks that occur naturalistically in the real world. The review reveals that there is a paucity of studies on everyday memory performance in the Indian aged. The present study focuses on the assessment of everyday memory in the aged (N=600) and its association with Physical health and Psychological health, Depression, and Life review. The main sample includes men and women with the age group of 60-75+. The intervention was carried out on a select sample of older men and women (n=120) with poor everyday memory performance. As the data indicates there are differences among different sub-groups in the performance of everyday memory. The interventions were carried out on a select sample of subjects.

Psychosocial Correlates



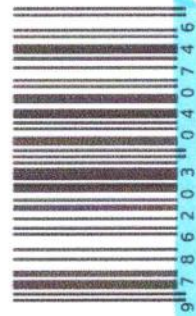
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Aswartha Reddy

Psychosocial Correlates of Everyday Memory in the Aged

An Intervention Study



Dr. K. Lalitha, Assistant Professor, Dept. of Psychology, Yogi Vemana University, Kadapa, A.P., India. Sri Venkateswara Award-1999, T.T.I.I. Award-2003, A.P. Scientist Award, 2017, Mid Career Gerontologist Award, 2019.
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In this book, an attempt is made to assess the everyday memory performance among older men and women, its relationship with Socio-demographic and Psychological variables, and also to see the efficacy of the intervention on a selected sample of older subjects. Everyday memory refers to memory operations that routinely occur in one's daily environment. The hallmark of everyday memory and associated research, then, is that it involves the performance of tasks that occur naturalistically in the real world. The review reveals that there is a paucity of studies on everyday memory performance in the Indian aged. The present study focuses on the assessment of everyday memory in the aged (N=600) and its association with Physical health and Psychological health, Depression, and Life review. The main sample includes men and women with the age group of 60-75+. The intervention was carried out on a select sample of older men and women (n=120) with poor everyday memory performance. As the data indicates there are differences among different sub-groups in the performance of everyday memory. The interventions were carried out on a select sample of subjects.

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Editors

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Chapter 11

Genetic Marker Identification for the Detection of Early-Onset Gastric Cancer Through Genome-Wide Association Studies



Manoj Kumar Gupta, Jinka Rajeswari, **Pamuru Ramachandra Reddy**,
Koppula Satish Kumar, K. V. Chamundeswaramma,
and **Ramakrishna Vadde**

Abstract The complete human genome sequence published by Celera and Human Genome Project in 2001 has provided us with in-depth knowledge about both location and structure of genes; however, they do not provide any information about the genetic diversity between and within human populations. International associations such as the 1000 genomes project, Simons Genome Diversity Project and International HapMap project employed high-throughput sequencing technologies to explore the genetic diversity among various human population across the world. All these studies suggested that every human endures 250–350 loss-of-function mutations on average as well as they are heterozygous for about 60–120 variants, which are associated with genetic disorders. Information about this genetic diversity among human enable us to carry out genome-wide association studies (GWAS) and recognize genes and its respective variants related with any traits of interest or diseases. Till date, more than 1600 GWAS studies have been reported on ~300 traits and diseases. Gastric cancer is a solid tumor with complex genetic and

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CHAPTER 11

Identification of targeted molecules in cervical cancer by computational approaches

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Abstract

Cervical cancer is the second leading cause of cancer death in adult women. The three most widely employed techniques for the treatment of cervical cancer are radiotherapy, surgery, and hormone chemotherapy. Recently several biomarkers have also been identified using classical and high-throughput technologies. High-throughput technologies generate huge data, which in turn demand development of robust computational approaches for analysis of this big data in a more comprehensive way. This, in turn, will enable us to better understand mechanisms associated with many diseases, including cervical cancer. Considering this, in the present chapter, we present information about different computational approaches that have been employed to detect target molecules associated with cervical cancer. Information obtained revealed that to date limited computational studies have identified several cervical cancer-associated key hub genes (e.g., *BTD*, *PEG3*, *RPLP2*, and *SPON1*), long noncoding RNA (e.g., *GOLGA2P5*, *EMX2OS*, *FLJ10038*, *FAM66C*, *ACVR2B-AS1*, *AMZ2P1*, *LINC00341*, *ZNF876P*, *MIR9-3HG*, and *ILF3-AS1*), and miRNAs (e.g., *Hsa-mir-1273g*, *Hsa-mir-5095*, *Hsa-mir-5096*, and *Hsa-mir-1273f*) that play a key role in cervical cancer development. However, as there are only a few number of computational studies performed on cervical cancer datasets, there is still scope for developing more robust software/algorithms and analyzing cervical cancer datasets. In the near future, the information in this chapter will be highly valuable for cancer biologists and immunologists toward cervical cancer treatment.

Keywords: Cervical cancer, Computational approach, Key genes, Drugs.

Abbreviations

circRNAs	circular RNA
GWAS	genome-wide association study
HPV	human papillomavirus
lncRNAs	long noncoding RNA
miRNA	micro RNA

1. Introduction

Cervical cancer is the second leading cause of cancer death in a young adult women. Cervical cancer affects women of different countries distinctly. Incidence of cervical cancer in women of high-income countries is lower than in low- and middle-income countries

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Immunotherapy for Gastrointestinal Malignancies

 Springer

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Chapter 13

Applications of Computational Biology in Gastrointestinal Malignancies



Manoj Kumar Gupta and Ramakrishna Vadde

Abstract Gastrointestinal cancers (GICs) are the most common cancers of the digestive tract system in humans. Earlier several techniques have been utilized to understand the molecular mechanism and identification of the key gene or protein–protein interaction that is responsible for causing GICs. Nevertheless, detecting key genes and protein–protein interaction through experimental equipment necessitates huge capital and time. Recently developed computational methods provide a distinct way to address such problems in a short interval of time with less cost. Thus, in the present chapter authors attempted to understand how computational approaches may help us in detecting key genes and protein associated with GICs. Information obtained revealed that several studies have employed computational methods to identify key hub genes, including *COL4A1* and *SERPINH1*, transcription factors (e.g., *MYC* and *MAZ*), and miRNAs (e.g., *miRNA-133b* and *miRNA-99a*) that play a key role in the gastric cancer development. Computational studies have also detected key hub genes (e.g., *AMBIP* and *APOB*) and miRNAs (e.g., *miRNA-7* and *miRNA-141*) that play a key role in the development of colorectal cancer. However, all these studies performed analysis on the bulk cell level, which in turn provides less information about gene expression at the cellular level, which might be the reason for ineffective treatment and low survival of GICs patients. Thus, there is an urgent requirement to understand gene expression in GICs at the cellular level. In the near future, the information present in the present chapter will be highly valuable for cancer biologists and immunologists toward the treatment of GICs.

Keywords Gastric cancer · Computational approach · Key genes · Drugs

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Chapter 11

Immuno-Oncology of Colorectal Cancer



Ramachandra Reddy Pamuru, K. V. Sucharitha, and Ramakrishna Vadde

Abstract The colorectal cancer (CRC) a second leading cancer become most predominant and causing deaths worldwide. Since its spread, more attention has been made to control the CRC. For developing anti-tumor therapies, it is important to know the immune-oncology of CRC. A number of events are identified in the tumor microenvironment of CRC. This chapter gives details of the basics of CRC, immune cells of tumor microenvironment, tumor suppression, and repression. These details of tumor immune-oncology of CRC may help to provide better understanding of CRC and suggest ways to control CRC.

Keywords Colorectal cancer · Microenvironment · Immune cells · Immune response · Immunosuppression

11.1 Introduction

Colon carcinoma (CRC), a third leading cancer reported more than 1.2 million cases worldwide every year and second leading chronic disease in the USA (Rebecca et al. 2019). CRC occupies fourth place in mortality among all cancers in western countries (Globocan, Agency for research on cancer, WHO, 2017) whereas, in the USA 2nd death causing most common carcinoma among other cancers (Tenesa and Dunlop 2009; Jemal et al. 2009). It is very unfortunate that CRCs are silent tumors; they grow slowly and do not show most of the symptoms until they attain large size.

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Chapter 8

Therapeutic Vaccines for Gastrointestinal Malignancies

Bonala Sabeerabi, Venkat R. Arva Tatireddygar, and Ramakrishna Vadde

Abstract Gastrointestinal (GI) cancers are highly aggressive and display genome instability, gene mutations, immune suppression, immune insensitivity, and desmoplasia. GI cancers represent as one among the most common cancer type with a burden of ~25% worldwide, with each year about 4.5 million global deaths. GI cancers are not preventive, the prognosis of patients with advanced tumors was difficult, and treating the GI cancers is the only option. For many years, the treatment of GI cancer patients involve surgery, radiotherapy, and chemotherapy in combination or alone. The successes oncologists achieved so far was great but not enough, since it is only recently, the very first promising clinical data comes into light in 2015. Hence novel therapeutic ways to treat GI cancer were much required. Presently, it appears that immunotherapy is the answer. Immunotherapy is advancing quickly and outlines, a conventional shift in the treatment of GI cancer through its promising benefits beyond conventional treatments. Currently, researchers are examining a variety of medicines and factors like immune checkpoint inhibitors, ACT, peptide vaccines, cytokines, and antibodies to treat GI cancers. In recent years, the FDA approved the utilization of anti-PD-1, anti-VEGFR2, and anti-CTLA-4, immunotherapy against a few GI cancers including gastric cancer, liver cancer, and colorectal cancers. Among all the GI cancers, biliary tract cancer and pancreatic cancer patients have limited/no immunotherapeutic options at the moment, nonetheless ongoing clinical investigation will provide some assuring therapeutic solutions. It is highly important to overcome the various factors contributing to varied effectiveness of immunotherapy in GI cancers. Researchers are currently investigating the potentiality of cancer stem cells and their specific markers as targets: outcomes from

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Chapter 7

Monoclonal Antibody Therapy Against Gastrointestinal Tract Cancers



Gayatri Gouda, Manoj Kumar Gupta, Ravindra Donde, Lambodar Behera, and Ramakrishna Vadde

Abstract Gastrointestinal (GI) cancer is one of the leading causes of cancer death across the globe. To date, numerous techniques have been developed for the removal or destruction of cancer cells via surgery, radiation, or chemotherapy. However, these techniques have various side effects on the human body. In comparison to other techniques, recently developed monoclonal antibodies have fewer side effects. Thus their usage in cancer treatment has increased recently. Considering above, in this chapter, the authors attempted to understand the molecular feature associated with monoclonal antibodies and how they can be employed for the treatment of GI cancer. Information obtained revealed that the two most widespread techniques used for producing monoclonal antibodies are hybridoma and phage display. Since 1986, various monoclonal antibodies have been developed against numerous receptors/genes, namely epidermal growth factor receptor (EGFR), human epidermal growth factor 2 (HER2), HER4, VEGF, CD20, CD30, tumor necrosis factor member11, PD1 and IL4, that play a key role in causing GI cancer at different stages. For instance, panitumumab in combination with epirubicin, oxaliplatin, and capecitabine can be used for treating advanced esophageal gastro adenocarcinoma. Tremelimumab, a monoclonal antibody, works against anti-CTLA4 and can be used for the treatment of gastro cancer, colon cancer, and melanoma. However, few studies have reported that these monoclonal antibodies have side effects. For instance, mucositis was observed for the cetuximab antibody. Thus, the monoclonal antibody should be used carefully under the provision of the medical practitioner. In the near future, the information present in this chapter will be highly useful for treatment in GI cancer.

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Chapter 5

Immune Cell Therapy Against Gastrointestinal Tract Cancers



Ravindra Donde, Manoj Kumar Gupta, Gayatri Gouda,
Sushanta Kumar Dash, Lambodar Behera, and Ramakrishna Vadde

Abstract Gastrointestinal (GI) cancers are responsible for major cancer-related mortality around the world. It has imposed a substantial burden and pressure on the healthcare sector across the globe. Recently advancements in high throughput techniques provide us with a unique opportunity to detect biomarkers and treat various diseases, including GI cancer, more comprehensively. However, most of these approaches are ineffective for treating patients with advanced or metastatic stages. Additionally, these treatments have severe side effects on cancer patients. Thus, there is an urgent requirement to identify new drugs and innovative immune therapies for the treatment of GI malignancies. Considering this, recently developed immune cell therapy provides a unique opportunity for early detection and treatment of various cancers, including GI cancer. It controls cancer either by activating or suppressing the immune system of cancer patients. Recently, immune checkpoints approaches have also been employed in the treatment and prevention of cancer. However, various studies have reported that few of these therapies have side effects. Thus, these therapies must be employed with utter caution. Recently several studies have also proposed that the personalized immunotherapy approach can also be used for therapeutic cancer treatment with fewer side effects. Authors believe that by employing classical and advanced immunotherapeutic techniques together, we can easily diagnose and treat GI cancer in a more comprehensive way. In the near future, the information present in this chapter will be highly useful for the early detection and treatment of various cancers, including GI cancer.

Keywords Gastrointestinal cancers · Immune cell therapy · Personalized immunotherapy · Immune checkpoints · Monoclonal antibody

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Chapter 2

Immunocomposition of Gastrointestinal Tract of Gut



Mekapogu Madakka, Nambi Rajesh, and Jinka Rajeswari

Abstract The human gastrointestinal tract (GI tract) is a distinctive organ occupied by a series of commensal microorganisms, while also being showed to an overwhelming load of antigens in the form of dietary antigens on a daily basis. The GI tract has played dual role in the body, in that it performs uptake of nutrients and digestion while also performing out the complex and principal task of maintaining immune homeostasis, i.e., maintaining the balance between the good and the bad. It is equally important that we protect ourselves from reacting against the good, meaning that we reside tolerant to harmless food, commensal bacteria and self-antigens, as well as react with force against the bad, meaning induction of immune responses against harmful microorganisms. This complex task is achieved through the presence of a highly efficient mucosal barrier and a specialised multifaceted immune system, made up of a large population of scattered immune cells and organised lymphoid tissues termed the gut-associated lymphoid tissue (GALT). This book chapter provides an overview of the primary components of the human mucosal immune system and how the immune responses in the GI tract are coordinated and induced.

Keywords Lamina propria · GALT · Mucosal immunity · Mucosal tolerance · Immune homeostasis · Gut microbiota

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Chapter 1

Tumor Heterogeneity: Challenges and Perspectives for Gastrointestinal Cancer Therapy



Manoj Kumar Gupta, Gayatri Gouda, Ravindra Donde,
and Ramakrishna Vadde

Abstract Cancer is clinically characterized via the uncontrolled proliferation of cells. Several studies have reported that tumor heterogeneity is the main reason for the low treatment response rate in cancer patients. Thus, there is always a quest to understand the tumor heterogeneity in any cancer type. In this chapter, the authors attempted to understand the types and drivers for tumor heterogeneity, especially in gastrointestinal cancers, and discussed their biological as well as clinical importance with respect to tumor evolution. Obtained information revealed that tumor heterogeneity can be either at inter- (amongst diverse tumors from diverse patients or within the same patients) or intra- (amongst diverse cells in the same tumor) level. Nevertheless, the main reason for inter-tumor heterogeneity is the intra-tumor heterogeneity. To understand this heterogeneity various high throughput sequencing approaches, for instance, single-cell RNA sequencing, and models, for instance, the “Clonal evolution” model and “big bang” model, have been developed to date. However, the complete mechanism associated with tumor heterogeneity remains elusive to date. Authors believe that by integrating information obtained from various disciplines, including pathology, clinical-radiology, genetic and molecular biology, we can unravel the mechanism comprehensively associated with tumor heterogeneity. In the near future, the information present in this chapter will be highly useful for the early detection and prevention of gastrointestinal cancer in humans.

Keywords Cancer · Heterogeneity · Clonal evolution model · Cancer stem cell model · Tumor

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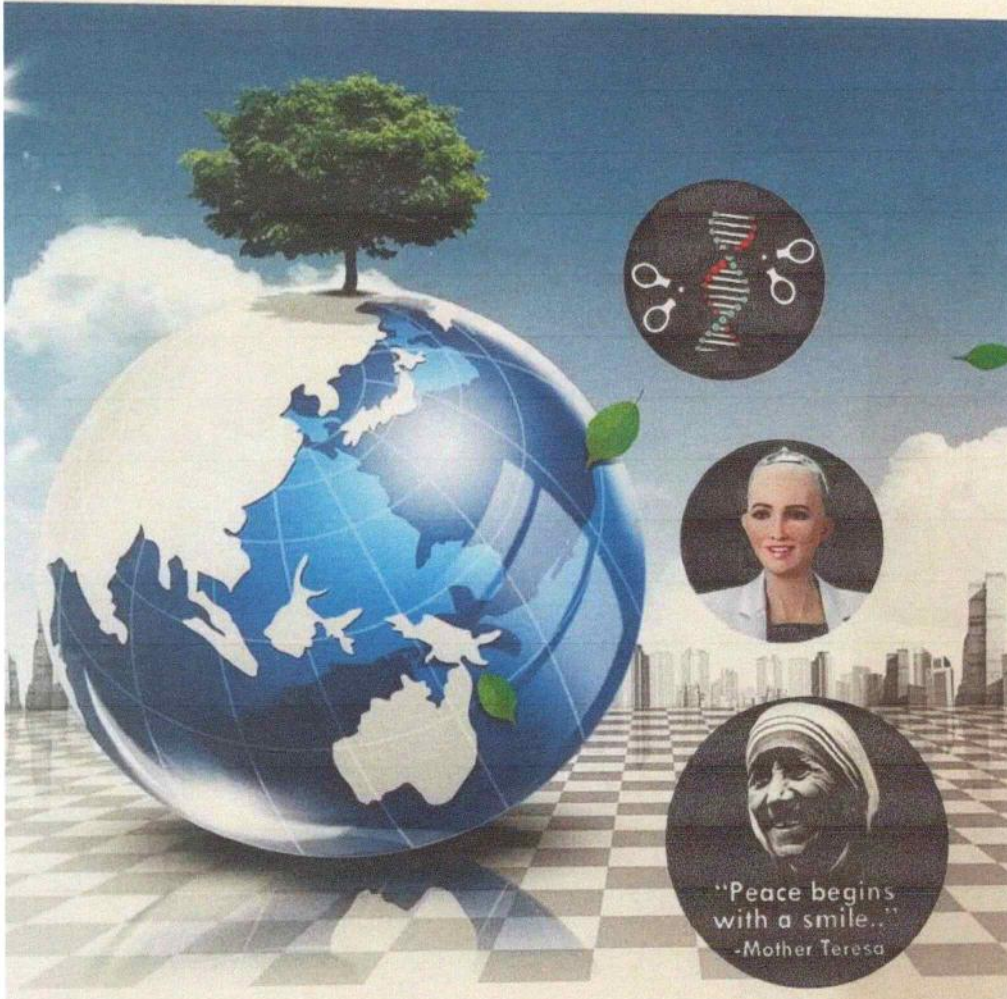
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ACID AND ALKALI PRETREATMENT METHODS OF GROUNDNUT FODDER FOR EFFICIENT HYDROLYSIS AND CELLULASES PRODUCTION IN SOLID STATE FERMENTATION

Dr M. Subhosh Chandra

Dr K. Shruthi

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Introduction

Pretreatment of lignocellulosic biomass to overcome its intrinsic recalcitrant nature prior to the production of value-added products has been studied for almost 200 years. Lignocellulosic biomass is renewable bioresource on earth and is a suitable raw material for wide variety of applications for sustainability (Kumar and Sharma, 2017). Although, because of the complex structure and recalcitrant nature of lignocellulosic biomass pretreatment steps present the most critical challenge

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Recent Developments in
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Chapter 23

Recent trends and future prospective of fungal cellulases for environmental management

Muni Ramanna Gari Subhosh Chandra and Panyam Suresh Yadav

Department of Microbiology, Yogi Vemana University, Kadapa, India

1 Introduction

Cellulases (EC 3.2.1.4) catalyze the hydrolysis of β -1,4-glycosidic linkages in cellulose, and play a significant role in nature by recycling this polysaccharide which is the main component of the plant cell wall (Srivastava et al., 2018a,b). These enzymes act in combination with other hydrolytic enzymes to ensure that the polysaccharide is completely degraded to soluble sugars, namely cellobiose and glucose, which are then assimilated by the cell (Amore et al., 2013). Microorganisms are recognized as effective producers of cellulase, and bacteria, as well as fungi, are considered major sources for the production of cellulase. In particular, bacteria (e.g., aerobic and anaerobic bacteria) and fungi (e.g., soft-rot fungi, white-rot fungi, and brown-rot fungi) are known to be potential cellulase producers among different types of microorganisms (Srivastava et al., 2018a,b). The enzyme produced has a different structure and mechanism for binding to the substratum, depending on the microorganism (Juturu and Wu, 2014). Cellulases formed by the fungi and aerobic bacteria are released as free molecules from the cell into the extracellular medium. In contrast, anaerobic bacteria produce cellulases that remain bound to the surface of the cell in a protein complex called cellulosome. By comparison, cellulases formed by aerobic microorganisms have a different architecture, with two domains: one for cellulose binding and the other as a catalytic site, and a peptide that links the domains (Siqueira et al., 2020). Certain structures on the protein can also be present, with many functions. The huge potential of cellulases in biotechnology is the driving force behind ongoing basic and applied work into these biocatalysts. Nevertheless, fungi are often favored over bacteria for efficient cellulase production because of their flexible use of substrates and their ability to penetrate (Behera et al., 2017). Although the fungi have the ability to produce better cellulase, it is very rare to have a single fungus possessing

all the components of the cellulase system for successful biomass hydrolysis (Srivastava et al., 2018a,b).

Fungal cellulases have now found application in many fields, such as animal feeding, brewery and wine, meat, textile and laundry, and pulp and paper industries. Increasing interest in transforming lignocellulosic biomass into fermentable sugars has created a further market for cellulases and their related enzymes (Kuhad et al., 2011). Additionally, biomass conversion has significant advantages over other alternative energy production methods, as lignocellulose is the most abundant and renewable biomaterial on our planet (Ahorsu et al., 2018). According to recent market reports on enzymes, the main sectors in which cellulase enzyme is increasingly being applied are health care, textiles, pulp and paper, detergent, food, and beverages (Jayasekara and Ratnayake, 2019). Its wide application is related to the food and beverage segment in coffee processing, wine making, and fruit juice production (Kumar et al., 2019). This is commonly used in many industrial applications to manufacture detergents for the laundry and cleaning and washing agents. This chapter provides an outline of fungal cellulases that have been characterized and the applications of these enzymes in the environmental management.

2 Cellulolytic microorganisms

Cellulases are represented by a broad range of naturally occurring microorganisms and cellulolytic microorganisms mainly use carbohydrates for their nutrition but cannot use proteins or lipids as sources of energy. Screening and isolation of cellulase-producing microbes from nature is one of the important ways to get novel cellulases. These newly screened microbes are sources of new cellulase genes with diverse properties. Cellulolytic bacteria and fungi that secrete free enzymes rely on the hydrolysis of lignocellulose

A Taxonomic Revision of the Genus
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in India

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2020

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Brachystelma kadapense M. Sridhar Reddy, C. Ankalaiah, T. Mastan, C. Venkata Ramana, K. Prasad & Venu *sp. nov.* (Plates 29 & 30).

Type: India: Andhra Pradesh, Kadapa district, Guvvalcheruvu reserve forest, 14° 19' 0.1" N, 78° 45' 45.8" E, 478 m, 22.04.2015, C. Ankalaiah, T. Mastan & M. Sridhar Reddy 5252 (holo: CAL; iso: BSID)

Etymology: The new species is named after Kadapa district, a part of the Southern Eastern Ghats of Andhra Pradesh, from where the type material was collected.

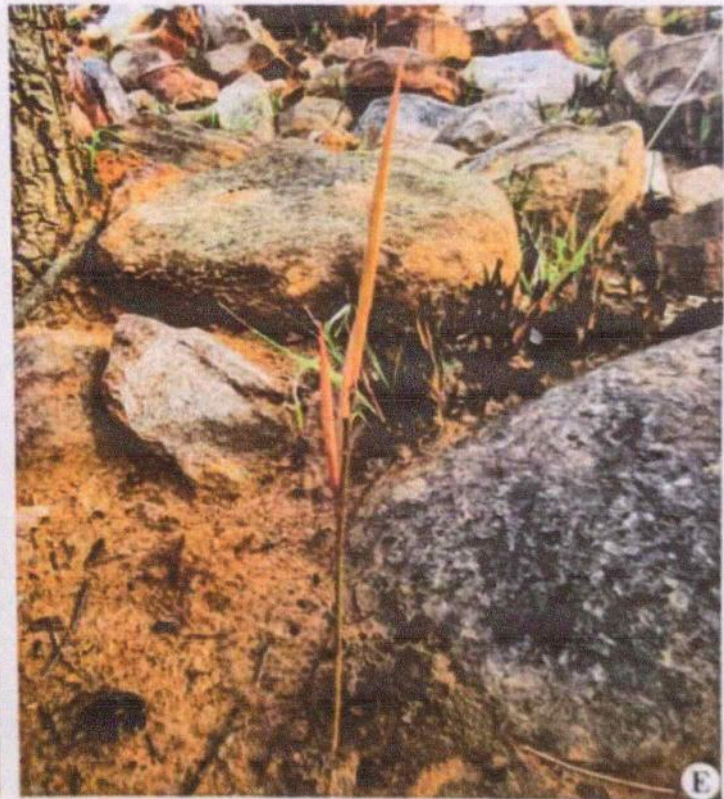
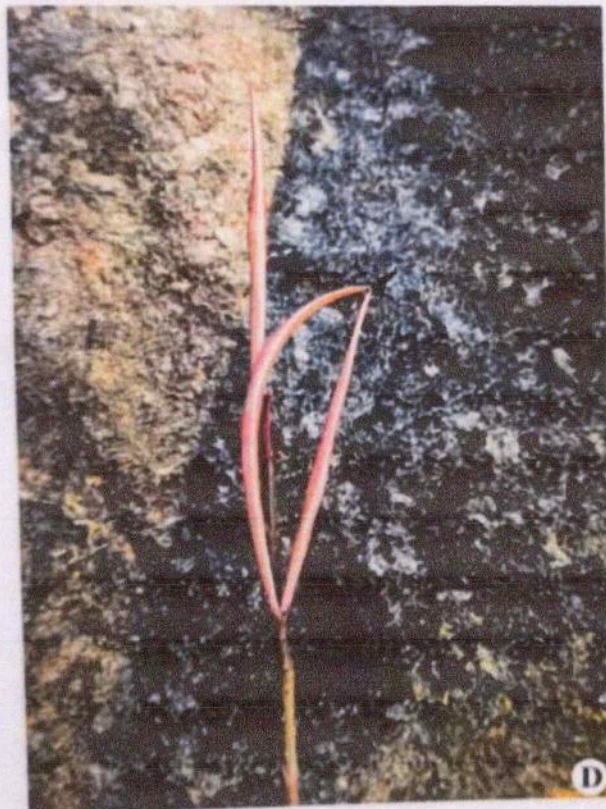
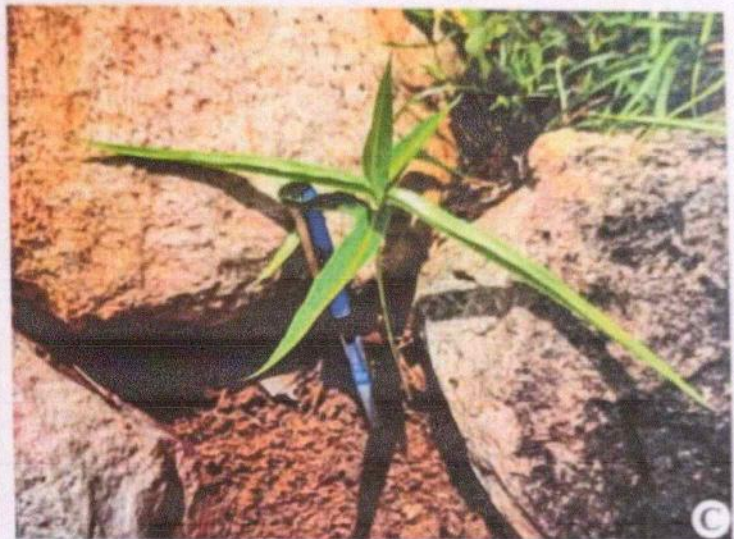
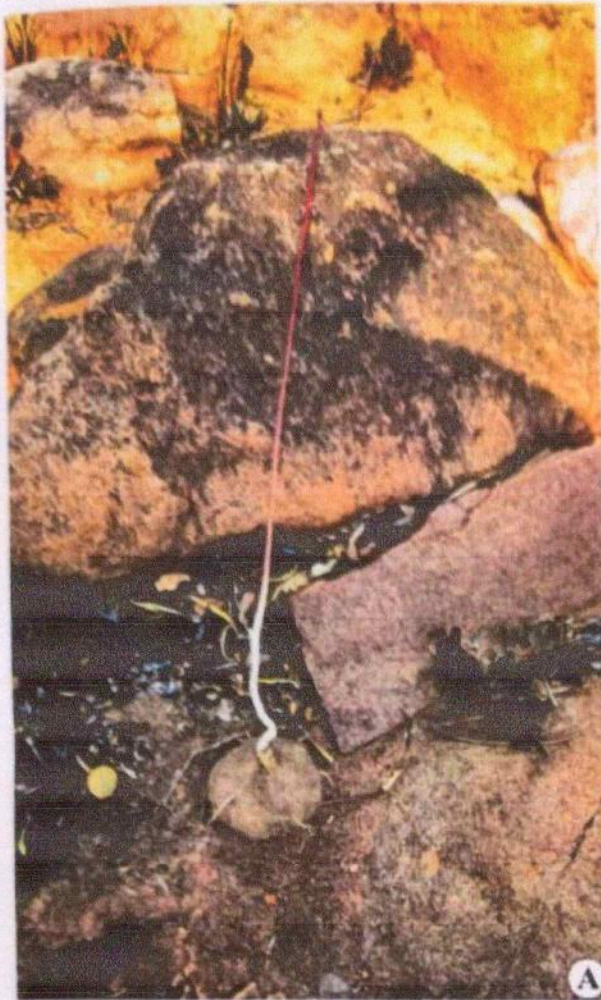


Plate 29: *Brachystelma kadapense* M. Sridhar Reddy, C. Ankalaiah, T. Mastan, C. Venkata Ramana, K. Prasad & Venu *sp. nov.*: A. flowering habit (during summer); B. flowers; C. vegetative habit (during rainy season). D-E: follicle(s).

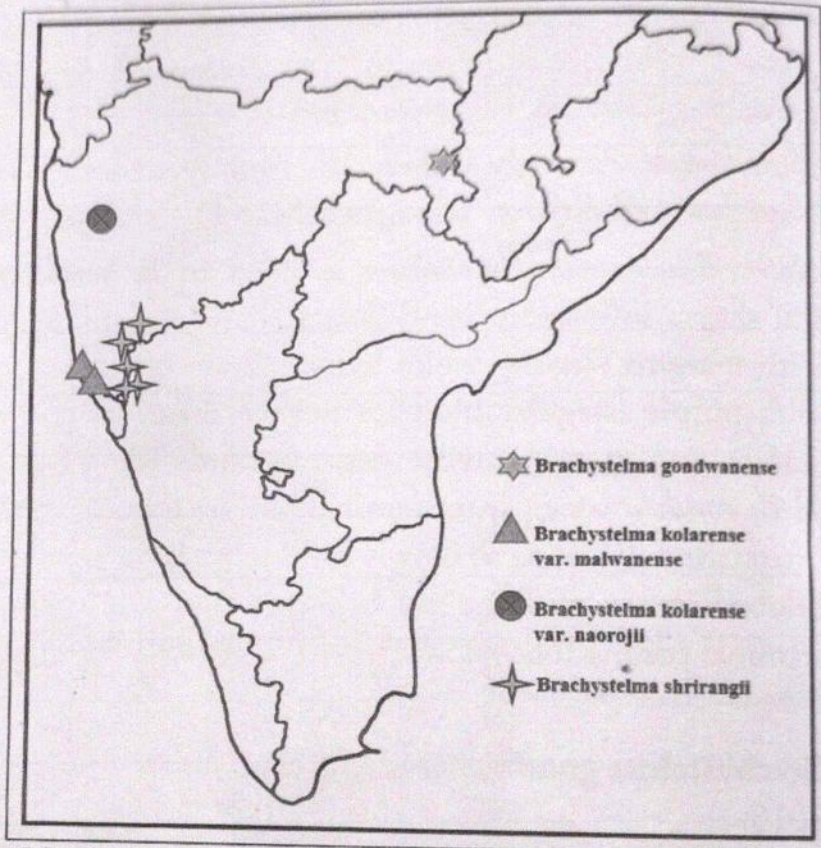
glandular or not, persistent; bracts *c.* 8 × 0.5 mm; bracteoles *c.* 3 × 0.3 mm. Calyx lobes 3–4 mm, triangular, acute at apex, glandular-hairy, yellowish-green. Corolla sharply angled, conical in bud stage; tube *c.* 1 mm long, shallow; lobes 14–18 × 1.5–2 mm, erect but twisted while opening, linear or subcylindrical, acute at apex, involute at margins, 2–3 mm long, scattered white hairy inside and on margins, more dense in the lower half and almost absent near tip, pale yellow, with irregular purple blotches, yellowish-green above, with few purplish blotches only towards base. Corona bowl shaped; interstaminal corona *c.* 3 mm across, slightly longer than the gynostegium, 5-lobed; lobes shallowly bifid, hairy inside, glabrous otherwise, yellowish-white, with purple dots; staminal corona lobes incumbent, lanceolate, white, blotched with deep purple. Pollinium ovoid. Follicles in pairs, 8–10 cm long, pinkish.

Fl. & Fr.: April–June.

Habitat: The species is found mostly in dry to moist deciduous lowland mixed forests with clayey-gravelly to loamy soils at 160–200 m altitude.

Distribution: Maharashtra, known only from type locality (Map 9).

Notes: This is a hysteranthous species (flowering stage is followed by vegetative stage). Higher temperatures in summer seem to trigger flowering. Plants remain vegetative during monsoon, from July to November.



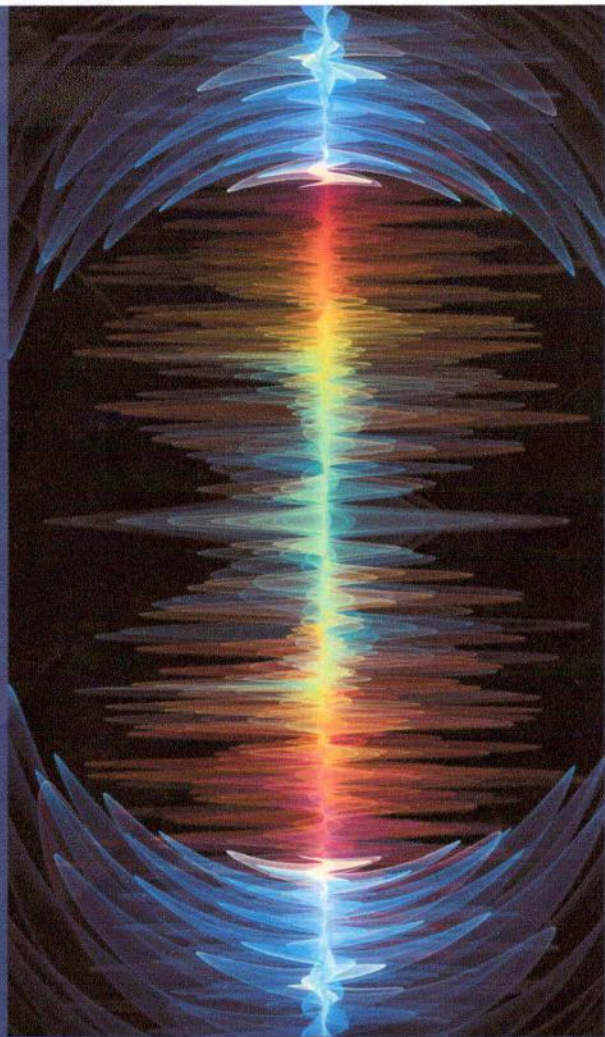
Map 9: Known locations for *B. gondwanense*, *B. kolarense* var. *malwanense*, *B. kolarense* var. *naorojii* and *B. shrirangii*.

Brachystelma kadapense M. Sridhar Reddy, C. Ankalaih, T. Mastan, C. Venkata Ramana, K. Prasad & Venu *sp. nov.* (Plates 29 & 30).

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Naturally occurring solid compounds like minerals and plant materials are widely used in medicine, industry, agriculture and also in daily life. Therefore, the identification and structural determination of trace metals in naturally occurring minerals and plant materials by spectroscopic techniques is one of the main objectives in solid state spectroscopy. In the present investigation, attempts have been made to identify and characterize the trace transition metal ions in minerals and plant materials using elemental analysis (EPMA, ICPMS, and CHNS) and selected spectroscopic methods (Mössbauer, EPR, Optical absorption, IR and Raman studies).



Dr. N.C. Gangi Reddy currently working as an Associate Professor in the Department of Chemistry, Yogi Vemana University, Kadapa. His research interests are i) Design and development of medicinally valuable organic compounds; and ii) Identification and characterization of trace metals in naturally occurring geological and biological compounds.

N. C. Gangi Reddy
S. Lakshmi Reddy
G. Siva Reddy

Spectral Investigation of Transition Metal Compounds



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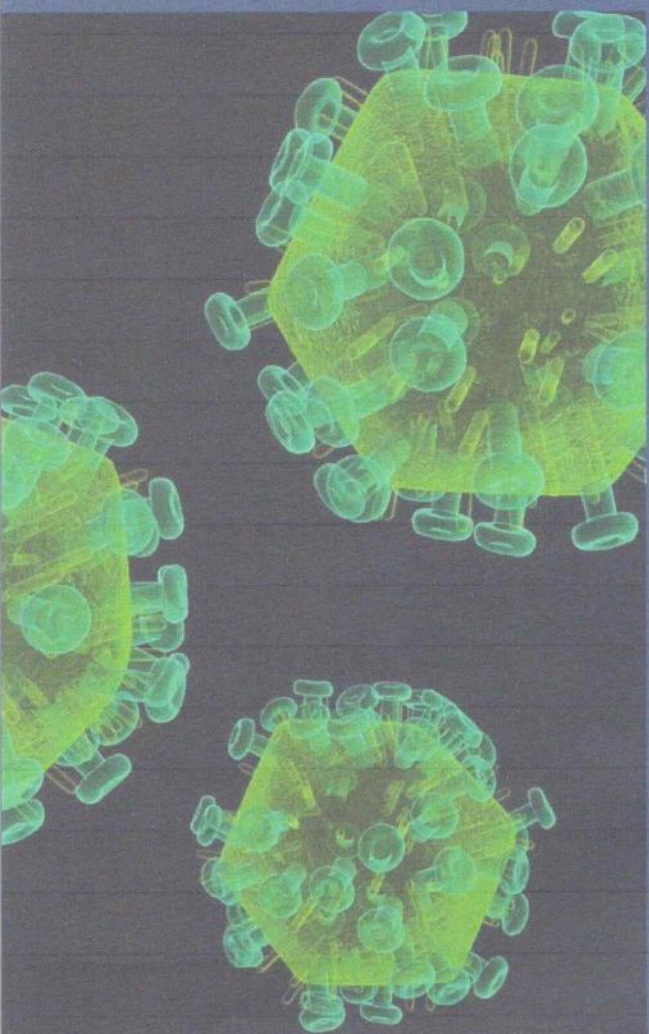
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This book, explains the organic functional groups of *Terminalia bellirica* fruit extract is most effectively and rapidly synthesized different nanoparticles by comparing with *Limonia acidissima* leaf extract. The synthesized Ag, Cu (UCuNPs), Pd and Au nanoparticles, ultra-small copper nanoparticles showed good antimicrobial activity by comparing with other metals. Because of its size, it plays a pivotal role to inhibit microbially, the size of smaller copper ions (2-7 nm). Future studies should include elucidation of the scope and mechanism of this method, followed by the extension of this reaction to other materials, including noble metal particles and bimetallic materials, as well as the synthesis of new Bunte salts with functional groups specific to a given application. Many of the challenges described in the previous chapters could be remediated by borrowing a key principle from another, demonstrating that new materials are rarely produced from entirely green methods at inception, yet many of the processes are easily improved.



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Noblemetal nanoparticles

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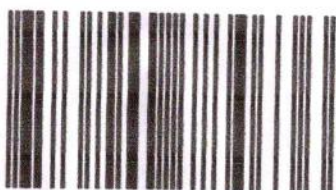
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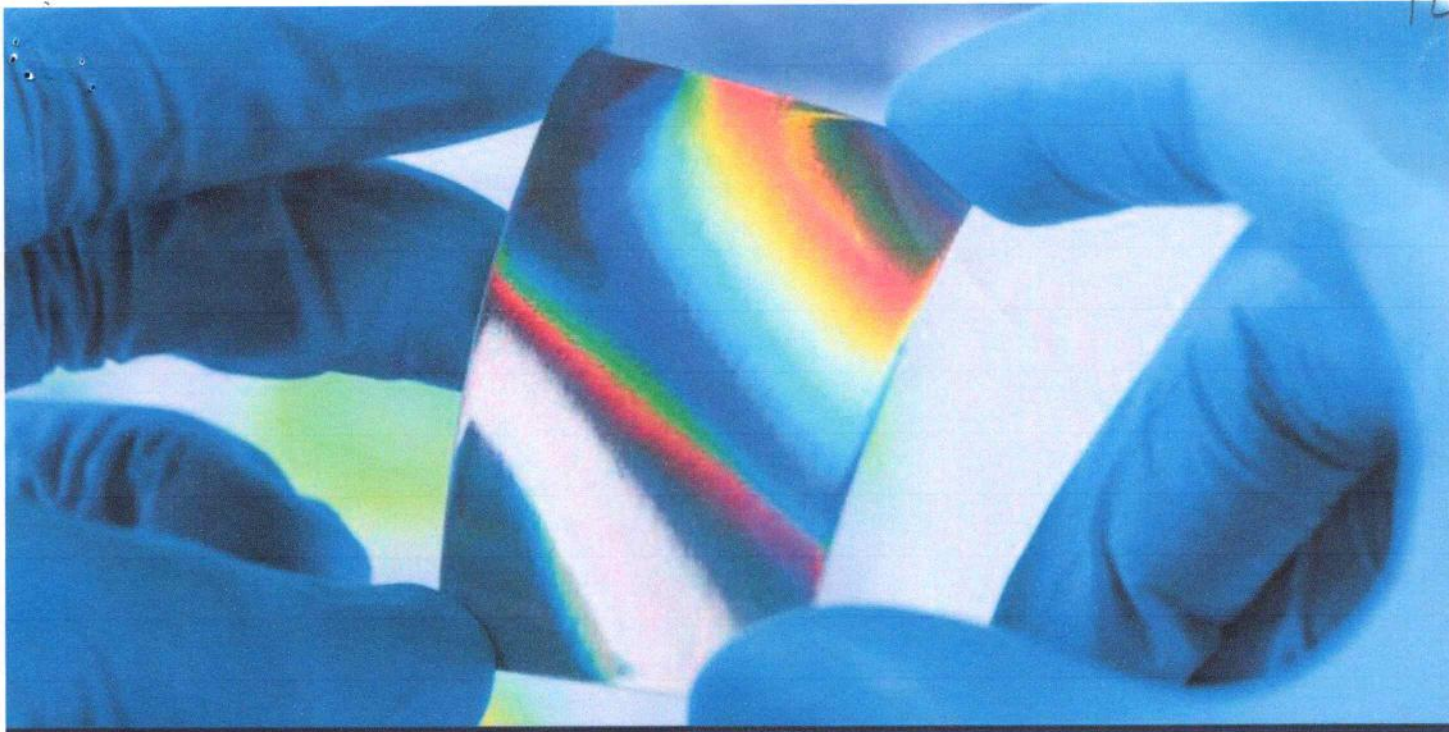
This book, explains the organic functional groups of Terminalia bellirica fruit extract is most effectively and rapidly synthesized different nanoparticles by comparing with Limonia acidissima leaf extract. The synthesized Ag, Cu (UCuNPs), Pd and Au nanoparticles, ultra-small copper nanoparticles showed good antimicrobial activity by comparing with other metals. Because of its size, it plays a pivotal role to inhibit microbially, the size of smaller copper ions (2-7 nm). Future studies should include elucidation of the scope and mechanism of this method, followed by the extension of this reaction to other materials, including noble metal particles and bimetallic materials, as well as the synthesis of new Bunte salts with functional groups specific to a given application. Many of the challenges described in the previous chapters could be remediated by borrowing a key principle from another, demonstrating that new materials are rarely produced from entirely green methods at inception, yet many of the processes are easily improved.



Dr. Annavaram Viswadevarayalu received his Master's degree from Sri Venkateswara University, Andhra Pradesh, India in 2010, and his Ph.D. from Yogi Vemana University, and Andhra Pradesh, India in 2016. He worked as a Postdoctoral researcher in Jiangsu University, China during the year 2017-2019.

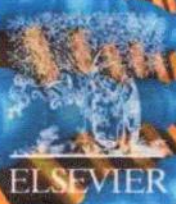
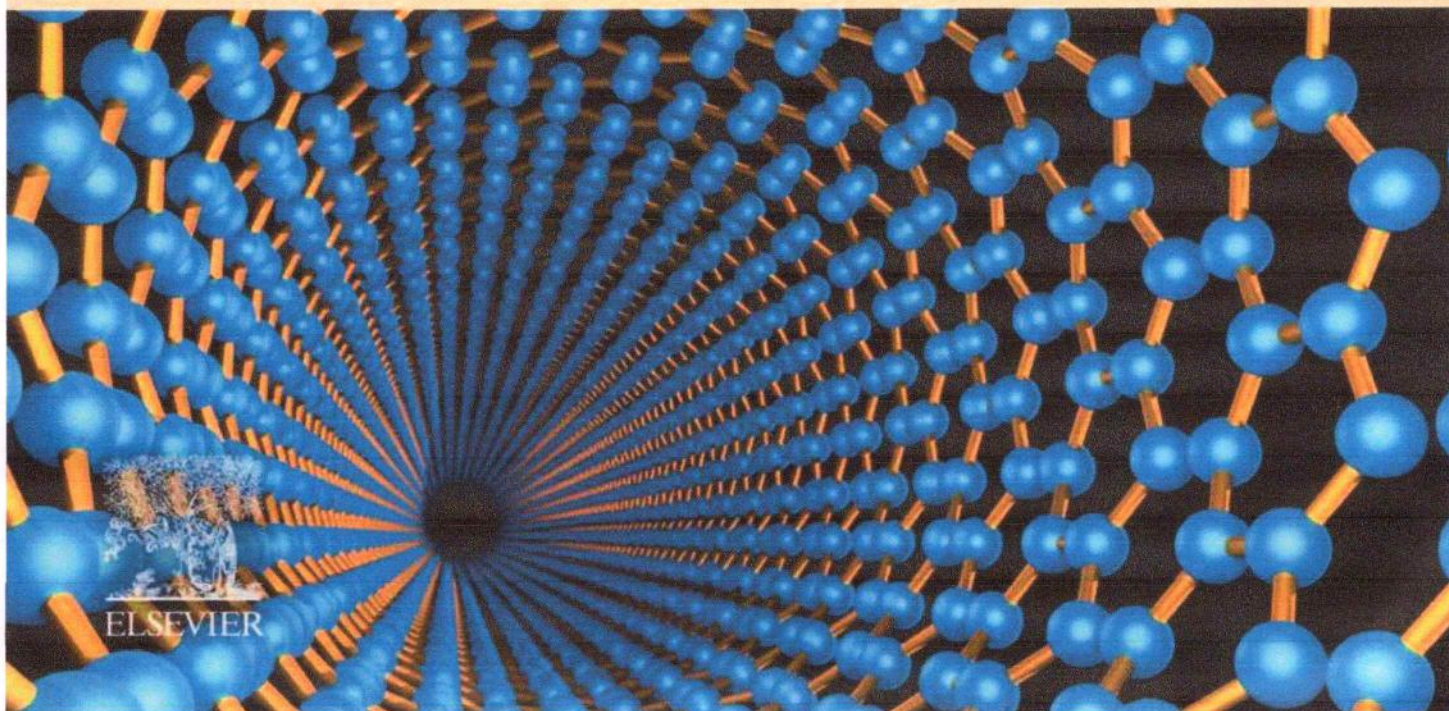


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Nanostructured, Functional, and Flexible Materials for Energy Conversion and Storage Systems

Edited by
Alagarsamy Pandikumar and Perumal Rameshkumar



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CHAPTER 9

Graphitic carbon nitride—based nanocomposite materials for photocatalytic hydrogen generation

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1. Introduction

Exploitation of efficient techniques for clean and renewable energy is a crucial strategy to defend the global energy demands. In this connection, the photocatalytic water splitting into gaseous hydrogen (H₂) and oxygen (O₂) by using solar energy has been regarded as a promising and sustainable strategy [1–3]. In the past few decades, various semiconductor materials, e.g., TiO₂ [4], ZnO [5], Fe₂O₃ [6], SnO₂ [7], ZrO₂ [8], Ag₃PO₄ [9], BiVO₄ [10], CdS [11], NiS [12], etc., have been reported for photocatalytic hydrogen evolution reaction (HER) under UV, visible, and solar light illumination. Also, other wide range of semiconductor composite photocatalysts such as noble metal/metal oxides, quantum dot—based composites, and carbanious were extensively investigated for photocatalytic H₂ generation applications [13,14]. Unfortunately, metal oxide—based semiconductors possess a wide band gap which restricted their light absorption in UV spectrum of solar energy. On the other side, metal sulfides, metal phosphides, and metal nitrides (e.g., CdS ~ 2.4 eV, SnS₂ ~ 1.7 eV, Ni₂P ~ 1.0 eV, InP ~ 1.4 eV, InN ~ 1.1 eV, etc.) have also been taken into account because they possess a narrow band gap with suitable band potential for photocatalytic HER; however, the photocorrosion and self-oxidation make them generally deleterious and volatile which limit their further application [3,15]. Hence, in the search of robust visible light active semiconducting photocatalyst, the g-C₃N₄, a polymeric semiconductor, has gradually opened up a new field of vision in photocatalytic HER since the pioneering study in 2009 by Wang

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Environment, Energy, Emerging
Applications, and Sustainability

Edited by
Chaudhery Mustansar Hussain
Ajay Kumar Mishra



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Emerging trends in photocatalytic transformation of biomass-derived glycerol into hydrogen fuel and value-added chemicals

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Chaudhery Mustansar Hussain⁴, M. Mamatha Kumari¹,
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11.1 Biorefinery concept in photocatalytic H₂ production and synthesis of value-added chemicals

Ever-increasing consumption of fossil fuels in transportation, domestic, and energy sectors releases greenhouse gases which results in global warming and unusual climate change, leading to irreversible damage to the environment [1,2]. In order to cater to the demand for energy and to overcome these environmental problems, new or improved energy resources that will produce alternative, renewable, and sustainable energy are being explored. Among the sustainable resources explored, biomass can be transformed into a variety of value-added products in solid, liquid, and gaseous forms, which can also supply energy in the forms of electricity, heat, and transport biofuels [3–5]. Among the lignocellulosic biomasses, cellulose is important as it is the major component of biomass and is useful in the production of a variety of chemicals, fuels, and other value-added products. The annual manufacture of lignocellulosic biomass globally is reported to be roughly 172 billion tons. Different sources of energy, biomass, and its conversion into fuels, chemicals, and other materials are illustrated in Fig. 11–1.

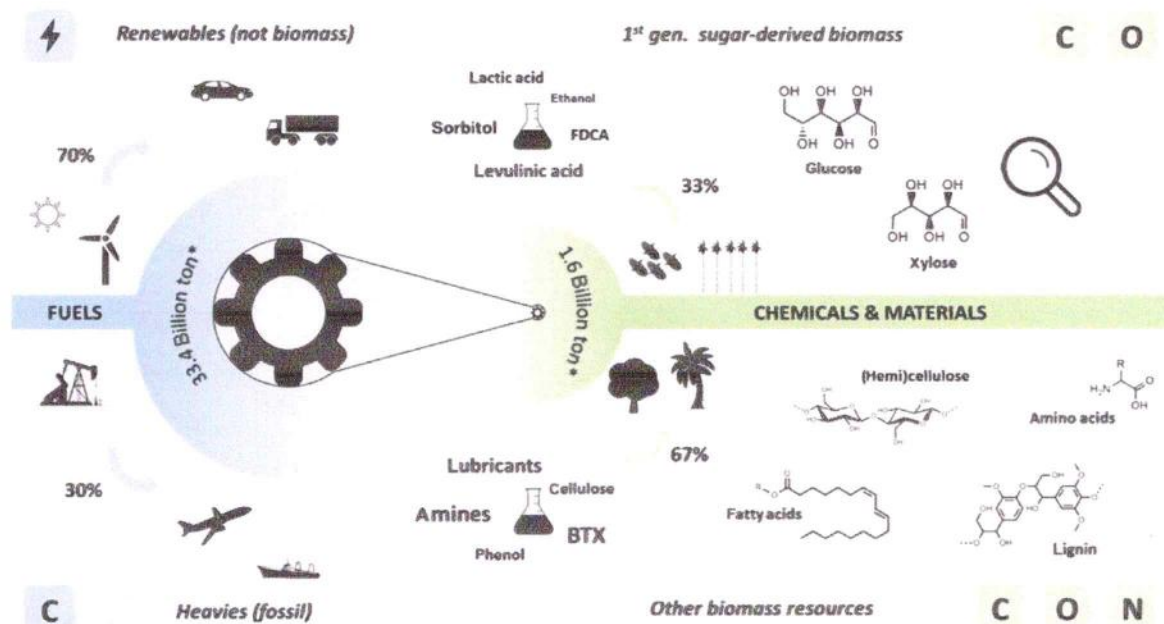


FIGURE 11-1 Renewable and fossil fuel resources and conversion of biomass into fuels, chemicals, and materials. Reproduced with permission from A. Deneyer, T. Ennaert, B.F. Sels, *Straightforward sustainability assessment of sugar-derived molecules from first-generation biomass*, *Curr. Opin. Green Sustain. Chem.* 10 (2018) 11–20. Available from: <https://doi.org/10.1016/j.cogsc.2018.02.003> [6].

Several methods exist for the conversion of biomass derivatives into value-added chemicals and biofuels, namely, steam gasification, fast pyrolysis, alkali pyrolysis, supercritical conversion, enzymatic degradation, hydrothermal conversion, and electrochemical, biological, and photocatalytic processes [7]. Photocatalytic reaction is a nonenergy-intensive process, which converts biomass-derived products (primary or secondary) into value-added chemicals through a photochemical reaction with in situ generated excitons (electron/hole) or secondary reactive species such as hydroxyl radicals and superoxide radical anions. A modern approach involves combination of chemical, biological, and photocatalytic methods utilizing the benefit and limitations of each method to achieve a sustainable process. Researchers have highlighted the potential of this sustainable process in large-scale applications for the selective transformation of biomass-derived substrates [8,9]. Recent reports have shown significant progress in heterogeneous photocatalysis used for synthesis of value-added products from biomass/biomass-based chemicals using different technologies [10]. This chapter focuses on the utilization of biomass-derived glycerol as a sacrificial agent in photocatalytic H_2 production and its parametric study. In addition, the conversion of bio-derived glycerol into value-added chemicals, its cost–benefit analysis, and its surface interaction with photocatalysts are elaborated on.

11.2 Photocatalytic H₂ production using biomass-derived glycerol

Glycerol is a colorless, odorless, and viscous sweet liquid. It is a low-cost and nontoxic compound. It is also called glycol alcohol, glycerin, or glycerine in some literature. The melting point of pure glycerin is 17.8°C and its boiling point is 290°C. The presence of three hydroxyl groups makes glycerol hygroscopic and highly soluble in water due to its ability to form intermolecular hydrogen bonds with water molecules. Glycerol is denser than water, with a specific gravity of 1.26 g mL⁻¹ and is used for various applications such as photocatalytic hydrogen production as a sacrificial reagent and surfactant, and is used in lubricants, detergents, cosmetics, polymeric materials, and Li batteries. Glycerol is commercially available and is manufactured either in a petrochemical process through catalytic cracking of crude oil or obtained in biorefineries as a side product.

Catalytic water splitting activated under sunlight is a clean, renewable, and sustainable process. The main advantage is that it works under ambient temperature and pressure, and it also requires water, sunlight, and an active semiconductor photocatalyst. However, overall water splitting efficiency is well below the requirement for commercial applications due to rapid recombination of photo-excited electrons, poor surface–interface reactions, and limited optical absorbance in the visible spectrum. On the other hand, photocatalysts that showed improved hydrogen production performance are unstable due to photo-corrosion. A literature survey has revealed that the efficiency of photocatalysts for H₂ production is generally lower compared to the degradation of pollutants; this is because both holes and electrons are mandatory for H₂ production, but degradation of pollutants can work either with electrons or holes alone. The oxidation of H₂O into H⁺ and O₂ by photo-holes is much more challenging than its reduction reaction with photoelectrons to produce H₂ gas. Hence, researchers used a wide range of compounds such as alcohols, amines, cellulose, and dyes as sacrificial agents that undergo oxidation by releasing electrons to photo-holes and generate a great deal of H⁺ [11–14].

A reactor set-up used for visible light active photocatalytic H₂ production is shown in Fig. 11–2. In the typical procedure, the photocatalyst is dispersed into the aqueous glycerol solution taken in the reactor, sealed with an air-tight rubber septum, and subjected to evacuation to remove oxygen and other gases present in the reactor. In the presence of dissolved oxygen, the generated H₂ favors a reverse reaction to form water, and to suppress such a reaction, the reactor is purged with nitrogen to ensure an oxygen-free environment. Under light irradiation, photo-holes and electrons at valence and conduction bands, respectively, are involved in oxidation and reduction reactions of the substrates. At the valence band, hole oxidizes glycerol into H⁺ and CO₂ and, simultaneously, water oxidation gives way to H⁺ and O₂. At the conduction band, H⁺ undergoes a reaction with electrons that continuously produce H₂ gas.

Several publications have emphasized the benefits of photocatalytic H₂ production using glycerol as a sacrificial agent. Table 11–1 lists various photocatalysts reported for H₂

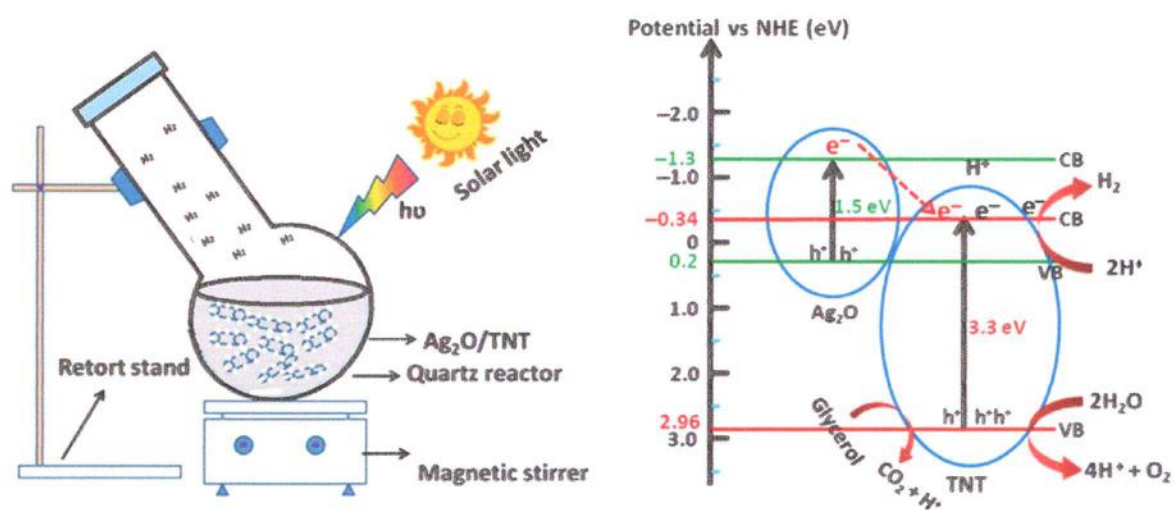


FIGURE 11-2 Schematic illustration of photocatalytic hydrogen production using $\text{Ag}_2\text{O}/\text{TNT}$ nanocomposites in the presence of glycerol and a water mixture under solar light irradiation. Reproduced with permission from D.P. Kumar, N.L. Reddy, M. Karthik, B. Neppolian, J. Madhavan, M.V. Shankar, Solar light sensitized $p\text{-Ag}_2\text{O}/n\text{-TiO}_2$ nanotubes heterojunction photocatalysts for enhanced hydrogen production in aqueous-glycerol solution, *Sol. Energy Mater. Sol. Cell* 154 (2016) 78–87. Available from: <https://doi.org/10.1016/j.solmat.2016.04.033> [15].

Table 11-1 Photocatalytic hydrogen production using glycerol as a sacrificial agent under solar light irradiation.

Sr. no	Photocatalyst	Light source	Photocatalytic H_2 production ($\mu\text{mol h}^{-1} \text{g}^{-1} \text{cat}$)	References
1.	Au/TiO_2	Solar	27,900	[16]
2.	NiO/TiO_2	Solar	1200	[14]
3.	$\text{Cu}/\text{Ag}/\text{TiO}_2$	Solar	47,200	[17]
4.	$\text{Cu}/\text{Ag}/\text{TiO}_2$	Solar	15,200	[17]
5.	Pt/TiO_2	Solar	173,695	[18]
6.	CuO/TiO_2	Solar	99,823	[19]
7.	$\text{SrTiO}_3/\text{TiO}_2$	Solar	3750	[20]
8.	$\text{Cu}_2\text{O}/\text{TiO}_2$	Solar	20,060	[21]
9.	CoO/TiO_2	Solar	11,021	[22]
10.	$\text{Cu}_2\text{O}-\text{TiO}_2$	Solar	50,339	[23]
11.	TiO_2 nanocrystals	Solar	46,523	[24]
12.	$\text{Cu}_x\text{O}/\text{TiO}_2$	Solar	114,900	[25]
13.	$\text{CuO}-\text{Cr}_2\text{O}_3$	Solar	823,900	[26]
14.	CuO/NiO	Solar	26,184	[27]

production under solar light irradiation using glycerol as a hole scavenger, and it can be seen that three catalysts exhibited a high rate of H_2 production ($> 90,000 \mu\text{mol h}^{-1} \text{g}^{-1} \text{cat}$). Highly efficient photocatalytic H_2 production of $173,695 \mu\text{mol h}^{-1} \text{g}^{-1} \text{cat}$ was reported using a Pt/TiO_2 catalyst. It was claimed that the effective Schottky barrier formed between the Pt

cocatalyst and the photocatalyst surface entrapped the photoelectrons and provided active sites for adsorption of H^+ for reduction reaction, thereby enhancing the catalytic activity [28–32]. Kumar et al. showed the use of glycerol as a sacrificial agent and claimed that an effective interaction between CuO and TiO_2 nanotubes triggered enhanced H_2 production of $99,823 \mu\text{mol h}^{-1} \text{g}^{-1}_{\text{cat}}$ [19]. Another report demonstrated that both Cu_2O and CuO present on TiO_2 nanotubes served the roles of photo-sensitizer and cocatalyst and were responsible for enhanced H_2 production ($114,900 \mu\text{mol h}^{-1} \text{g}^{-1}_{\text{cat}}$) under solar light irradiation [21]. The report also proved that oxidation of glycerol forms some intermediates, which subsequently undergo irreversible oxidation to CO_2 .

Lakshmana Reddy et al. demonstrated that an aqueous solution of crude glycerol obtained from a biodiesel production unit can be used as an effective hole scavenger which leads to enhanced H_2 production (Fig. 11–3) [33]. They also illustrated that incorporation of $Ni(OH)_2$ quantum dots on TiO_2 nanotubes creates an efficient photocatalyst for H_2 production and showed about a 12-fold improvement in efficiency compared with pristine TiO_2 .

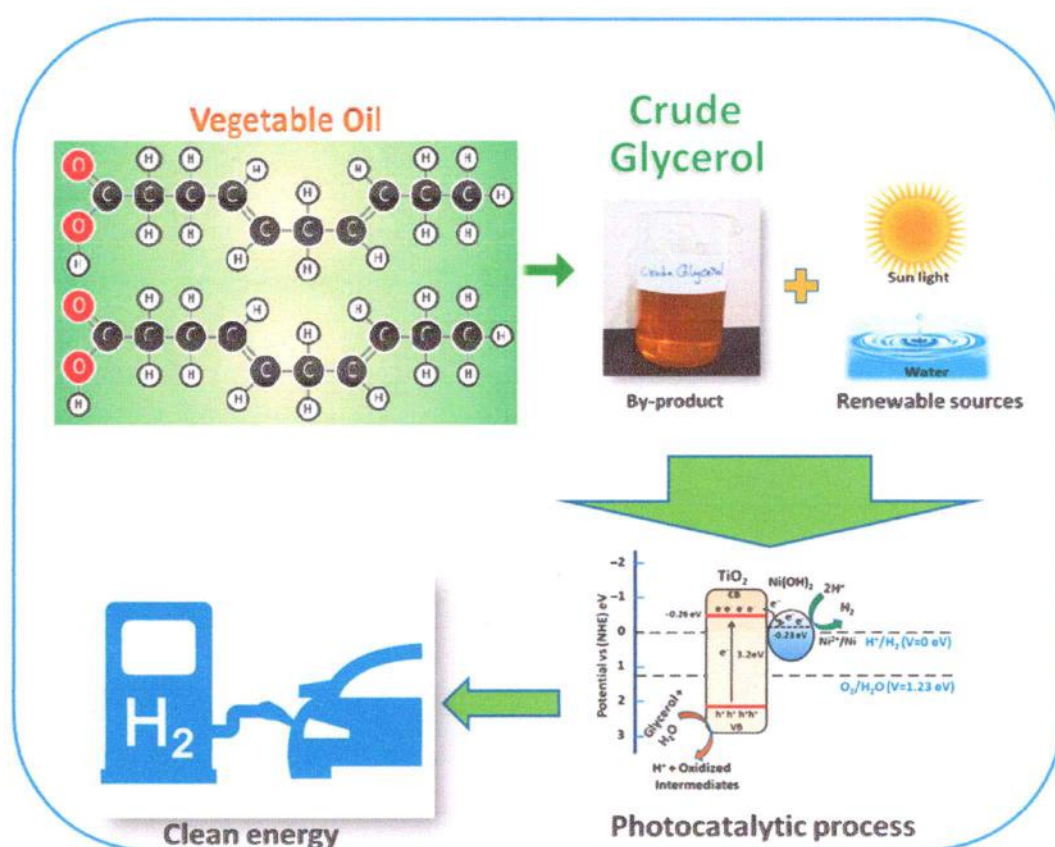


FIGURE 11–3 H_2 production from crude glycerol obtained from a biodiesel production unit. Reproduced with permission from N. Lakshmana Reddy, K.K. Cheralathan, V. Durga Kumari, B. Neppolian, S. Muthukonda Venkatakrishnan, Photocatalytic reforming of biomass derived crude glycerol in water: a sustainable approach for improved hydrogen generation using $Ni(OH)_2$ decorated TiO_2 nanotubes under solar light irradiation, ACS Sustain. Chem. Eng. 6 (2018) 3754–3764. Available from: <https://doi.org/10.1021/acssuschemeng.7b04118>.

11.2.1 Nature of glycerol and its role on photocatalytic H₂ production

The alcohol fractions and percentage of impurities in glycerol may vary based on the preparation method. Glycerol has been proven as one of the most efficient sacrificial agents in aqueous medium for hydrogen production through a photocatalytic process. Irradiation of semiconductor photocatalyst with a suitable light leads to in situ generation of holes and electrons at valence and conduction bands, respectively. Glycerol undergoes an irreversible oxidation reaction by donating electrons to holes, ensuring a continuous supply of electrons to the valence band and also forms oxidized intermediates and H⁺. This glycerol oxidation mechanism ensures the availability of H⁺ to produce H₂ gas with electrons available from a suitable energy level at the conduction band of the photocatalyst. Hence, the use of a small amount of glycerol or crude glycerol (a byproduct from biodiesel production units) is useful to trigger a higher rate of H₂ production as reported by Lakshmana Reddy et al. [17]. The same group elaborated the dual role of bimetallic photocatalyst, Cu–Ag/TiO₂ nanocomposite with different sacrificial agents that showed photocatalytic efficiency in the order: pure glycerol > ethylene glycol > crude glycerol > ethanol > methanol, as shown in Fig. 11–4. M/TiO₂ (M = Pd, Pt, and Au) nanocomposites with various sacrificial reagents, namely methanol, ethanol, 1,2-ethane diol, 2-propanol, 2,3-propane diol, glycerol, and tetra butanol, were tested by Zakiya et al. for hydrogen production [34]. Among the sacrificial agents studied, glycerol was superior in terms of photocatalytic efficiency [34]. Chong et al. [35] examined Cu–Ni/TiO₂ nanocomposite for hydrogen evolution and found that it was greatly influenced by glycerol as a sacrificial agent. However, based on the cost–benefit analysis, crude glycerol is still suitable for scale-up operation as it is available as a byproduct in large quantities from

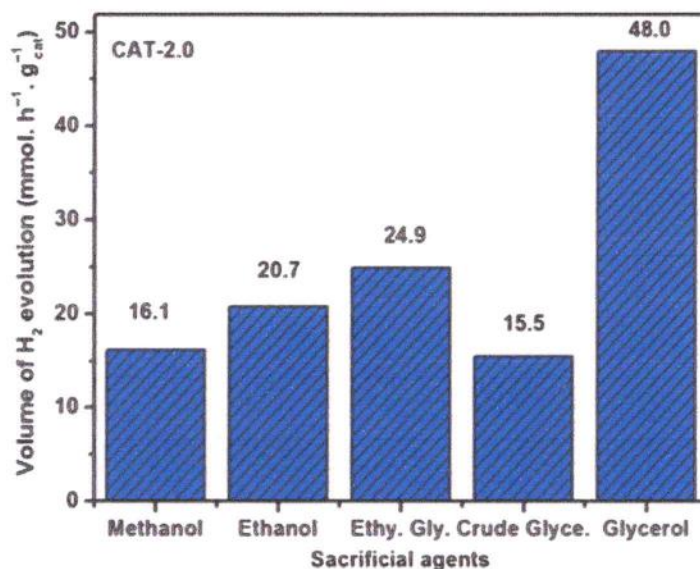


FIGURE 11–4 Performance of Cu–Ag/TiO₂ nanocomposite for hydrogen production in the presence of different sacrificial agents. Reproduced with permission from N. Lakshmana Reddy, S. Kumar, V. Krishnan, M. Sathish, M.V. Shankar, Multifunctional Cu/Ag quantum dots on TiO₂ nanotubes as highly efficient photocatalysts for enhanced solar hydrogen evolution, *J. Catal.* 350 (2017) 226–239. Available from: <https://doi.org/10.1016/j.jcat.2017.02.032>.

biomass processing industries [32]. The overall rate of H_2 production depends on the surface property of the catalyst and the nature of its interface with the organic sacrificial agent. The interaction of the sacrificial agent with the catalyst may vary based on the number of hydroxyl groups and the extent of carbon in its structure. The important criteria for choosing sacrificial agents are its ability to be oxidized quickly and its capacity to be adsorbed on the catalyst surface.

11.2.2 Effect of solution pH

Solution pH greatly influenced the efficiency of the photocatalytic process and H_2 generation [36–40]. The concentration of H^+ and OH^- ions in aqueous solution have a strong influence on the semiconductor band potential, surface–interface properties of the catalyst, and ionic charges of sacrificial agents, and all these factors are equally important to achieve enhanced photocatalytic efficiency. A literature survey revealed that some catalysts demonstrated higher efficiency in acidic medium (pH = 1–7) and others in basic medium (pH = 8–14). Recently, Zhou et al. [39] examined Pt/TiO₂ nanocomposites at different pH intervals between 2 and 14. The authors achieved the highest rate of H_2 production at pH 11.2 due to the enhanced surface interaction between Pt and TiO₂. Zhen et al. explained that in a metal colloid complex catalyst, reaction at pH 7 showed greater quantum yield in acidic pH because of the isoelectric point of the photocatalyst (Fig. 11–5) [41]. Alternatively, a recent report that explained the effect of solution pH (5–9) on MoS₂/graphene at MOF support indicated enhanced H_2 production in alkaline conditions [36]. Bhattacharya et al. reported the effect of pH on carbon quantum dot-based photocatalysts and tested activity at a pH range of 0–14, showing that pH

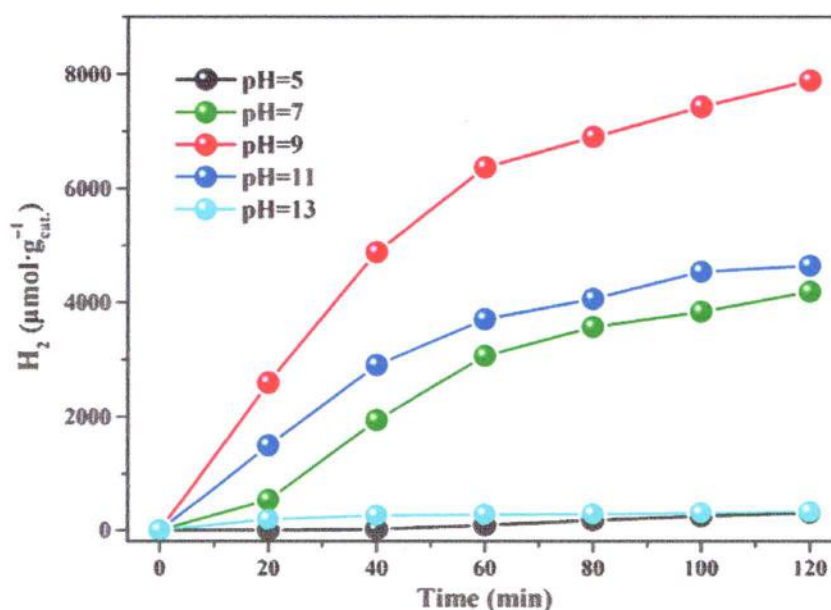


FIGURE 11–5 Hydrogen production at different pH. Reproduced with permission from W. Zhen, W. Jiao, Y. Wu, H. Jing, G. Lu, *The role of a metallic copper interlayer during visible photocatalytic hydrogen generation over a Cu/Cu₂O/CuTiO₂ catalyst*, *Catal. Sci. Technol.* 7 (2017) 5028–5037. Available from: <https://doi.org/10.1039/c7cy01432e>.

8.5 enhanced the rate of H₂ production [37]. Based on the literature reports, it is clear that the optimum solution pH for better hydrogen production may vary with respect to the nature of the catalyst and other reaction parameters. Hence, controlling the solution pH is the key parameter, especially in the case of a particulate system where all three dimensions are available for adsorption. The enhancement of H₂ production efficiency depends on the point of zero charge, below which a catalyst surface acquires positive charge and above which it shows negative charge. It is clarified that positive charge on the catalyst surface triggers oxidation of the sacrificial agent to H⁺, which is the most important reaction for H₂ production.

11.2.3 Effect of glycerol concentration

There are some experimental reports on the optimization of glycerol concentration for improved hydrogen production. The concentration of glycerol is known to affect the solution pH followed by band bending and surface active sites of the catalyst, which as a result controls the adsorption characteristics. It is worth noting that optimal adsorption of the glycerol is important, as both weak and strong adsorption on catalysts have shown a negative influence on photocatalytic activity. Ravi et al. [27] investigated the influence of glycerol concentration on hydrogen production activity of CuO–NiO@TiO₂ photocatalyst. The addition of a small amount of 5 vol.% of glycerol to water tremendously increased the volume of H₂ produced and the authors gave as a reason that the presence of glycerol in water suppresses the photogenerated electron–hole recombination and facilitates H⁺ production. Concentration of glycerol beyond the optimum level lowers the rate of H₂ production due to competitive adsorption of glycerol and its intermediates on the catalyst surface, which limits its electron-donating character.

A recent study used Ni/CdS quantum dots with glycerol in water as a reaction mixture from 0.02 to 7.5 M concentrations where 0.45 M showed greater photocatalytic H₂ production [42]. Recently, Fujita et al. [14] examined five parameters for boosting photocatalytic activity on NiO/TiO₂ nanocomposite, where they had studied glycerol concentration from 1 to 4 mol dm⁻³. Here, 2.5 mol dm⁻³ showed higher efficiency due to Langmuir-type adsorption and the optimum amount of glycerol adsorbed on the photocatalyst. Lalitha et al. studied the effect of glycerol concentration (2–20 vol.%) on photocatalytic H₂ evolution of 0.5 wt.% CT-2 photocatalyst under solar light irradiation. In this case, 5 vol.% of glycerol was found to be the optimum concentration. The optimum vol.% of glycerol was found to be proportional to the surface area of the photocatalyst, which facilitates adsorption of glycerol and effective production of H₂ gas [21]. Slamet et al. [43,44] studied the effect of glycerol concentrations ranging from 10 to 70 vol.% in water on Pt@N-TiO₂ nanotubes. The study indicated 50 vol.% glycerol as the optimum concentration for an enhanced rate of H₂ production. Sadanandam et al. tested cobalt-doped TiO₂ nanocomposite for H₂ production and 5 vol.% (2–20 vol.% solutions were tested) glycerol showed better performance (Fig. 11–6) due to better catalyst dispersion in the reaction mixture, whereas lower activity observed both below and above the optimized concentration was ascribed to the shielding effect of surface active sites. These results convey that optimization of glycerol concentration is essential for efficient

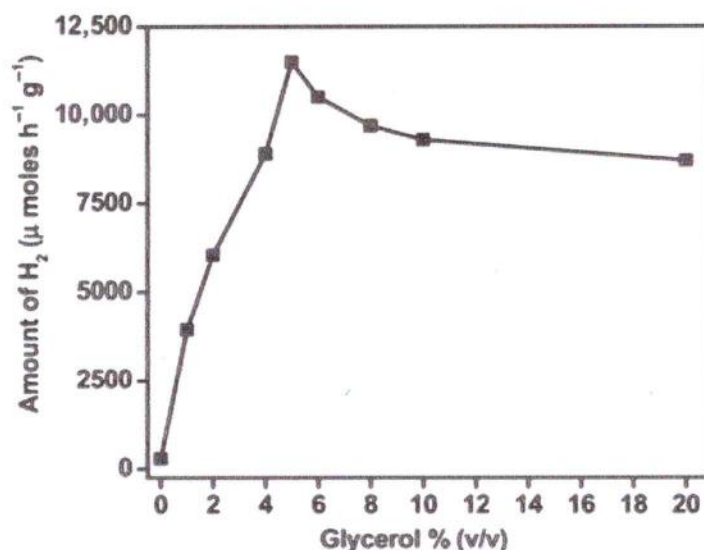


FIGURE 11-6 Effect of glycerol concentration on photocatalytic H₂ production. Reproduced with permission from G. Sadanandam, K. Lalitha, V.D. Kumari, M.V. Shankar, M. Subrahmanyam, Cobalt doped TiO₂: a stable and efficient photocatalyst for continuous hydrogen production from glycerol: water mixtures under solar light irradiation, *Int. J. Hydrog. Energy* 38 (2013) 9655–9664. Available from: <https://doi.org/10.1016/j.ijhydene.2013.05.116>.

H₂ production. The glycerol concentration can also influence the reaction pathway. It is evident from the above results that the optimum concentration of glycerol may vary from one type of catalyst to another, and it also depends on the surface area, surface–interface property, and the amount of catalyst.

11.2.4 Intermediate formation during photocatalytic H₂ production

In addition to photocatalytic hydrogen production, when glycerol is used as a sacrificial reagent different reactive intermediates may be formed and finally glycerol is converted to carbonate (Fig. 11-7). Lakshmana Reddy et al. [46], in their study on photocatalytic hydrogen production using metal oxide nanocomposite with 5 vol.% glycerol aqueous solution, described the mechanism involved in glycerol oxidation (Fig. 11-8).

11.3 Opportunities in conversion of biomass-derived glycerol into value-added chemicals

Glycerol is one of the major byproducts generated during biodiesel production (Fig. 11-9). Lakshmana Reddy et al. [33] reviewed the literature on bioconversion technologies of crude glycerol to value-added chemicals. They indicated the possibility of combining the energetic utilization of biomass to produce H₂ with the simultaneous treatment of waste. Biomass derivatives can be used for the sustainable production of value-added chemicals and a series of processes has been developed for this purpose, such as catalytic conversion, steam

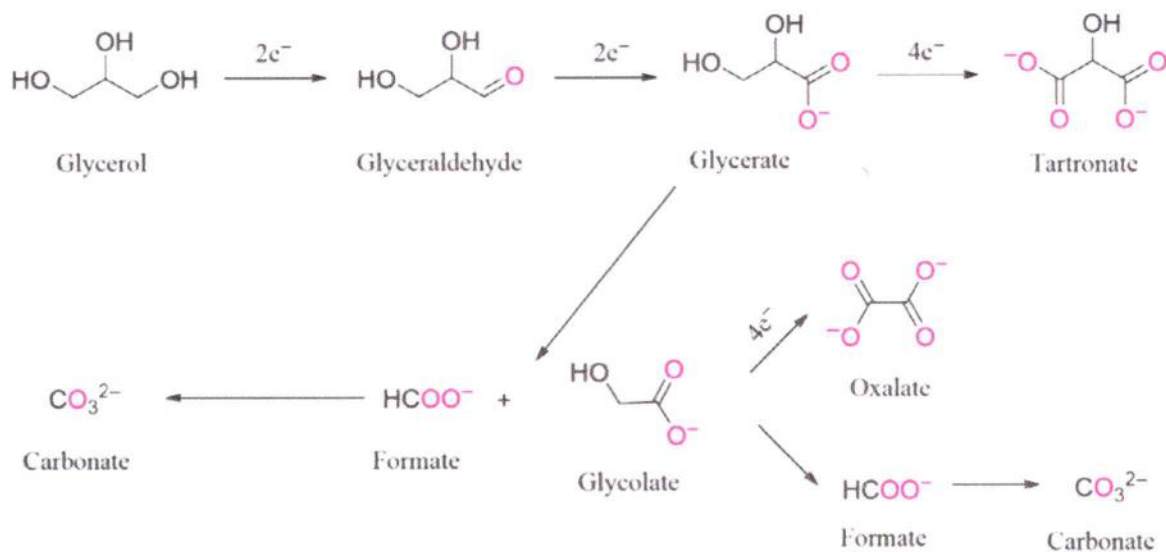


FIGURE 11-7 Plausible reaction mechanism and reaction intermediates for glycerol oxidation in alkaline medium. Reproduced with permission from Y. Kang, W. Wang, Y. Pu, J. Li, D. Chai, Z. Lei, An effective Pd–NiOx–P composite catalyst for glycerol electrooxidation: co-existed phosphorus and nickel oxide to enhance performance of Pd. *Chem. Eng. J.* 308 (2017) 419–427. Available from: <https://doi.org/10.1016/j.cej.2016.09.087> [45].

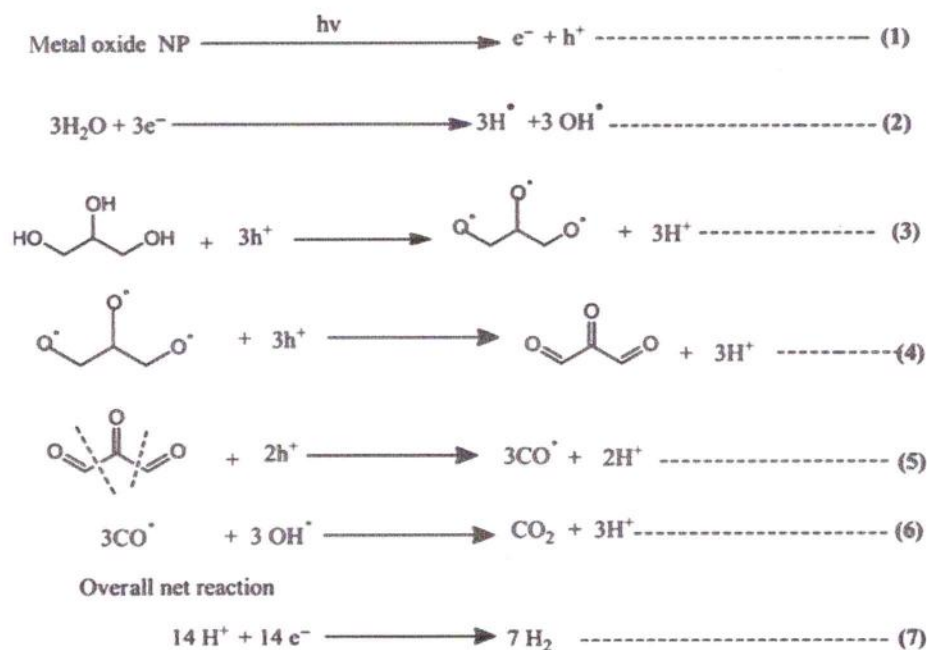


FIGURE 11-8 Proposed reaction mechanism for photocatalytic hydrogen production and reaction intermediates of glycerol in glycerol and water aqueous mixture. Reproduced with permission from N. Lakshmana Reddy, V. Navakoteswara Rao, M. Mamatha Kumari, R.R. Kakarla, P. Ravi, M. Sathish, et al., Nanostructured semiconducting materials for efficient hydrogen generation, *Environ. Chem. Lett.* 3 (2018) 765–796. Available from: <https://doi.org/10.1007/s10311-018-0722-y>.

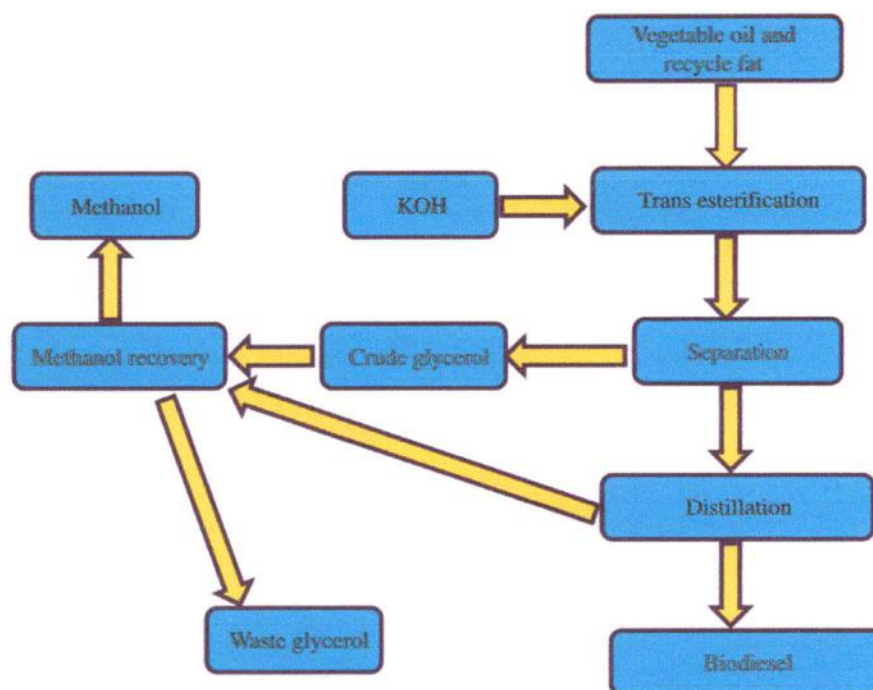


FIGURE 11–9 Schematic representation of biomass (vegetable oils and animals fatty oil) to glycerol production. Reproduced with permission from V.K. Garlapati, U. Shankar, A. Budhiraja, *Bioconversion technologies of crude glycerol to value added industrial products*, *Biotechnol. Rep.* 9 (2016) 9–14. Available from: <https://doi.org/10.1016/j.btre.2015.11.002> [47].

gasification, fast pyrolysis, and supercritical conversion. In contrast to these energy-intensive processes, photocatalytic conversion of biomass can be driven by sunlight at ambient temperatures/pressures. Photocatalysis can also be used for the conversion of food industry waste into value-added chemicals. The combination of solar light active photocatalysis and biomass utilization represents a greener pathway to achieving sustainability in chemical production [8,48].

There are definite opportunities for the conversion of glycerol into value-added chemicals via selective oxidation, selective dehydration, pyrolysis and gasification, steam reforming, selective etherification, thermal reduction into syngas, selective transesterification, selective hydrogenolysis, oligomerization, and polymerization [49–51]. The different reaction pathways for conversion of glycerol into value-added chemicals can be seen in Fig. 11–10. Recently, Xiao and Varma [52] reported the conversion of biowastage glycerol to aromatic hydrocarbons in the presence of Pd/ZSM-5 and Pt/ZSM-5 bifunctional catalysts, where they achieved around 60% hydrocarbon yield at ~90% glycerol conversion. Corma et al. investigated acrolin production from a gas-phase glycerol and water mixture using zeolite catalysts [53,54]. Bühler et al. [55] examined degradation of glycerol in near- and supercritical water to allyl alcohol, acrolin, acetaldehyde, propionaldehyde, and methanol. Chong et al. reported selective oxidation of glycerol to hydroxyacetaldehyde (90%) and H₂ on rutile TiO₂ (110) photocatalyst [35]. Len and Luque

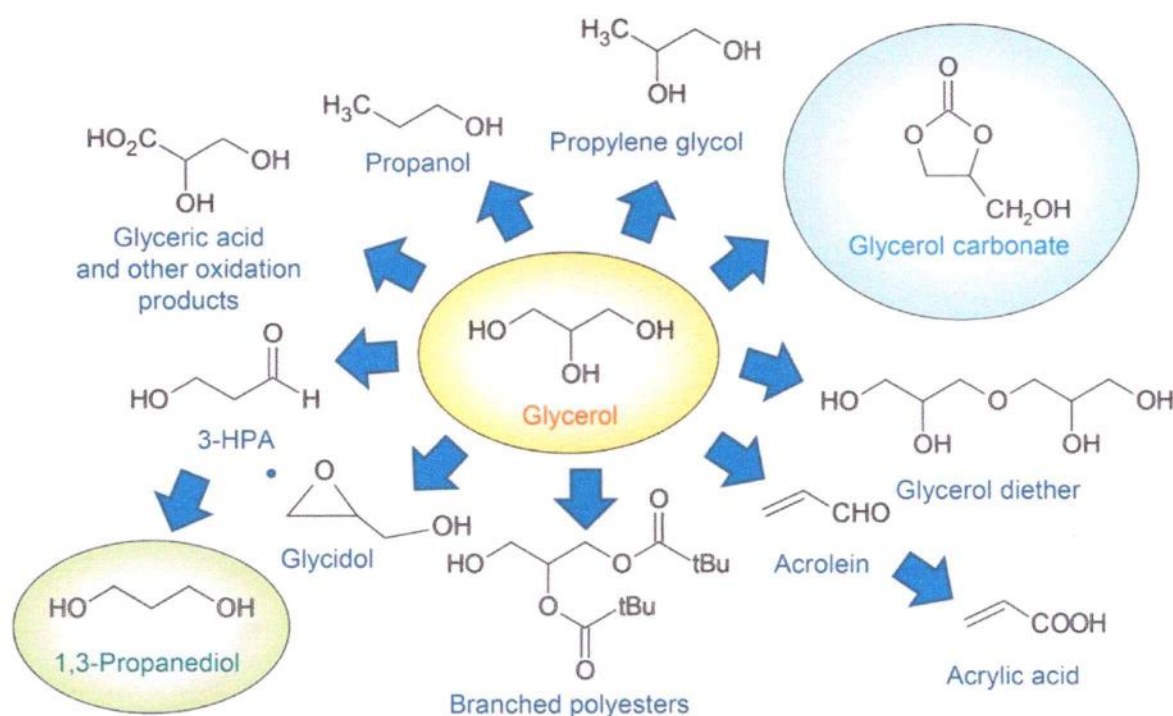


FIGURE 11-10 Glycerol conversion to value-added chemicals reaction pathways.

reviewed the conversion of glycerol to commercial products by various types of reactions such as oxidation, reduction, pyrolysis, and deoxygenation [56]. Konaka et al. [57] probed on $ZrO_2-FeO_x(K/ZrO_2-FeO_x)$ composite for conversion of glycerol into allyl alcohol. Pagliaro et al. reviewed the production of value-added chemicals from glycerol [58]. Roy et al. [59] investigated a low-temperature selective hydrothermal route for production of lactic acid from glycerol over Cu/Cu_2O at low concentrations of $NaOH$ which showed excellent recyclability and selectivity. Yun et al. studied catalytic production of 1,2-propane diol from glycerol over $Ni-Cu$ nanocomposite prepared by the sol-gel method. They examined various $Cu:Ni$ molar ratios of the catalyst (9:1, 7:3, and 5:5), with the 9:1 ratio showing the higher activity [60].

11.3.1 Cost-benefit analysis

The glycerol market has been forecast to reach USD 2.52 billion by 2020 globally, as seen in Fig. 11-11, and the biodiesel industry has emerged as the most important source of glycerol. While comparing the cost of crude glycerol originated from biodiesel industry, it is cheaper (Rs. 25/L \approx \$0.375/L) than that of pure glycerol (purchased from Merck India), (Rs.1170/L \approx \$18/L). The cost of pure glycerol is about 47 times higher than crude glycerol. Pure glycerol leads to higher H_2 production and solar conversion efficiency, but its higher cost makes it less favorable than crude glycerol for photocatalytic reforming. According to some reports, crude glycerol may contain impurities, such as carbon content at an average of about 25%,

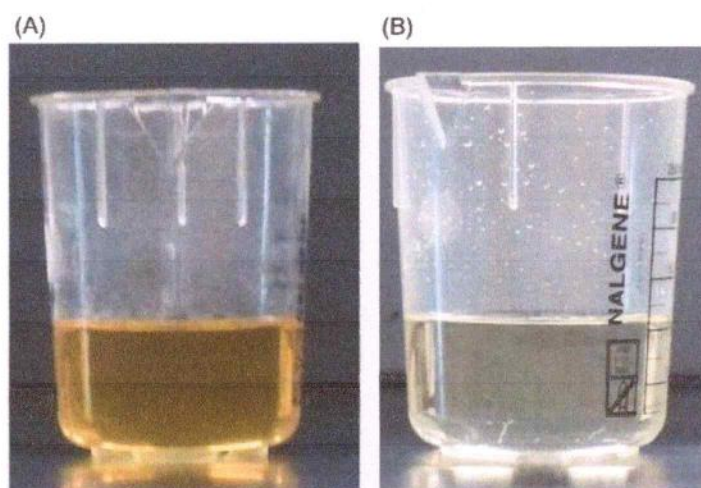


FIGURE 11–11 Photographic images showing the color of (A) crude glycerol (pale yellow) and (B) purified glycerol (colorless).

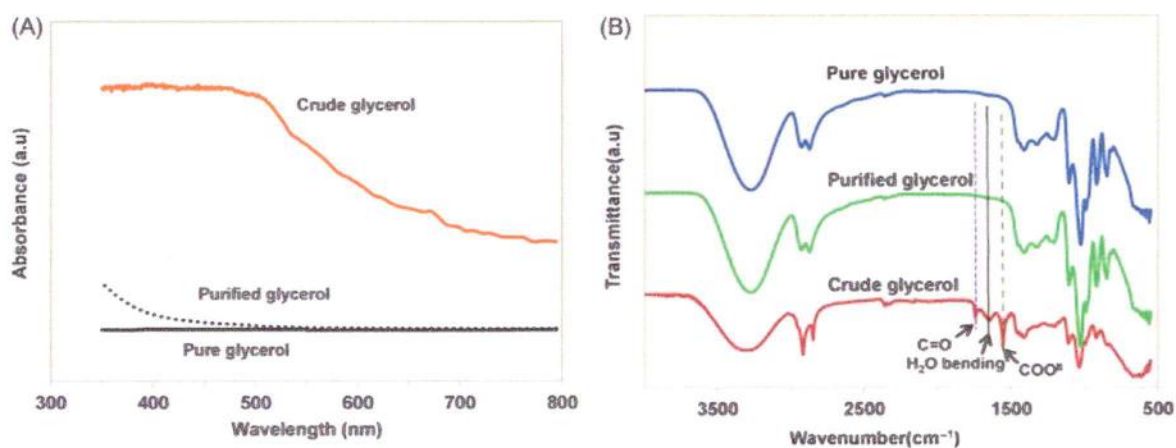


FIGURE 11–12 Optical and structural comparison of pure, purified and crude glycerol samples; (A) UV-visible spectra and (B) FTIR spectra.

which includes methanol, fatty acid, methyl esters, monoglycerides, diglycerides, glycerol oligomers, polymers, and unreacted triacyl glycerol. In addition, water and a small quantity of compounds containing elements like Na, Ca, K, Mg, P, and S can also be present, along with salts left over from the transesterification reaction which are soluble in the glycerol layer. Nanda et al. [61] reported the purification of crude glycerol by acidification using sulfuric acid, phosphoric acid, and hydrochloric acid, and compared the color of crude glycerol with pure glycerol (Fig. 11–12). Further, a study using UV–visible spectroscopy revealed the light absorbance of crude, purified, and pure glycerols, as shown in the Fig. 11–13A. The FT-IR spectra of the glycerols are shown in Fig. 11–13B. In crude glycerol, some extra peaks at 1580, 1740, and 3050 cm^{-1} are noticed. The absorbance peak at 1580 cm^{-1} indicates the

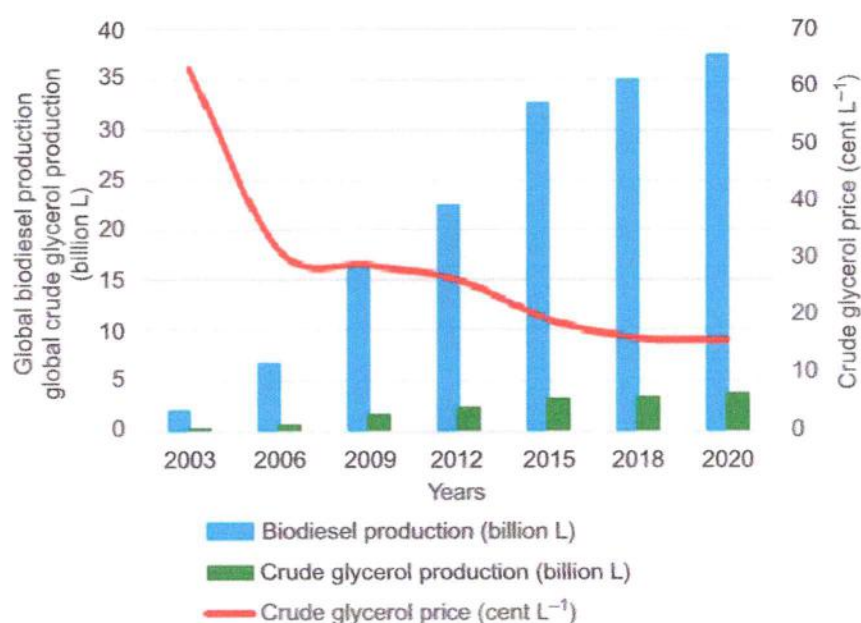


FIGURE 11-13 Global scenario of crude glycerol and biodiesel production (values from 2003 to 2020 in terms of billion/liters and cent/liters). Reproduced with permission from S. Nomanbhay, R. Hussein, M.Y. Ong, *Sustainability of biodiesel production in Malaysia by production of bio-oil from crude glycerol using microwave pyrolysis: a review*, *Green. Chem. Lett. Rev.* 11 (2018) 135–157. Available from: <https://doi.org/10.1080/17518253.2018.1444795> [62].

presence of impurities containing carboxylate ions (COO^-) from soap in the crude glycerol, and the peak at 1740 cm^{-1} indicates the existence of keto and aldehyde groups ($\text{C}=\text{O}$) of esters and carboxylic acids.

11.3.2 Types of surface interactions of glycerol with the photocatalyst surface

On the basis of surface charges, the nature of the surface interactions between catalyst and glycerol is classified into three types (1) negative, (2) positive, and (3) nonionic. Fig. 11-14 shows three pathways of interactions between glycerol with Cu, Cu–Cu, Ni, and Ni–Ni catalytic surfaces. Here the hydrogenolysis of glycerol is followed by the dehydration–hydrogenation route, the ideal conditions for this route include the presence of catalytic acid sites, hydrogen pressure, and a small amount of water in the feed. At first the oxygen on terminal $-\text{OH}$ groups of glycerol is adsorbed on Cu metal, then the dehydration into acetol occurs at the acid sites of the alumina support (Fig. 11-14). In the absence of Ni, a small quantity of 1,2-PDO is generated due to the absence of hydrogen. Further, upon addition of Ni, there are two possible ways to produce hydrogen by Aqueous Phase Reforming (APR) of glycerol on the Ni metal via route (1) and route (2). Finally, oxidation of glycerol in the presence of Cu results in 1,2-propane diol. Sun et al. [63] elaborated that the nature of acid sites governs the type of reaction. Brønsted acid sites favor the formation of acrolin, whereas Lewis sites lead to dehydration product of ketol, as displayed in Fig. 11-15.

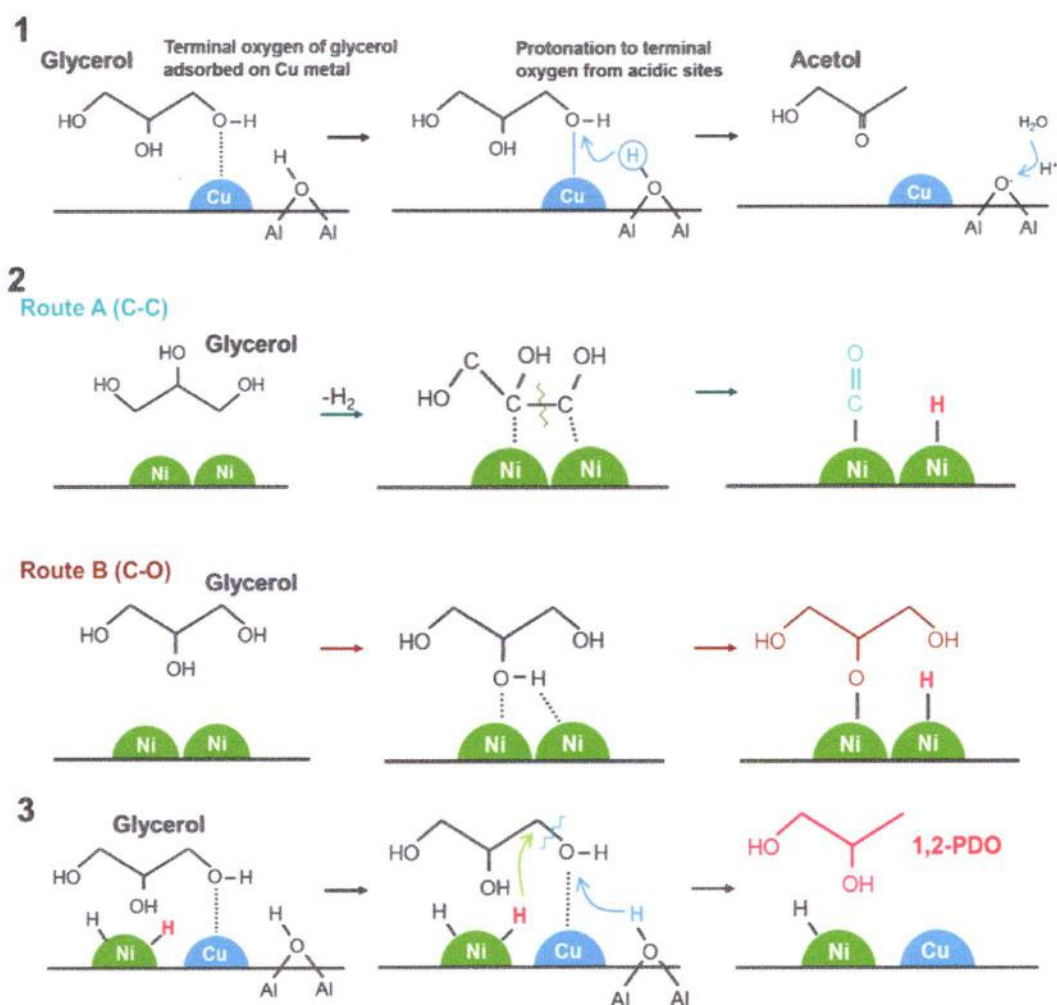


FIGURE 11-14 Reaction surface interaction pathways for 1,2,3-propane triol to 1,2-propane diol in the presence of Ni and Cu photocatalyst. Reproduced with permission from Y.S. Yun, D.S. Park, J. Yi, Effect of nickel on catalytic behaviour of bimetallic Cu–Ni catalyst supported on mesoporous alumina for the hydrogenolysis of glycerol to 1,2-propanediol. *Catal. Sci. Technol.* 4 (2014) 3191–3202. Available from: <https://doi.org/10.1039/c4cy00320a>.

11.4 Conclusion and future prospects

In the last decade, energy and environmental issues have necessitated the production of fuels and value-added chemicals from natural resources. In this direction, utilization of biomass from different origins has been investigated for the production of value-added chemicals and hydrogen fuel. Glycerol is the major byproduct from biodiesel production processes which could be a potential candidate for the production of H₂ and chemicals. Understanding the reaction parameters and mechanisms involved in the catalytic conversion of glycerol into value-added chemicals and glycerol-assisted photocatalytic water splitting are important aspects that this chapter has addressed. The developments in glycerol conversion technologies

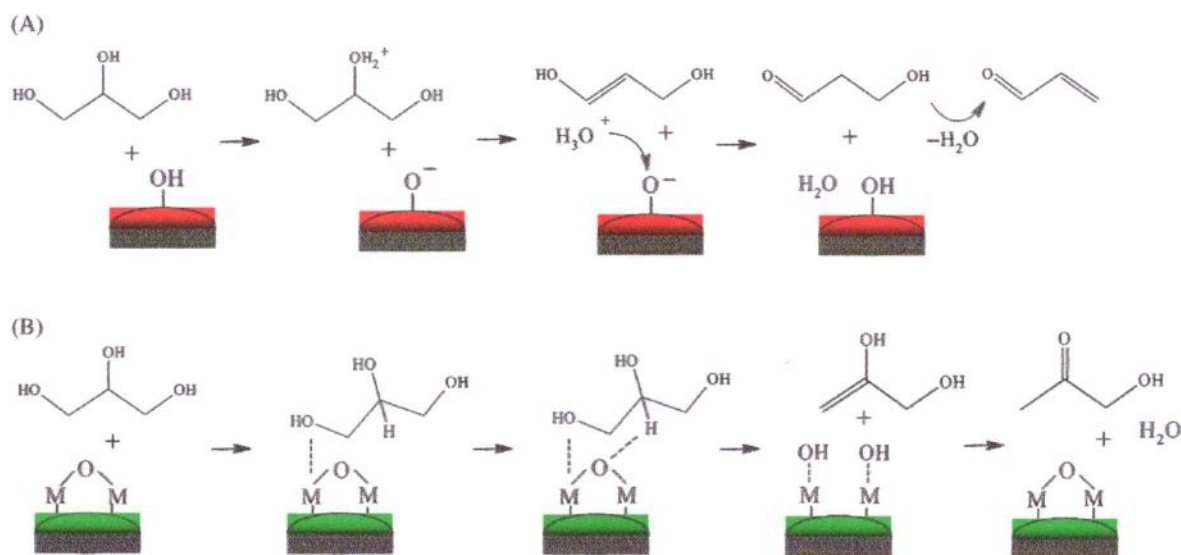


FIGURE 11-15 The reaction mechanism of glycerol dehydration over Brønsted acid sites (A) and Lewis acid sites (B). Reproduced with permission from D. Sun, Y. Yamada, S. Sato, W. Ueda, *Glycerol as a potential renewable raw material for acrylic acid production*. *Green Chem.* 19 (2017) 3186–3213. Available from: <https://doi.org/10.1039/c7gc00358g>.

have led to a variety of glycerol derivatives such as propylene, allyl alcohol, lactic acid, acrolin, acrylonitrile, 3-hydroxypropionic acid, and alcohol that provide possibilities for producing various industrially important chemicals. However, currently, the growth of a competitive bio-based process is not easy because of the lower cost of conventional fossil resources and production technologies. However, we still have opportunities if we use bio-based waste as the raw materials and develop processes using efficient and affordable photocatalysts. In addition, fossil resources are limited, and it is a matter of time before we see the replacement of fossil resources by renewable resources in the near future.

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Handbook of Smart Photocatalytic Materials

Environment, Energy, Emerging Applications, and Sustainability

Edited by
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Ferroelectric semiconductors for photocatalytic energy and environmental applications

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1.1 Introduction

Photocatalysis is a process that delivers multiple applications toward energy production and environmental remediation [1,2]. It is the photocatalyst that through its band edge potential and charge carrier dynamics largely decides its application. For instance, Fig. 1–1 shows the band edge position that dictates the prerequisite for a photocatalyst to perform the hydrogen and oxygen evolution reaction [3]. Other than the appropriate positioning of band edge potentials, the other parameters such as effective separation of charge carriers, increased recombination resistance, carrier transportation at the interface, surface reactions, surface adsorption of molecules of the photocatalysts are important for the photocatalytic process to be conducted efficiently for any given application [4,5]. With such insights, photocatalysts are equipped with additional materials via doping [6], plasmonic metal sensitization [7], cocatalyst loading [8], etc. and designed with various configurations such as heterojunction [9] and Z-scheme [10] toward enhancing the specific properties of the photocatalyst system. The process of doping was initially found to be helpful in tuning the band structure in photocatalysts; however the major shortfall of doping is the reduction of lifetime of the charge carriers as it often acts as recombination centers in the system [11,12]. Later, the other techniques known as the formations of heterojunction have become an important modification process to produce the hybrid photocatalyst to enhance the overall photocatalytic process in the system [13]. These heterojunction formations basically include the categories such as semiconductor–semiconductor (e.g., typical composites) [14], semiconductor–metal (e.g., plasmonic and cocatalyst loading) [15],

This book explains the major experimental finding on synthesis, characterization and photocatalytic activity of TiO₂ based 1-D nanocomposite materials for highly efficient hydrogen (H₂) production under solar light irradiation. A simple and effective hydrothermal method was adopted for synthesis of one-dimensional nanostructure such as nanotubes and nanorods. Calcination and impregnation techniques were adopted to improve the crystallinity of pristine titanates and deposition of narrow band gap metal oxides such as Ag₂O, CuO and Cu₂O on the surface of TiO₂ nanostructures. The surface and structural properties of photocatalysts were studied using various characterization techniques. Experimental conditions such as morphologies of catalyst, crystal phase composition, surface chemical composition, amount of catalyst in suspension, water splitting reaction with or without organic scavengers were optimized to achieve the best rate of H₂ production. The present study also applicable to bio-mass derived glycerol as sacrificial agent in photocatalytic H₂ production paves the sustainable way to dispose-off industrial waste into H₂ fuel.



Praveen Kumar D.
Lakshmana Reddy N.
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TiO₂ Based Nanocomposite Photocatalysts for Efficient H₂ Production

Dr. Praveen Kumar Dharani was born on 1st august 1987 in Vidvath Khani (Gani) village, Andhra Pradesh, India. He obtained Doctoral degree (Ph.D.) in the area of nanocatalysis for photocatalytic H₂ production on November 2015 from the Department of Materials Science and Nanotechnology, Yogi Vemana University, Kadapa, Andhra Pradesh, India.



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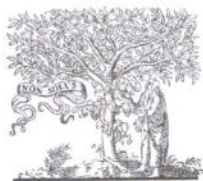
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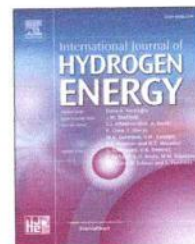


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Editorial



Preface to the special issue on the 2nd International Conference on Sustainable Environment and Energy (ICSEE – 2019)

The second International Conference on Sustainable Environment and Energy (ICSEE – 2019) was organized by the Hindustan Institute of Technology and Science on 21st & 22nd of February, 2019 in Chennai, India. The aim of this conference is to provide a common platform for the scholars, scientists, academicians and industrial experts who are actively involved in the promotion and execution of research in the field of sustainable environment and energy. The conference covered a broad spectrum of topics including sustainable building materials, waste management, hydrogen production and storage, sustainable energy production, materials and manufacturing. The first ICSEE conference held in 2017 witnessed a phenomenal success in bringing experts in the field of energy. The International Journal of Hydrogen Energy (IJHE) brought a special issue covering a large number of scientific works presented in the 1st ICSEE – 2017.

The present 2nd ICSEE – 2019 conference witnessed 131 and 50 poster presentations in addition to invited plenary and key note lectures. All the contributed authors were invited to submit full length articles to the special issue of International Journal of Hydrogen Energy (IJHE). A total of 40 papers falls under the scope of IJHE were sent for the peer review and 30 papers were recommended for publication. Majority of the papers deal with the hydrogen production technologies such as photocatalytic water splitting, hydrogen recovery from industrial wastewaters, photobiological hydrogen production etc.,. The emphasis was made on exploring convenient fabrication methodologies for developing photocatalysts with controlled structures for enhanced hydrogen production. Some papers reported promising possibilities offered by nanocomposites for hydrogen evolution reaction (HER) and oxygen reduction reaction (ORR). Another two papers discuss both experimental and theoretical aspects of prevention of cathodic flooding in proton exchange membrane fuel cells. In

addition, two papers were particularly focused on the designing of photoreactors for the recovery of hydrogen from industrial sulphide wastewaters. Four review articles covered the recent progress on metal – organic frame works, metal oxy nitrides, metal-doped TiO₂, non-metal doped TiO₂ nano-structures, interface engineering in the carbonaceous titania for photocatalytic hydrogen production. Some papers were dedicated to the development of cathode materials for zinc ion battery, graphene-based counter electrodes for dye sensitized solar cell, and composite membranes for fuel cell applications.

The guest editors take this opportunity to profusely thank all the prospective authors, IJHE editors and staff for their unstinted support for making this IJHE special issue on 2nd ICSEE – 2019 most successful.

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Sadhan Kumar Ghosh *Editor*

Urban Mining and Sustainable Waste Management

 Springer

Temporal Changes of Solid Waste at Limestone Quarries in and Around Yerraguntla, YSR District, A.P., using Google Earth Images



Y. Sudarshan Reddy, B. Suvarna, M. Prasad, V. Sunitha
and M. Ramakrishna Reddy

Abstract In limestone mining and cement industry, solid and liquid wastes are generated in every day and every stage of the operations and are required to mitigate properly. Different types of waste generated from both the industries are cement and limestone quarry. Due to environmental impact and public health and safety, proper efforts must be made to decrease waste generation and hence efficient disposal practices have to be followed. Hence, this study aims at a better understanding of spatial and temporal changes of unplanned dumping sites from 2006 to 2018. Google Earth mapping is one of the most advanced methods for identification of rock-solid waste clearly for collecting on satellite image data. This paper is centered on application of Google Images in assessing the temporal changes of solid waste at limestone quarries in and around Yerraguntla. Time series multi-date Google Earth imageries of 2006–2018 are used to demarcate the evolutionary changes in limestone waste disposal management and to understand the spatial and temporal changes that happened due to the changes by expanding the rock waste dump around Yerraguntla village, YSR district, A.P. Results revealed that the solid waste management in the study area is very poor which need to be properly monitored so as to mitigate the present and future environmental threats.

Keywords Temporal changes · Solid waste · Limestone quarries · Google Earth · Yerraguntla

1 Introduction

Waste is defined as the discarded and discharged material generated during every stage of life causing adverse health and environmental impact (Bringi 2007). Environmental contamination and waste management are the major concerns to earth scientist and form other related fields of science all over the world both in developing

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In view of associated environmental problems and their impacts on public health and safety, efforts must be made to minimize waste generation, systematic disposal practices must be followed. Hence, this study aims at a better understanding of spatial and temporal changes of unplanned dumping sites from 2006 to 2018. Google earth mapping is one of most advanced method for identification of rock solid waste clearly for collecting on satellite image data. This paper is centered on application of Google images in assessing the temporal changes of solid waste at limestone quarries in and around Yerraguntla. Time series multi date Google Earth Imageries of 2006 to 2018 are used to demarcate the evolutionary changes in limestone waste disposal management and to understand the spatial and temporal changes that happened due to the changes by expanding the rock waste dump around Yerraguntla village, YSR district, A.P. Contamination in drinking water is the most common form of environmental problems encountered in water resources management.



Sai Sudha
Vangala Sunitha

Solid Waste Management and Hydro Geochemistry of Limestone Quarries

in and around Yerraguntla Town,
Y.S.R District, A.P



Sai Sudha graduated Master in Earth Sciences from Yogi Vemana University. She is a first rank holder in the department of earth sciences at Yogi Vemana University. She has participated in several national conferences such as Andhra Pradesh Science congress and Indian Science Congress to present her projects.



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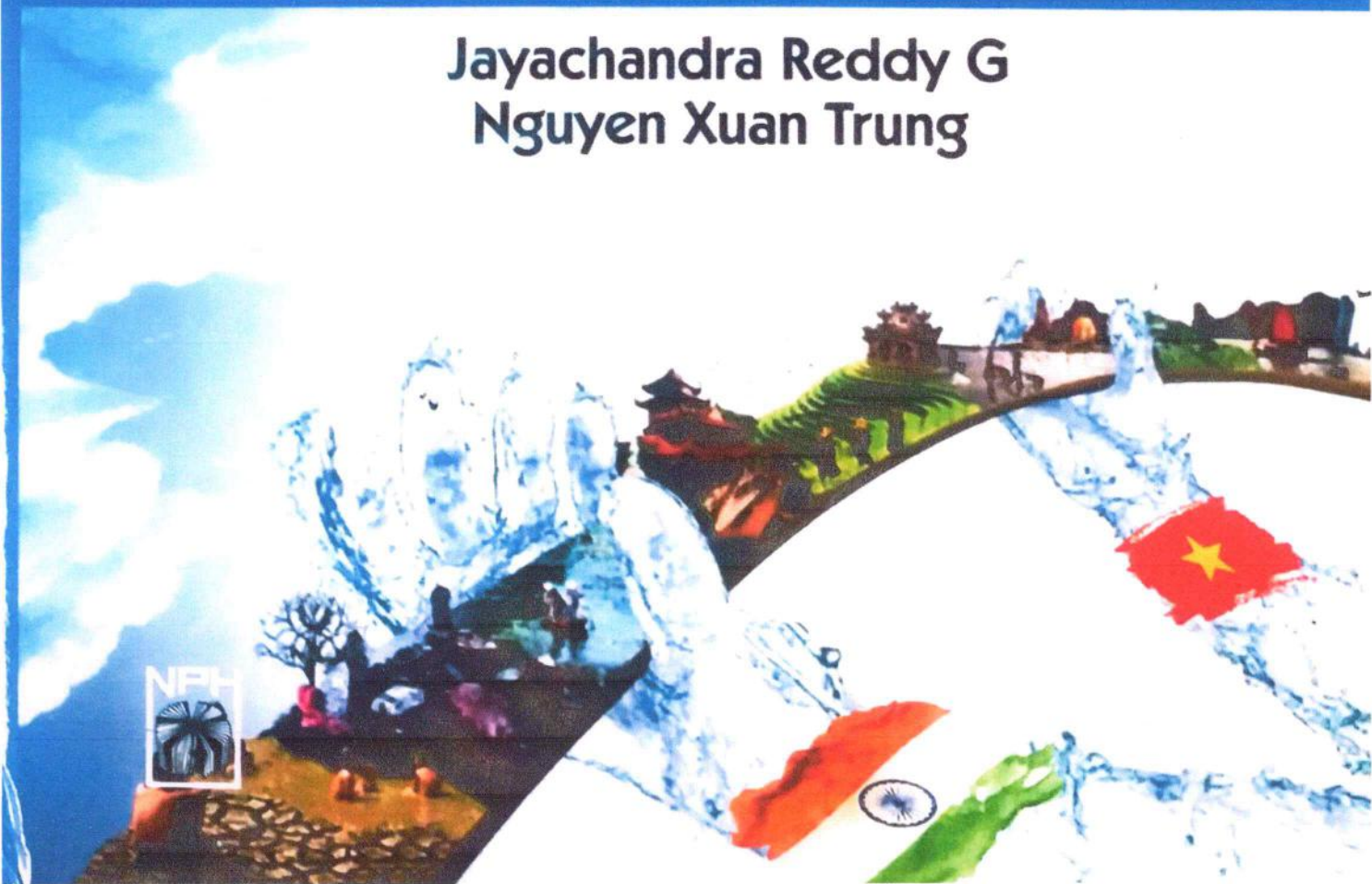
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INDIA-VIETNAM

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Jayachandra Reddy G
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Improving Economic Ties between India and Vietnam

Srinivasulu Bayineni

Abstract

The significance of India's ebb and flow association with Vietnam and its future potential for commonly gainful development will require more noteworthy political, financial and conciliatory commitment with ASEAN. Trade and capital flows are main factors shaping international relations between countries because they touch broad economic development that include resource transfer, job creation and knowledge transfer. Driven by their social linkages, ideological closeness and a typical broad perspective, India and Vietnam have shared a friendly respective connection since their autonomy. In any case, till the 1990s the financial and business cooperation's never figured fundamentally in their reciprocal relations. The household monetary's never predominant worldview and remote arrangement inclinations in both the nations, of two-sided financial relations, were the significant reasons obstructing the development presented the 'Doi Moi' (redesign) strategy. In 1986 the essentially 'shut economy' of Vietnam on 'showcase arranged financial administration'. The 'Doi Moi' approach concentrated opening its 'import substitution'-based economy with the presentation of the basic change program in the mid-1990s. Over the past five years there has been a steady increase in the trade volume between India and Vietnam. An important highlight of the India-Vietnam trade is that the balance of trade has continuously been in favour of India. On a government-to-government level, the India-Vietnam joint

Improving Economic Ties between India and Vietnam - Commission for Economic, scientific and technical cooperation, establishment of a platform to discuss various issues of bilateral economic importance. This paper takes a gender at numerous measurements of India's developing monetary ties with the Vietnam. Takes an investigative point of view on exchange, job of FDI and reciprocal venture streams.

Keywords: Trade Policy, Foreign Direct Investment, Balance of Trade, Exports and Imports and Reciprocal Trade Policy, Foreign Direct Investment, Balance of Trade, Exports and Imports

Indiquery of India and Vietnam Economic Ties

Indiquery of ties between India and Vietnam instigated as back as in the second century. The Hindu Kingdom of Champa that existed along the southern and central coast of Vietnam from the second to eighteenth century had considerable trade with India. The initial economic exchanges between India and Vietnam took place placidly through trading on the sea, tempted by the fascination of *Suvarnabhumi* and spices in Southeast Asia. India-Vietnam relations have been to a great degree well-disposed and genial since their establishments were laid by establishing fathers of the two nations - President Ho Chi Minh and President Rajendra Prasad and Prime Minister Jawaharlal Nehru. Nehru was one of the principal guests to Vietnam after its triumph against the French at Dien Bien Phu in 1954. President Ho Chi Minh went to India in February 1958. For more than 45 years, India and its one of the "most trusted friend and ally" Vietnam, have consistently promoted the expansion of trade and economy. After the formation formal diplomatic relations in 1972, India granted "Most Favoured Nation" status to Vietnam in 1975. India and Vietnam signed a bilateral trade agreement in 1978, a Bilateral Investment Promotion and Protection Agreement (BIPPA) was also signed between the two countries in 1997. The paper focused on economic ties between India and Vietnam and study trade and the investment landscape for firms based in these countries.

As a member of the ASEAN, Vietnam is an important enabler for India's growing trade and investment ties with the rest of Southeast Asia. India is now among the top ten trading partners of Vietnam. Total trade between the two countries during fiscal year 2016-2017 was US\$ 6244.92 million. The two sides fixed to set the target of bilateral trade at US\$ 15 billion (Rs. 97,778 crore) by 2020. To honor their growing partnership, Vietnamese President Mr. Tran Dai Quang visited India in March, 2018. Mr. Tran welcomed Indian companies to invest in Vietnam and acknowledged Vietnam's commitment to create sympathetic environments and

assistance for Indian investments in synchronization with Vietnamese law. It also re-emphasized that economic and trade cooperation is the core aspect of the bilateral relations, including international security in maritime and cyberspace, by strengthening regional trade engagement.

Trade between India & Vietnam

The two countries marked a Memoranda of Understanding (MoU) in March for advancing monetary and exchange participation. India's Ministry of Agriculture, Research and Vietnam's Ministry of Agriculture and Rural Development outlined an extensive work plan for 2018-20 to advance the exchange of innovation and specialized skill in the field of agribusiness and its associated parts. A Joint Sub-Commission on Trade meeting will occur this year in Vietnam's capital city, Hanoi – where the two nations will talk about diminishing exchange boundaries in the usage of the Framework Agreement on Comprehensive Economic Cooperation amongst ASEAN and India. Respective exchange expanded right around ten times in the course of the most recent 10 years, from US\$1.15 billion (Rs. 7,494 crore) in 2007 to US\$10.1 billion (Rs. 65,840 crore) in 2017. India is Vietnam's fifth biggest exchanging accomplice in ASEAN; Vietnam holds the nineteenth position worldwide for India.

However, significant Indian imports from Vietnam include: electrical and electronic hardware, elastic, apparatus and instruments, espresso, tea and flavors. Significant Vietnamese imports from India are: meat and edible meat offal, angle, shellfish, iron and steel, cotton, corn and grains, pods and seeds of peanuts, seeds of cassia, cocoa, beans and tamarind. Tata International Limited (TIL) signed two MoUs for its Vietnam activities, one with a main corporate gathering, the Vinal Cement Group for the usage of the Vinh Port and the other with Agri-bank, the biggest business bank in Vietnam for financing of ranch hardware. The groups were a piece of the appointment going with Mr. Tran Dai Quang, President of the Socialist Republic of Vietnam at the India-Vietnam Business Forum held in New Delhi on March 3, 2018. Noel N'Tata, overseeing executive, Tata International, had exchange with the secretary of common gathering advisory group of the Government of Vietnam, Nguyen Dac Vinh, amid the occasion that denoted the further reinforcing of ties amongst India and Vietnam. The talks rotated around the current exchange openings in the territory in power, farming and minerals areas.

Aggressive Economic Ties between India and Vietnam

Tata power, the biggest power organization in India and a backup of the Tata Group, is moving in the direction of setting up a US\$2.2 billion 1,320-megawatt power plant in the Soc Trang region of Vietnam and has another warm joint in the proposition arrange. India's biggest espresso maker and exporter, Tata Coffee, is likewise taking a shot at a US\$63 million (Rs. 410 crore) cutting edge office for solidify dried espresso in Binh Duong area of Vietnam. The Tata Group likewise exchanges steel and pesticides with Vietnam. The proposed tasks will additionally biggest Indian financial specialists in Vietnam. Besides, Tata's achievement in exchange and venture targets set by the two nations. Besides, Tata's achievement in the Vietnamese market will reinforce Indian financial specialist certainty towards Vietnam.

Aggressive work costs, an expansive developing white collar class, and the simplicity of setting up – are for the most part real draws for financial specialists taking a gander at both Vietnam and India. India's 'Make in India' producing program offers appealing motivators for Vietnamese organizations, and India is quickly executing simplicity of working together changes; in the interim, availability between the South Asian and ASEAN locale keeps on growing. The two governments encourage businesspersons to exploit different open doors in various need segments inside the two economies, including –

- » hydrocarbons,
- » power generation,
- » renewable energy,
- » energy conservation,
- » infrastructure,
- » textiles,
- » footwear,
- » pharmaceuticals,
- » machine tools,
- » agriculture and agro-products,
- » tourism,
- » chemicals,

- » ICT, and
- » other service sector industries.

India presently has 131 noteworthy tasks in Vietnam in the regions of nourishment handling, compost, auto parts, and material extras, among others. Add up to Indian interests in Vietnam adds up to about US\$1 billion (Rs. 659 crore), positioning it 25th for FDI inflow to Vietnam.

However, with the business condition grabbing in the two nations and the opening up of provincial fringes, desires point to a gain in speculation force by 2020. Vietnam's Special Economic Zones (SEZs) as key speculation goals for Indian partners in the district, however, Saponti Barrowa, Associate Director, Business Intelligence at DezanShira & Associates' Vietnam office points that exchange may remain the main thrust in respective financial ties, in the close term. Vietnam's SEZs are an awesome open door for remote financial specialists to exploit particular plans while setting up activities in the nation. Be that as it may, notwithstanding, a couple of Indian aggregates that have put resources into vast ventures in Vietnam, send out import exchange is probably going to remain the principle driver of this relationship for a long time to come. This to a substantial degree will be driven by India's own particular push towards send out arranged residential assembling which thus may open up open doors for expanded sourcing of contributions from Vietnam.

Table 1 displays the Vietnam's imports from world and India's fares to Vietnam amid 2012 to 2014. The compound yearly development rate of all best 25 results of Vietnam's Imports from world is 9.12 and comparably India's export to Vietnam is 8.68. The rate offer of India's total exports to Vietnam is 2.10 of every 2014. Indian interests in Vietnam have stayed consistent at around US\$ 1 billion yet are relied upon to ascend in the coming years. Amid 2016, as indicated by figures from the Foreign Investment Agency of Vietnam, Indian organizations enlisted 17 new tasks with an aggregate capital of US\$98.12 million in the territories of sustenance handling, manures, auto parts, material embellishments and so on. With these undertakings India currently has 131 noteworthy tasks with add up to speculations of about US\$707.95, positioning 25th among 110 nations and regions putting resources into Vietnam. The figure from Vietnam does exclude Indian venture from third nations. Significant divisions of venture are vitality, mineral investigation, agro-forensic, sugar fabricating, agrochemicals, IT and auto segments.

Opening Economic Ties between India and Vietnam

Henceforth, both India and Vietnam are members from the ASEAN India Free Trade Area (AIFTA), which happened in 2010. The FTA incorporates tax progression of more than 90 percent of items exchanged between the two regions. The last time frame for levy decrease or end under the different duty classes for Vietnam is set for 2024. India is additionally at present arranging the Regional Comprehensive Economic Partnership (RCEP) exchange understanding between part conditions of ASEAN, Australia, China, Japan, South Korea, and New Zealand.

Vietnam Trade Outline

Trade is a basic system in the improvement techniques of Vietnam. Heckscher-Ohlin trade model maintains that each state exports that commodity that utilizes its own most richly endowed factor of production intensively. Then again, the special case is that, as found by Dr. Leontief in his underlying measurable details of the info yield model of the US Economy, the most capital rich country on the planet (USA), sent out work concentrated products and imported capital-escalated items. Contemporary research proposes that, outright favorable position, relative preferred standpoint, and hypotheses of creation and exchange, resemble moving targets. Vietnam's utilization reflects changes in its national wage, social and human capital, and work and capital efficiencies. Vietnam's terms of trade and examples of exchange change with changes in local and world interest. This is reflected in local financial changes and factor alterations, and in political and authoritative change.

Table 1. India and Vietnam Exports and Imports

S. No.	Description	Vietnam's Imports from world					India's Export to Vietnam						
		2012	2013	2014	% Growth (2014 over 2013)	CAGR	2012	2013	2014	% Growth (2014 over 2013)	CAGR	%share (2013)	%share (2014)
1	Electrical/electronic equipment	22.96	31.42	34.08	8.46	14.02	0.05	0.04	0.11	146.45	31.18	0.14	0.12
2	Machinery, nuclear reactors, boilers, etc.	12.26	14.25	12.13	16.24	10.52	0.08	0.15	0.24	49.80	36.25	1.02	1.23
3	Mineral fuels, oil, distillation products, etc.	11.50	10.17	10.34	2.6	3.1	0.02	0.01	0.18	307.04	016.02	0.44	1.21
4	Plastics and articles thereof	7.12	8.74	9.71	13.12	10.99	0.12	0.14	0.11	8.23	2.52	1.20	1.36
5	Iron and steel	7.55	8.09	9.29	14.22	2.12	0.10	0.32	0.21	43.81	26.85	4.51	2.25
6	Residues/waste of food industry/animal fodder	2.46	3.08	3.25	5.24	9.84	0.28	0.14	0.14	59.22	21.48	10.99	1.54
7	Cotton	2.32	2.87	1.21	11.64	10.64	0.16	0.22	0.34	26.33	28.41	9.46	10.20
8	Articles of base metal	2.30	2.83	3.19	12.65	10.01	0.02	0.02	0.02	5.48	6.22	0.66	0.36
9	Extraction of ores/ores of iron	2.16	2.24	3.19	16.29	11.91	0.00	0.00	0.00	108.80	30.62	0.04	0.06
10	Waxes and other substances of animal origin	1.22	1.39	3.18	68.24	22.21	0.04	0.04	0.02	90.59	40.98	2.02	2.29
11	Paper or parchment and articles thereof	2.13	2.44	2.91	19.29	11.14	0.01	0.01	0.02	48.20	34.54	0.11	0.35
12	Chemicals, in primary forms	2.06	2.53	2.84	12.16	5.95	0.01	0.03	0.03	1.64	4.42	1.22	1.04
13	Iron ores and concentrates	2.03	2.53	2.43	30.62	2.25	0.09	0.09	0.11	16.94	6.50	1.65	1.51
14	Iron ores and concentrates	1.95	2.06	2.12	8.56	4.54	0.24	0.25	0.22	2.91	3.1	1.72	1.59
15	Iron ores and concentrates	1.81	1.77	2.16	35.23	10.03	0.00	0.00	0.00	4.51	10.03	0.00	0.00
16	Iron ores and concentrates	1.78	1.78	1.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Iron ores and concentrates	1.78	1.78	1.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	Iron ores and concentrates	1.78	1.78	1.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Iron ores and concentrates	1.78	1.78	1.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	Paper and paper articles of pulp, paper and board	1.51	1.63	1.39	7.68	7.24	0.02	0.03	0.04	3.19	18.26	1.65	1.41
21	Copper and articles thereof	1.32	1.49	1.71	14.55	7.61	0.01	0.02	0.06	210.59	21.53	1.20	3.25
22	Aluminium and articles thereof	1.30	1.46	1.62	16.08	9.16	0.06	0.05	0.04	8.65	3.62	3.32	2.61
23	Raw hides and skins (other than furskins) and leather	0.98	1.16	1.62	44.75	19.80	0.07	0.08	0.10	33.10	14.48	6.67	6.14
24	Rubber and articles thereof	1.58	1.50	1.55	3.39	0.65	0.03	0.02	0.02	0.06	7.81	1.38	1.34
25	Fertilizers	1.62	1.71	1.24	27.28	9.85	0.01	0.01	0.01	18.78	12.41	0.42	0.52
26	Tanning, dyeing extracts, dyes, pigments etc.	0.81	0.91	1.08	18.61	10.15	0.02	0.03	0.04	42.30	23.16	2.29	3.34
Total of Top 25 Products		96.62	112.41	126.36	12.41	9.36	1.87	2.44	2.40	1.53	8.68	2.17	1.90
Total of All Other Products		12.16	19.62	21.47	9.44	7.76	0.29	0.44	0.71	61.31	34.86	2.24	3.30
Vietnam's Total Imports from World		113.78	132.03	147.84	11.97	9.12	2.16	2.88	3.11	8.05	12.92	2.18	2.10
India's Total Exports to Vietnam													

Source: Various Issues of World Development Reports, the World Bank, Washington DC.

However, Vietnam trade has turned out to be differentiated. This expansion methodology is a piece of it long haul plan of social and financial advancement. It depends on the WTO Committee on Trade Development show. The WTO understandings involve uncommon exchange necessities for creating countries, centers on building up country's exchange, obligation, and innovation exchange, through included tolerance, uncommon and differential treatment, including arrangements for non-correspondence in exchange transactions among developing and creating countries. Vietnam fares and imports have delighted in noteworthy development over the period 2007 and 2015 as found in Table 2 and Figure 1. The average percentage of export growth rate is 10.86 and average percentage of import growth rate is 17.2 (Table 2).

Table 2. Vietnam Export and Import Growth Rate during 2007-15

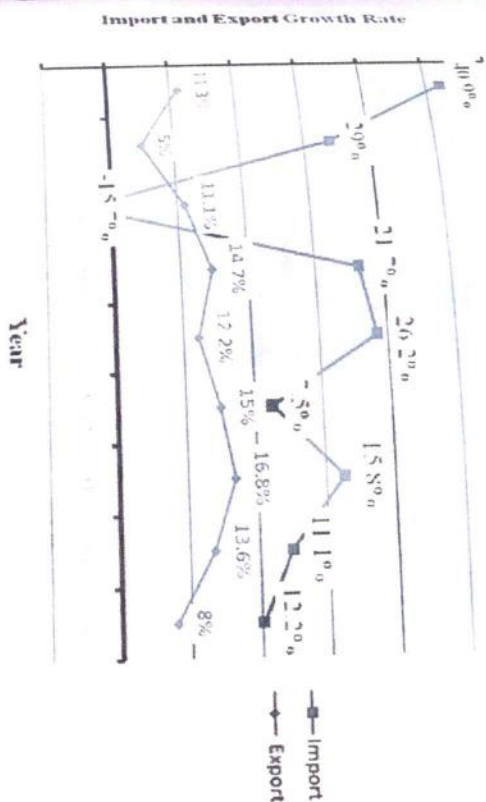
Year	Percentage of Export Growth Rate	Percentage of Import Growth Rate
2007	11.3	40.9
2008	5.0	29.0
2009	11.1	-15.7
2010	14.7	21.7
2011	12.2	26.2
2012	15.0	7.5
2013	16.8	15.8
2014	13.6	11.1
2015	8.0	12.2
Average	10.86	17.2

Source: The World Bank (2015), Trade summary for Vietnam.

Retrieved from <http://wits.worldbank.org>.

Since 2012, Vietnam's has been detailing trade surpluses all the more habitually as fares development have been more grounded than imports. As of late, the greatest exchange deficiencies were recorded with China, Korea, Taiwan, Singapore and Thailand. Vietnam records exchange surpluses with the United States, Hong Kong, United Kingdom, Cambodia and United Arab Emirates.

Fig 1. Vietnam Export and Import Growth Rate during 2007-15



FDI between India & Vietnam

Vietnam has an extraordinary favorable position on account of its geographic vicinity to China. Given China's times of predominance in assembling for trade it is as yet the focal point of gravity for worldwide assembling. The all-around created biological community of providers is something which will be exceptionally hard to recreate in another locale, for instance, South Asia or Africa. For an organization that is hoping to expand its assembling base out of China, another manufacturing plant in Vietnam can be essentially "stopped" into its local production network instead of one more distant away from home in South Asia which will at present need to import segments from China. Given Vietnam's closeness to southern China, it could be the pulsating heart of China's huge workshop economy. This is as of now being reflected in the FDI numbers - Vietnam's net FDI inflows as a percentage of GDP were around 5% a year ago versus only 1.7% for India.

Vietnam, then again, has plentiful extension for enhancing its investments into India. It right now positions 97th regarding FDI inflow to India, at US\$4.76

million (Rs. 31.7 crore). By the by, this is advance from ventures worth US\$60 million (Rs. 78 lakh) in 2007. Respective exchange among India and Vietnam has seen nonstop development over the past numerous years. India is currently among the best ten exchanging accomplices of Vietnam. As indicated by Government of India information, add up to exchange between the two nations amid during 2016-17 was US\$ 6244.92 million. Real fare wares from India are hardware and garments, pharmaceuticals, cottons of numerous sorts, vehicles, materials and cables, steel, steers feed fixing, synthetic concoctions, plastic pitches, results of synthetic substances, filaments of different types, steel of assorted types, textures of synthetic types, standard metals and adornments and valuable stones.

With 70% of its FDI coming into the assembling division, Vietnam is by all accounts on the cusp of a fare blast which will have multiplier impacts over the economy. Vietnam's upper hand in drawing in assembling FDI is additionally underscored by the way that it performs exceptionally well on two basic contributions of mechanical creation – power and water. Vietnam has just charged 99% of its family unit's surprisingly high number for an outskirts showcase and altogether higher than India's 79% inclusion. As far as water supply, Vietnam is one among not very many quickly industrializing nations that is confronting a water emergency. China, India and various swathes of sub-Saharan Africa are for the most part confronting up and coming water emergencies. Not exclusively will this put the brakes on modern movement however it could likewise prompt inner hardship as networks battle about what is an extremely fundamental asset too geopolitical tussles with neighbors over control of streams.

However, India has 132 activities with add up to investments of about US\$11 billion including speculations steered through different nations. Significant parts of investment are vitality, mineral investigation, agro-handling, sugar fabrications agrochemicals, IT and auto segments. In the oil and gas part, ONGC Vedaft Limited (OVL) and Essar Oil are as of now giving oil and gas investigation benefits in Vietnam alongside Petro Vietnam. In 2013, Tata Power, some portion of the Tata Group, granted a US\$ 2.1 billion warm power investment in Soc Trang Province, which is the biggest Indian speculation investment in Vietnam till date. Another organization that has granted a similar gathering, Tara Coffee, declared setting up a Greenfield investment in Vietnam at an expense of US\$ 50 million in December 2016. Other Indian investors in Vietnam include Gimpex, JK Tires, and Glenmark Pharmaceuticals.

India-Vietnam Enhancing Partnership

Economic Ties between India and Vietnam

Alongside the private segment, the administration is likewise pushing for an expansion in exchange and investment. The Indian government has as of late endorsed a Project Development Fund of Rs. 500 crore (US\$ 77 million) for supporting Indian organizations to fabricate generation and supply chains in Cambodia, Laos, Myanmar, and Vietnam. This will profit India's investments as far as business development, keeping up cost focused supply chains, alongside expanded combination with worldwide creation systems. In 2014, the Indian government likewise offered a US\$300 million credit extension to Vietnam as a force to quicken material exchange and investment between the two nations. The credit is to be dispensed through the Vietnam Exim Bank, is to be utilized essentially to set up a materials and article of joining mechanical stop near the Ho Chi Minh city and to encourage Indian and Vietnamese organizations to fashion joint endeavors.

The two governments are at present chipping away at key issues to encourage trade and investment, for example, expanding air availability and direct containerization. Moreover, FTAs marked by Vietnam alongside ASEAN gives Indian firms access to more prominent markets like China, Australia, and the Eurasian Economic Union, and the European Union (EU). Vietnam's FTA with EU, one of its best exchanging accomplices is reeled in 2018. To energize FDI, Vietnam has set up a progression of impetuses for outside financial specialists. These incorporate particular corporate salary charge rates, import obligation exceptions, exclusion from charges on eminences, to build-operate-transfer (BOT), build-transfer-operate (BTO) and build-transfer intended to advance FDI in the cutting edge part, underprivileged regions, work serious enterprises, and other need segments, for example, education and health.

Challenges

There have been persistent trades of visits of best pioneers between the two nations all the time, additionally solidifying the common ties and looking for more up to date methods to investigate the new vistas with the goal that both can amplify shared advantages. It would not be right to state that no other nation inside the ASEAN region has gotten the sort of significance and full focus that Vietnam is getting from India. This is the reason that makes India-Vietnam relations something extremely exceptional.

The year 2017 imprints the 45th year commemoration of the foundation of the "Key Partnership", which had been set up in July 2007, and was commemorated to an "Extensive Strategic Partnership", amid the present Prime Minister, Narendra Modi's visit to Hanoi in September 2016. Despite the fact that 45 years is a not critical and deserving of specificity, the steps made amid this period are turning points of Indo-Vietnam ties.

In global exchange and trade, organizations and nations contend and participate in the meantime. This additionally remains constant for India-Vietnam reciprocal exchange and business. Because of the complementarities of their significant business relations. As noted before, India and Vietnam send out comparative set of merchandise, which restrains the quick development of exchange. In any case, given the immense development of the market in the two nations, the space in two-sided exchange is extending. A large group of issues have been talked about in a few understandings came to between the two countries. These incorporate a wide number of subjects going from monetary issues, key choices, to protection, and on instructive and social discoursed. The accompanying were the major testing items:

- » up-evaluating the Indo-Vietnam relationship to a Comprehensive Strategic Partnership, which Hanoi so far just has with two different nations in particular Moscow and Beijing;
- » announcement of another resistance credit line of \$500 million to Vietnam by India;
- » signing of an agreement for quick seaward watch vessels by I&ST with Vietnam Border Guards under \$100 million from the safeguard and police given;
- » agreement on participation in space for quiet purposes;
- » Navy-to-Navy concession to White Shipping data sharing;
- » memorandum of comprehension on digital security;
- » agreement for India to help Vietnam in taking an interest in UN peace-

- » grant of \$5 million for a product stop;
- » joint collaboration in the IT division;
- » MoU on setting up a Center for Excellence in programming advancement;
- » MoU on setting up a Center for Excellence in programming advancement;
- » postgraduate and doctorate grants for Buddhist and Sanskrit thinks about in India;
- » protocol on twofold tax assessment shirking understanding;
- » protocol on twofold tax assessment shirking understanding;
- » MoU for shared acknowledgment of models;
- » MoU on collaboration in well-being and solution; and
- » MoU between the Indian Council for World Affairs and the Vietnamese Academy of Social Sciences.

Conclusion

The discussion above shows unmistakably that with the rise of the current key organization among India and Vietnam to a "far reaching" level, the economic connections and the discussions on speculations have begun expecting more prominent potency and force. In spite of the way that India is a financial powerhouse and Vietnam, Asia's quickest developing economy, two-sided exchange and venture are in underneath the level of real potential. Given that Vietnam's two-sided exchange with both China and US has crossed the US \$ 10 billion check, the India-Vietnam exchange volume of US \$ One billion appears to be very low. Yet, the development degree in the financial relations is empowering. Past that, there is noteworthy degree to investigate in the financial domain on zones, for instance, vitality, mineral investigation, agro-preparing, human services, IT, and instruction, among others, which will help existing ties.

Besides, social and individuals-to-individuals trade should be fortified further as there is huge generosity that can be utilized by the two countries. Generally speaking, this is a relationship that is ready to take off in the coming years, driven by political initiatives in the two nations resolved to make this relationship really in an introduction. The situation in South East Asia has been changing quickly and the two nations, India and Vietnam need to associate at the most elevated level every now and then. The ongoing visit has demonstrated that there

are different territories in which the two nations can cooperate. The relationship has been advancing extremely well in the previous decade and that is the reason for particular MoUs in fields of atomic, horticulture have been made.

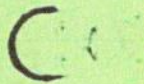
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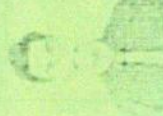
ABOUT THE BOOK

This book is a collection of papers presented in the seminar on "Sustainable Agriculture in India: Issues and Challenges". This book addresses major issues related to Indian agriculture and also came out with valuable suggestions and recommendations for the sustainable and inclusive development of agriculture in India. In this book, some papers are biological and much appropriate to agricultural economics. Econometric models have been applied by some of the researchers in their papers and these models are valuable instruments to Indian agriculture. This book is very useful for Researchers, Academicians and Policy Makers.

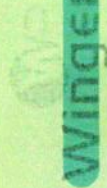
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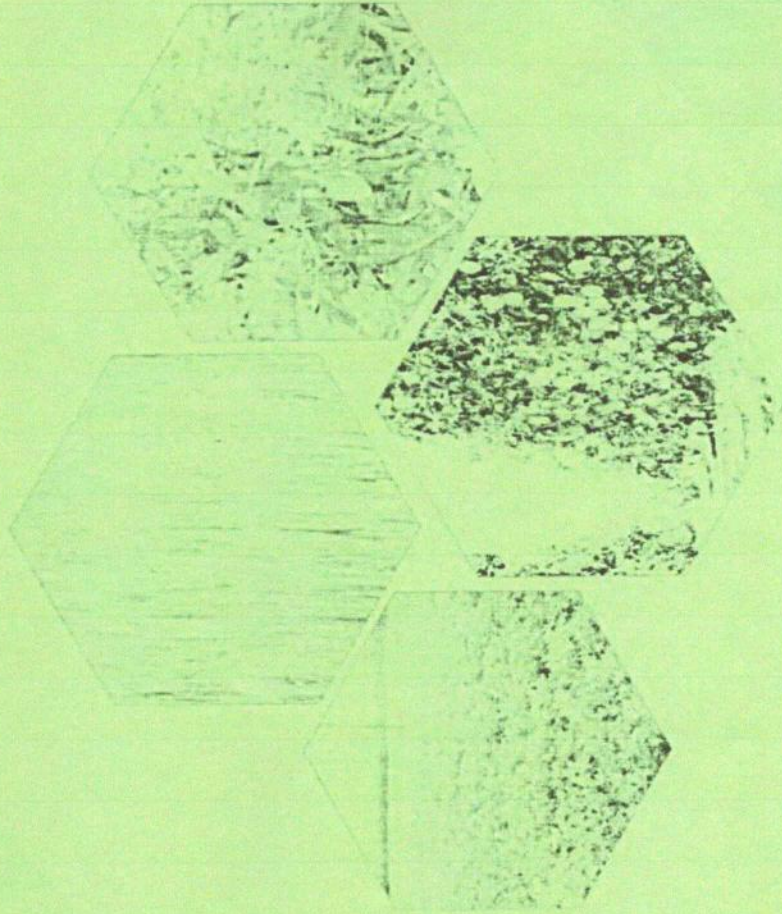


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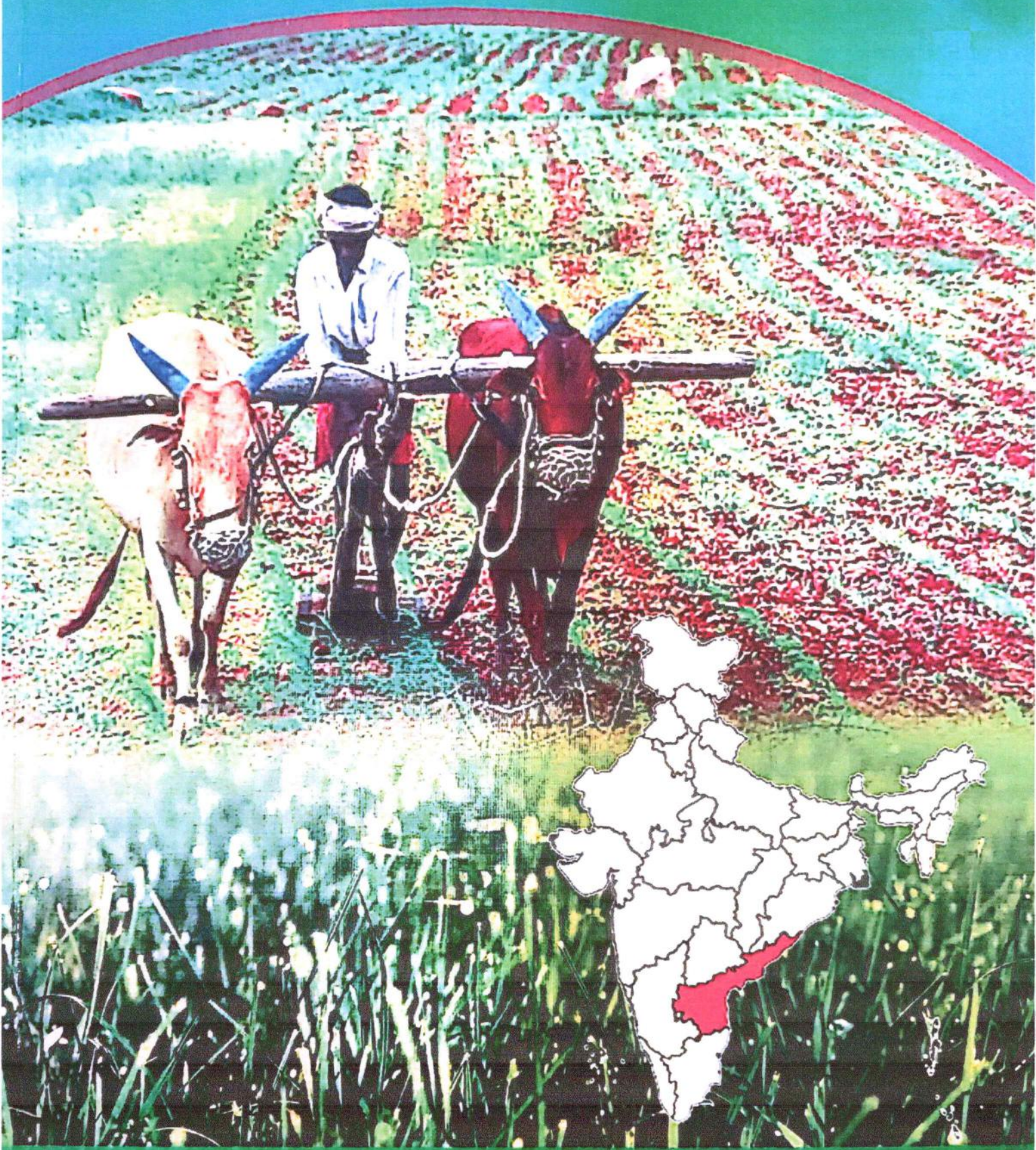
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- REGIONAL EXPERIENCES AND POLICIES



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Migration of Agriculture Labour to Gulf: Evidence from Village Studies in Nizamabad District

Dr. N. Ganesh Naik

1. Introduction

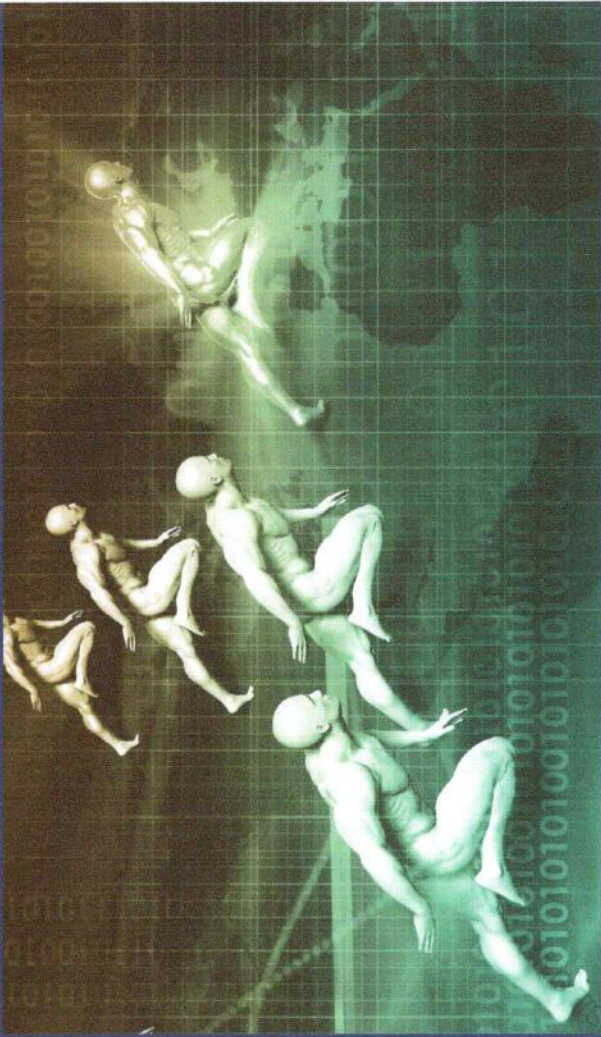
Human migration is one of the most important aspects of social sciences. Throughout human history, people have migrated to escape poverty and persecution and to improve their life chances and living standards. "Migration, or more exactly mobility, of some form is a universal experience and it is rare for anyone to spend his or her entire life within the boundaries of a single village or city ward and, when this does occur, it is more likely to be due to some physical or mental handicap than to choice" (Ronald, 1997). On the whole, different parts of the world have experienced different types of mobility caused by various socio-economic conditions. Since "a better life and livelihood are at the root of the decision to migrate" (WHO, 2006). As per World Bank statistics, around 3.4 per cent of the global population residing in other than country of origin, constituting more than 247 million migrant population (World Bank, 2016). India is also one of the major contributors of emigrant population as a country of origin, transit and destination in international migration (Gurucharan, 2013). India has the largest Diaspora population in the world, with 16 million Indians living outside the country they were born in (UNDSEA, 2015). One of the largest migrant corridors in the world can be found in the six Gulf States - Kuwait, Saudi Arabia, Qatar, Bahrain, Oman and the United Arab Emirates. Of the 12 million Indian migrants worldwide in 2011, the Gulf region represents 6 million or 50 per cent of non-resident Indian immigrants (Didar Singh and Rajan, 2016). It is an important source of remittances to India. According to World Bank (2016) statistics, India ranks first (\$ 72.2 billions) among remittance receiving countries in the world. Remittances greatly contribute in reduction of poverty and increasing household income (Ratha, 2013). Major share of remittances comes from high migrating states - Kerala, Goa, Punjab, Tamil Nadu, Andhra Pradesh, Karnataka, Gujarat and Maharashtra. Of late, trend of migration from the new states, like Bihar, Uttar Pradesh, West Bengal and Rajasthan has been emerging (Pachouri & Aggarwal, 2015; MOIA, 2016). Despite its significance, research efforts on this subject have been limited in Indian context with exception to Kerala state (Rajan, 2014). Given existing research gaps in the literature on Gulf migration in the Indian context, this doctoral study provides understanding of the factors that determine migration and its developmental impact on migrant families in the state of Telangana, with reference to Nizamabad district.

2. Objectives of the Study

- 1) To study trends and patterns of gulf emigration from India.
- 2) To study socio-economic profile migrants from study area

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The concept of leadership is a very ancient origin. In today's fast-changing world, leadership issues are getting increasingly important in organizations both at policy and implementation levels. The key to the progression of leadership is the need to coordinate the efforts of a group. The person who coordinates the group's effort is called the leader, and the behavior of the leader towards the members of the group (followers) is his leadership style. Thus, leadership is an interpersonal relationship between the leaders and followers. Leadership style is the result of philosophy as well as the personality and experience of leaders. It depends upon the nature of the tasks, type of followers, conditions prevailing in the organization, etc. Leading is a very human activity, as diverse and robust as any other activity. Each and every leader has his/her own style. Therefore, there are as many leadership styles as there are leaders.



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Assistant Professor of Commerce at Yogi Vemana
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PERAM VENKATA NAGARJUNA REDDY
Gundluru Haranath

Leadership Perspectives

A Case Study of Zuari Cements Limited

NAGARJUNA REDDY, Haranath



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LEADERSHIP STYLES IN ZUARI CEMENT LIMITED

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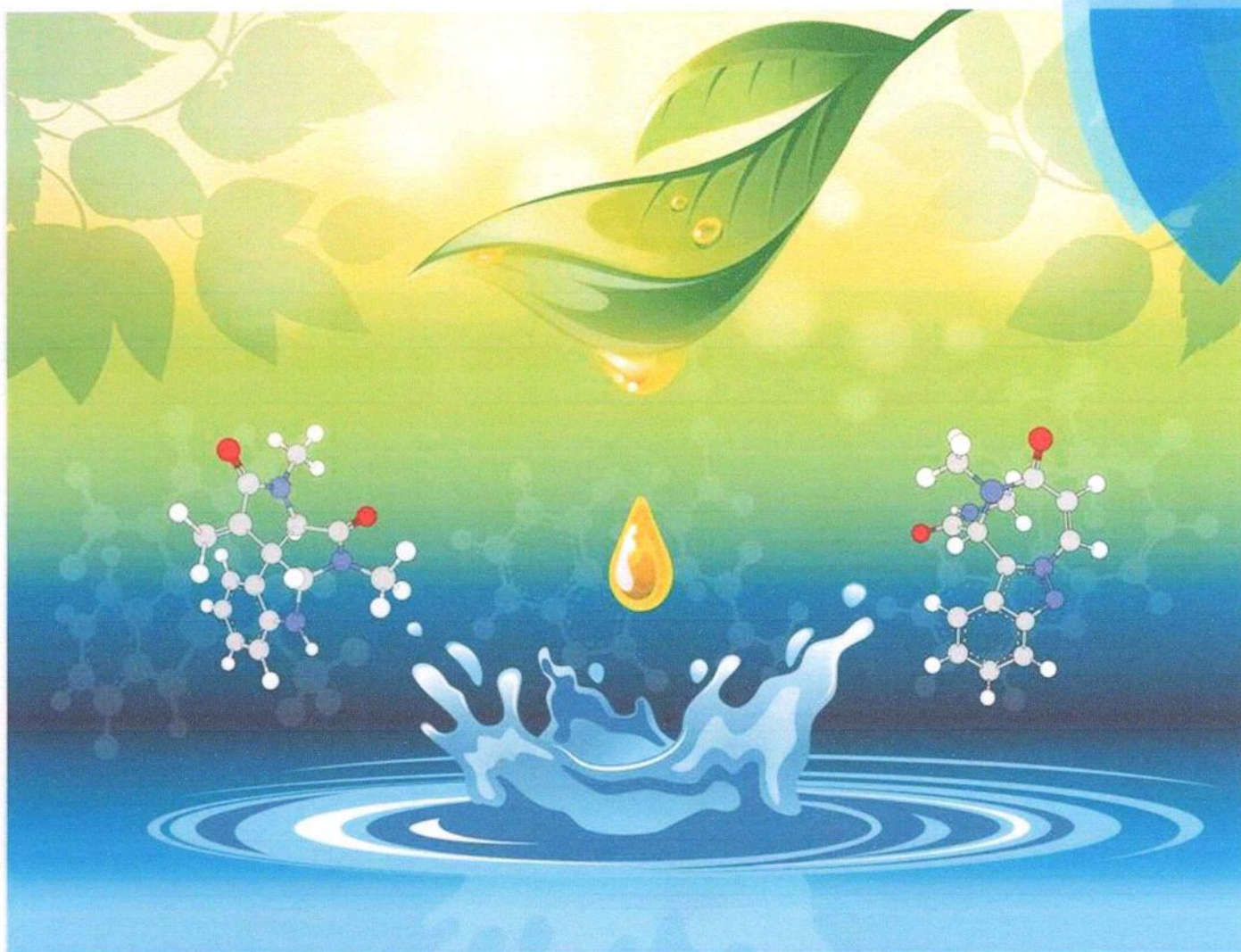
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Algal Based Synthesis of Silver Nanoparticles and it's Applications: A Green Synthesis Approach

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Abstract:

The use of green technology for the synthesis of silver nanoparticles is growing dynamically every day. In this report, we are focused recent developments used for Green Synthesis of Silver Nanoparticles (AgNPs) using Algae and their uses in development of various products. Biomass obtained from various forms of algae, including Macro algae (Seaweed) and Micro algae culture can be used for reduction of silver ions. Size of the nanoparticle thus formed will be under the influence of many parameters viz., incubation time, pH and temperature of the substrate as well its concentration. These nanoparticles can be characterized using various techniques including UV- visible spectroscopy, Zeta potential, XRD, FTIR, EDX, EDS, DLS, SEM, FESEM, TEM, HRTEM, AFM, ICP-OES etc. Chemical based synthesis of silver nanoparticles is tedious, and the byproduct release into the environment has raised concern about their toxicity and safety. To address the issues linked with the chemical based synthesis of silver nano particle, several biological methods came into force in which, algal based synthesis is one of the cost effective and ecofriendly methods. The nanoparticles synthesized using algae are effective and potent against various microbial strains and have other applications too. Presently we are focusing and discussing more about various methodologies for silver nanoparticles synthesis using algae and their applications.

Keywords: Green Synthesis, Silver Nanoparticles, Macroalgae, Microalgae

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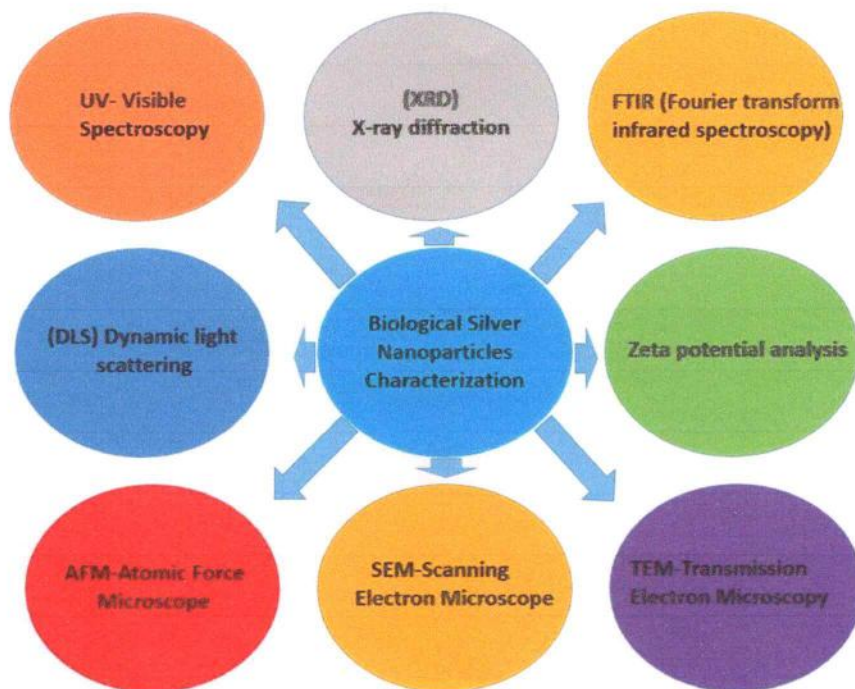


Fig:2 Characterization of Biological Silver Nanoparticles



Fig: 3 Various Applications of Silver Nanoparticles

Tinospora cordifolia (willd.) Miers Ex Hook. f. & Thoms, is a medicinal plant of family Menispermaceae. It is a large, glabrous, succulent, perennial climber plant. It is indigenous to tropical areas of the Indian subcontinent, ascending to an altitude of 300 m. This plant is found from Himalayas in the north to down to the southern part India, and also found in other Asian countries like China, Myanmar, Sri Lanka, Thailand, Philippines, Indonesia, Malaysia, Borneo, Vietnam, Bangladesh, Pakistan, North Africa, West Africa, South Africa. It is used in Ayurveda for treatment of various diseases. This plant has been used ethnobotanical for various purposes to treat diseases in several forms such as root and stem decoction; leaves and stems in the form of paste and juices; these are used to treat jaundice, fever, asthma, cough, some skin disorders and urinary infections.

Hairy Root Production

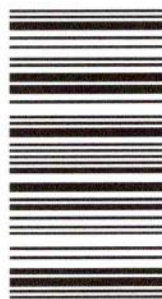


Hadi Fathima Nazneen
Produtur Chandramati Shankar

Production of Hairy Root in a Medicinal Plant

(*Tinospora cordifolia* L.)
for Secondary Metabolite Production
using *Agrobacterium Rhizogenes*

Dr. Hadi Fathima Nazneen did Masters and Doctoral Degree in
Biotechnology from Yogi Vemana University,
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Production of Bioethanol from Green Alga *Chlorella Vulgaris*: An Important Approach to Utilize Algal Feedstock or Waste



D. Varaprasad, N. Ragasudha, K. Paramesh, P. Chandramati Shankar, S. Nazaneen Parveen and T. Chandrasekhar

Abstract Regular depletion of fossil fuels urges human society to depend on renewable resources seriously and invest more on biofuels sector. Recently generation of bioethanol from algal feedstock or algal waste has been an interesting research. Unlike fossil fuels, production of bioethanol from algal feedstock or waste will take less time and expensive. In the present study, an important green alga *Chlorella vulgaris* (*C. vulgaris*) was selected for ethanol production. *Chlorella vulgaris* cultures were initiated under in vitro conditions using universal tris-acetate-phosphate (TAP) medium along with various concentrations and combinations of vitamins such as thiamin, biotin and cobalamin (B1, B7 and B12) to enhance the biomass in turn ethanol production. Optimal level of vitamins i.e. CV2 medium (TAP with 0.4 g/L of B1, 0.002 g/L of B7 and 0.002 g/L of B12) augmented the biomass production including lipid contents. Later all the algal feedstocks were used for production of ethanol in the company of *Saccharomyces cerevisiae* (*S. cerevisiae*) in both light and dark fermentations. Higher levels of ethanol production was achieved with the feedstock generated from CV2 medium at 48 h in dark fermentation and compared with other feedstocks as well with light fermentation yield at different time intervals. The results of the present investigation may grab the attention of investors in bioenergy sector for the production of bioethanol at commercial level from algal feedstock or algal waste.

Keywords *Chlorella* · Vitamins · Bioethanol · Yeast · Fermentation · Light and dark

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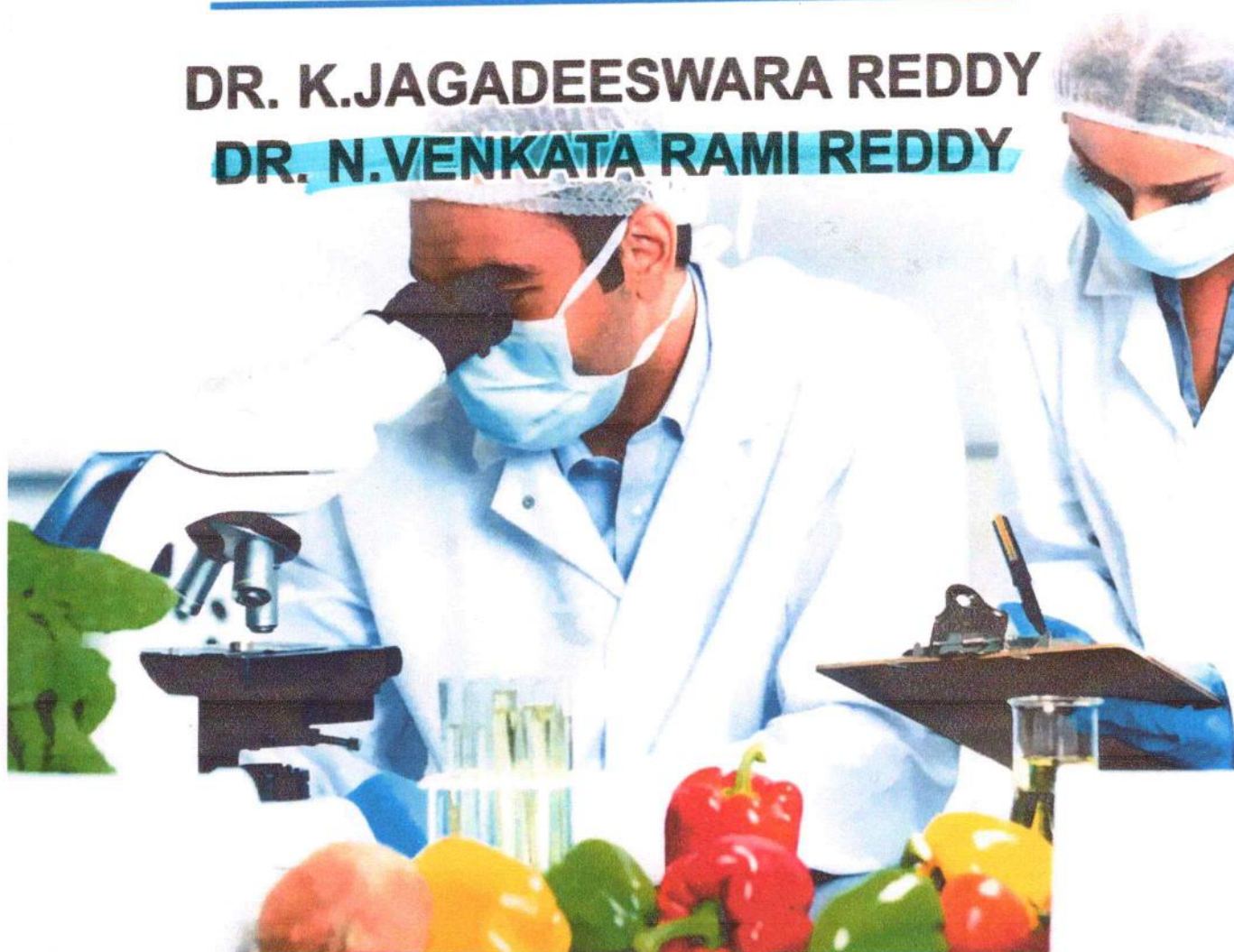
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Importance of Toxicology in Food Science

DR. K.JAGADEESWARA REDDY
DR. N.VENKATA RAMI REDDY



IMPORTANCE OF TOXICOLOGY IN FOOD SCIENCE

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Food is one of the most essential materials for the survival of living organisms, in addition to oxygen and water. It is a complex mixture of chemical substances having proteins, fats, carbohydrate, food additives and flavours etc. Many of these substances have their own intrinsic toxicity. In general everything is toxic--determined by dose and exposure. Food toxicology is the study of the nature, properties, effect and detection of toxic substances in food and their disease manifestation in humans.

Here in this book we have given an elaborate account of food toxins and their role in food science and human health. Based on scientific analysis the information contained herein will be useful for one and all concerned.



Dr. Jagadeeswara Reddy Kanala has completed his M. Sc and Ph.D in Biotechnology and is having research experience in toxicology with expertise in designing and performing in toxicology studies as per the regulatory guidelines of OECD, EPA, KCR & Schedule Y. He is also well experienced in the field of therapeutic biomolecules which involves fermentation, purification, characterization and formulation in compliance with cGMP. At present, he is working as Associate Director at Sugan Life Sciences, Tirupati, Andhra Pradesh, India and his responsibilities are conducting toxicology and pharmacology studies to get national and international regulatory approvals for pharmaceutical compounds and agrochemicals. Along with scientific activities, he has the authority and formal responsibility for the organisation and functioning of the test facility as a Test Facility Management. With his area of expertise in toxicology, biotechnology and cancer biology. Dr. Kanala has authored more than twenty scientific publications and contributed to books.



Dr. N.Venkata Rami Reddy is Assistant Professor in Animal Science at **Yogi Vemana University**, Kadapa, Andhra Pradesh, India, where he has taught cell & molecular biology, genetics, immunology, pharmacology, toxicology and biotechnology to post graduate students for 10 years. His research interests are focused on the identification of ligands for nuclear receptors and study their role in airway inflammation and injury. Dr. Narala has authored more than forty scientific publications and contributed to several book chapters. He has completed several major research projects funded by DBT, CSIR, DST, SERB agencies in India. He is the recipient of couple of awards such as Visiting Scholar fellowship at University of Michigan, UGC-Raman Post-Doctoral Fellowship and DST-SERB fast track grant.



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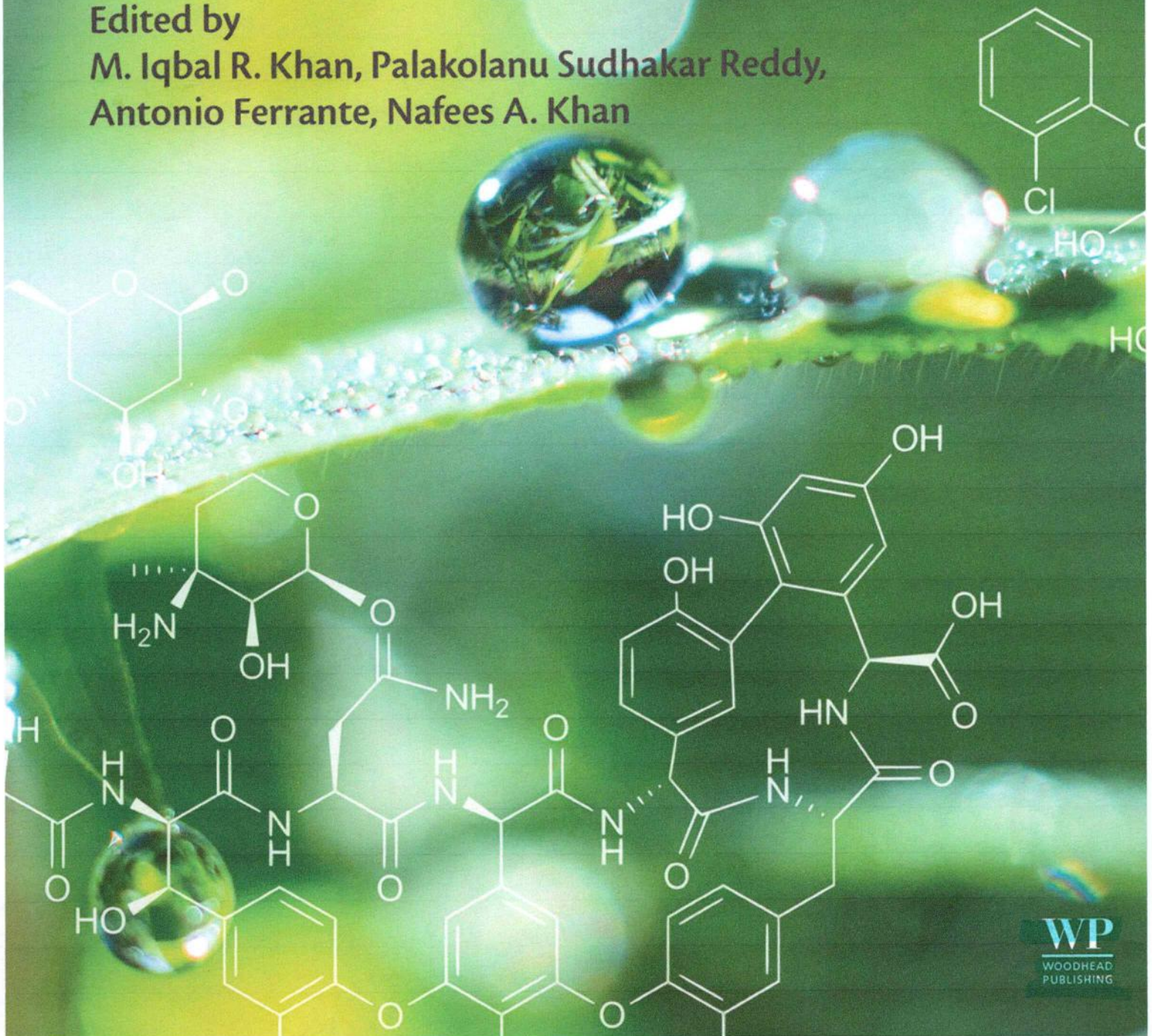
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Plant Signaling Molecules

Role and Regulation Under Stressful Environments

Edited by

M. Iqbal R. Khan, Palakolanu Sudhakar Reddy,
Antonio Ferrante, Nafees A. Khan



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Engineering Signaling Molecules to Improve Abiotic Stress Tolerance in Crop Plants

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3.1 INTRODUCTION

Plants as sessile organisms come across several biotic and abiotic stresses during their course of growth and development. Global climatic changes impose abiotic stresses such as drought, salt, and extreme temperatures, which majorly affect geographical distribution of plants and agricultural productivity and cause a dearth of food (Fedoroff et al., 2010). It has been estimated that globally 70% of plants' potential yield is reduced by abiotic stresses (Acquaah, 2007). Rapid changes in global climate are predicted to increase the intensity of abiotic stresses in the near future; at the same time global population is expected to reach 9 billion by 2030 (Husaini

and Tuteja, 2013). Plant scientists anticipate a need to improve plants to enhance productivity under adverse climatic conditions to meet the global population demands. Conventional breeding methods proved unsuccessful for complex traits, that is, abiotic stress. Advancements in the field of plant improvement technologies such as transgenic approaches permit to introduce gene(s) from a wide range of organisms into plants and to develop transgenic plants to cope with complex abiotic stresses in a faster way. Identification of candidate genes is the foremost step in the development of transgenic plants. It is of utmost importance to understand how the plants sense abiotic stress signals and transduce at the molecular level for successful

Environmental Chemistry for a Sustainable World

129

Inamuddin
Mohd Imran Ahamed
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Nanophotocatalysis and Environmental Applications

Energy Conversion and Chemical
Transformations

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Chapter 2

Highly Stable Metal Oxide-Based Heterostructured Photocatalysts for an Efficient Photocatalytic Hydrogen Production



Murikinati Mamatha Kumari, Raghava Reddy Kakarla, N. Ramesh Reddy, U. Bhargava, M. V. Shankar, and S. K. Soni

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Abstract The need for fuel generated by renewable resources has become important in the global scenario. Solar energy is an abundantly available renewable resource for the earth. There is a huge potential for H₂ derived from clean energy resources for commercial applications such as generation of electricity, fuel for transportation, domestic usage, rocket propulsion, etc. With H₂ as a fuel, a zero-emission process using fuel cells produces electricity with only water as the

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Functionalized magnetic nanoparticles/biopolymer hybrids: Synthesis methods, properties and biomedical applications

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1 Introduction

Nanotechnology deals with the preparation and application of functional materials and structures (Tseng et al., 2017). By definition, nanostructured materials have at least one dimension (thickness, diameter, length, etc.) between 1 and 100 nm. Nanostructured materials often exhibit unique mechanical, optical, electrical, chemical, structural, and magnetic properties (Qiu Zhao, Boxman, & Chowdhry, 2003; Tseng et al., 2017), and have potential applications in different areas including sensors, bioprocessing, magnetic refrigeration, and ferrofluids (Dang, Zhu, & Xu, 2017; Park & Ha, 2018). The interest in nanosized materials originates from the fact that

new characteristics are at this nanoscale due to quantum confinement and finite size effects. The properties on this length scale are not only dependent on the size, but also on the type of materials. The possibility to selectively tune the size, shape and electronic states has motivated scientists to develop methods for the fabrication of a wide range of nanomaterials.

Magnetic iron oxide (Fe_xO_y , $\text{Fe}_3\text{O}_4/\text{Fe}_2\text{O}_3$) nanoparticles with sizes $< 100\text{ nm}$ denote a significant class of nanoscale material. Due to their excellent optical, magnetic and biological characteristics, nanosized superparamagnetic iron oxide nanoparticles have potential applications in the removal of industrial toxins, drug targeting, tissue engineering, bioimaging, contrast agents and separation of biochemical products (Skumryev et al., 2003; Zeng, Li, Liu, Wang, & Sun, 2002). There are few limitations for utilizing magnetic particles for practical applications in the biomedical field. The main limitation is the great level of aggregation and deterioration of morphological structures. This limitation could be avoided by a few approaches. Magnetic particles of smaller sizes with uniform size distribution could be used and surface functionalization of magnetic nanoparticles could be developed.

Generally, surface functionalization can be achieved by physical or chemical adsorption or modification of choosing molecules on the surface of nanosized particles. Coating of polymer layers on magnetic particles prevents the aggregation of nanoparticles and improves the chemical stability of the magnetic Fe_3O_4 nanoparticles. The modifying layer may also provide multifunctional optical, electronic, magnetic and other properties. For example, the coating layer on magnetic particles offers excellent photoluminescence, biocompatibility and stability against photo bleaching. Such nanocomposites could replace the fluorescent compounds in bio-assays and bio-imaging methods (Kim, Cho, Park, Mano, & Choi, 2018). A polymer can be coated on the surface of magnetic particles to result in a composite with multifunctional properties that could find applications in neural tissue engineering and drug delivery (Ma et al., 2018; Miculescu et al., 2017; Perera, Zhang, Homer-Vanniasinkam, Coppens, & Edirisinghe, 2018).

Biopolymer particles are prepared by mixing biopolymers (e.g. chitosan, NaAlg) with inorganic materials (e.g. SiO_2 and Fe_3O_4) (Jing et al., 2017; Tran, Prosenec, Franko, & Benzi, 2016; Zhao et al., 2017). Such bio-functionalized composites exhibit physical properties synergistically derived from both the polymer and the inorganic components. These composites can show superior physico-chemical and biocompatible properties in comparison to the pristine polymers. Recently, a new class of more effective nanostructured biopolymer composite including nanosized materials and biopolymers has been developed. Biopolymer nanocomposites are expected to have the advantageous features of composites and nano-sized nanoparticles due to their versatile characteristics and various applications in the biomedical field.

Core-shell nanocomposites in which the shell consists of biopolymer and the core consists of inorganic particles, have attracted interest due to their potential applications. In another type of polymer nanocomposite, inorganic nanoparticles are dispersed as guests into biopolymers (hosts). Such biofunctionalized composites

depend on their components and are suited to various biomedical applications. Preparation of such biocomposites involving metal nanoparticles and biopolymers will be significant. Such nanostructured composites may have exciting multifunctional properties and features when applied to the biomedical field (Gao, Goriacheva, Tarakina, & Sukhorukov, 2016; Neufeld, Ware, Lutzke, Khetani, & Reynolds, 2016; Zhang et al., 2017).

Among the inorganic nanostructured materials, magnetite nanoparticles (Fe_3O_4 NPs) have received attention due to their potential applications in drug targeting, contrast agents and bioimaging. Fe_3O_4 NPs can be incorporated into polymers to prepare biopolymeric hybrids. These biohybrids are expected to have the properties of both the biocompatible polymer and the magnetite particles. A core-shell type magnetite-polymer nanocomposite was prepared by using surfactant templating (Ge et al., 2017; Shen, Ma, Yu, & Ji, 2016). The synthetic process involved the synthesis of magnetite NPs using the precipitation-oxidation technique followed by a polymerization reaction in the presence of magnetite NPs and sodium dodecylbenzenesulfonate. The composite particles were in a spherical shape with diameters >50 nm. Fe_3O_4 -crosslinked polymer composite has been prepared by using formaldehyde as a cross-linking agent (Deng et al., 2002). It was reported as a 'one step method' for the preparation of polymer/ $\gamma\text{-Fe}_2\text{O}_3$ composite (Sun et al., 2016, 2017). In this method, FeCl_3 plays a dual role as an oxidant for the polymerization of monomer and a source for the formation of $\gamma\text{-Fe}_2\text{O}_3$ particles. This review addresses several aspects such as synthesis methodologies and characteristics of magnetic nanoparticles, surface functionalization with various biopolymers and applications such as antibacterial agents and magnetic resonance imaging (MRI) T2 contrast agents. Microbiological aspect of MRI contrast agents for visualizing bacteria, fungi and viruses is also discussed.

1.1 Magnetic iron oxide nanoparticles

In recent years, the preparation of magnetic nanostructured materials, especially Fe_3O_4 NPs, has been given importance to their potential applications ranging from nanoelectronics to medical diagnostics and drug delivery. These nanoparticles show unique optical, chemical and magnetic properties (Malyutin et al., 2015; Seeni et al., 2017).

1.1.1 Synthesis of magnetic nanoparticles

Decomposition of organometallic precursors in the presence of surfactants is generally employed as a method for the preparation of dispersed magnetic nanoparticles. The organometallic compounds such as the metal carbonyls and the coordinated metal complexes are generally used for the decomposition process, while a wide range of inorganic metal salts can be reduced to the metal species by the reducing agents through chemical methods. In the presence of organic surfactants, the Fe_3O_4 NPs that are readily synthesized and well dispersed in the solvents to form stable dispersions of nanoparticles. Such a solution-phase chemical method is useful for making well dispersed magnetic nanoparticles (Hou et al., 2016).

Iron nanoparticles were prepared by high-temperature decomposition of iron precursors such as iron pentacarbonyl, $\text{Fe}(\text{CO})_5$ (Burke & Dawson, 2002), or the reduced decomposition of iron (II) bis(trimethylsilyl) amide (Dumestre, Chaudret, Amiens, Renaud, & Fejes, 2004), or other iron salts, in the presence of alkyl amine or alkanolic acid. Besides iron particles, iron oxide ($\gamma\text{-Fe}_2\text{O}_3$) nanoparticles are more stable and can be readily synthesized. Fe_3O_4 nanoparticles were prepared via high-temperature organic-phase decomposition of iron pentacarbonyl followed by oxidation (Yu, Falkner, Yavuz, & Colvin, 2004) or decomposition of iron carboxylate. Also, Fe_3O_4 nanoparticles were synthesized by various wet-chemistry techniques, such as chemical co-precipitation, the reverse micelle process, one-step-hot injection, ultrasound irradiation, laser pyrolysis techniques and high-temperature hydrothermal method (Zhu, Zhao, Chen, & Shi, 2007).

1.1.2 Strategies for surface functionalization of magnetic nanoparticles

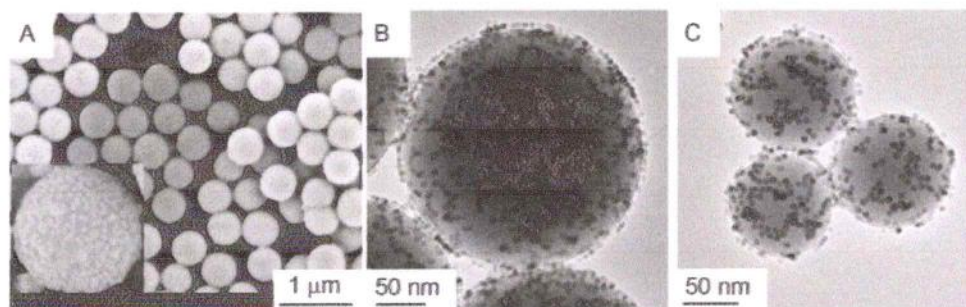
The magnetic nanoparticles can be functionalized with different functional reactive groups such as $-\text{COOH}$, $-\text{NH}_2$, and $-\text{SH}$ on the surface of the nanoparticles. Two general methods are available for the surface modification of nanoparticles: (i) addition of a surfactant and (ii) exchange of surface surfactant. In comparison to the surfactant addition method, the surfactant exchange process leads to stronger chemical bonds to result in more stable hydrophilic nanoparticles. For this reason, the exchange method has been much researched and a wide range of water-soluble Fe_3O_4 NPs have been produced. Also, the surfactant exchange reaction has been used for coating a silica layer over the surface of Fe_3O_4 particles to improve the solubility of modified nanoparticles that are suitable for attaching the biomolecules (Bruce & Sen, 2005).

It was reported (Wang, He, Rosenzweig, & Rosenzweig, 2004) that surface of $\gamma\text{-Fe}_2\text{O}_3$ particles were modified with thiol (SH) groups and carboxyl (COOH) groups to coat quantum dots (QDs) of CdSe@ZnS as a shell. A single layer of QDs was formed on the surface of functionalized $\gamma\text{-Fe}_2\text{O}_3$ nanoparticles via the formation of thiol-metal (S-M) bonds to form hybrid nanoparticles with both luminescent and magnetic properties (Fig. 1). Kim et al. (2006) synthesized multifunctional silica nanoparticles by assembling nanoparticles of Au or CdSe@ZnS or Pd on the



FIG. 1

The carboxy ($-\text{COOH}$) and thiol ($-\text{SH}$) functionalized $\gamma\text{-Fe}_2\text{O}_3$ particles that react with CdSe@ZnS quantum dots to form hybrid particles with luminescent and magnetic characteristics (Wang et al., 2004).

**FIG. 2**

(A) SEM, and (B and C) TEM images of multifunctional nanoparticles/Fe-silica spheres (Kim et al., 2006).

surface of Fe_3O_4 nanoparticles (Fig. 2). These composites exhibit magnetism, surface plasmon resonance, luminescence and catalysis depending on the components in them.

The surface functionalization of magnetic particles can also be done through organic vapour condensation (OVC), coating of the polymer layer, adsorption of surfactant molecules or organo silanation using a silane-coupling agent. A number of synthetic polymers in the range of (Abu-Much, Meridor, Frydman, & Gedanken, 2006; Flesch et al., 2005; Gómez-Lopera, Arias, Gallardo, & Delgado, 2006; Jacobo, Apesteguy, Lopez Anton, Schegoleva, & Kuryandskaya, 2007; Nunes et al., 2006; Sun et al., 2007; Vestal & Zhang, 2002; Wu, Guo, Yang, Wang, & Fu, 2006; Xu, Cui, Tong, & Gu, 2006) have been used for functionalizing the surface characteristics of Fe_3O_4 NPs to achieve the required surface multi-functionalities through different strategies. Wu et al. (2006) described a two-step process to synthesize poly (acrylic acid) polymer spheres that have magnetic behaviour (Fig. 3). In this method, firstly chitosan cores with Fe_3O_4 nanoparticles were synthesized through the self-assembling process of chitosan with positive charges then Fe_3O_4 NPs with negative charges and acrylic monomer molecules were polymerized on the magnetic core. They also used such composites for release of the captured ammonium glycyrrhizinate.

Flesch et al. (2005) prepared biocompatible and magnetic core-corona poly (ϵ -caprolactone) hybrid nanoparticles by the ring-opening polymerization reaction of ϵ -caprolactone monomers that initiated from the surface of organosilane modified Fe_2O_3 (maghemite) particles as shown in Fig. 4.

Sun et al. (2007) synthesized Fe_3O_4 @polystyrene core-shell nanoparticles (Fig. 5) by surface-initiated atom transfer radical polymerization (ATRP) of styrene monomers on the surface of an ATRP initiator that covalently bonded magnetic nanoparticles. Xu et al. (2006) prepared Fe_3O_4 /polystyrene/silica nanospheres via combined miniemulsion/emulsion polymerization. Likewise, several other polymers such as poly(ethyl methacrylate-*co*-methacrylic acid) (Nunes et al., 2006), polystyrene (Vestal & Zhang, 2002), PVA (Abu-Much et al., 2006), poly(lactic acid) (Gómez-Lopera et al., 2006), and polyaniline (Jacobo et al., 2007) were functionalized onto magnetite nanoparticles by different strategies.

6 Functionalized magnetic nanoparticles/biopolymer hybrids

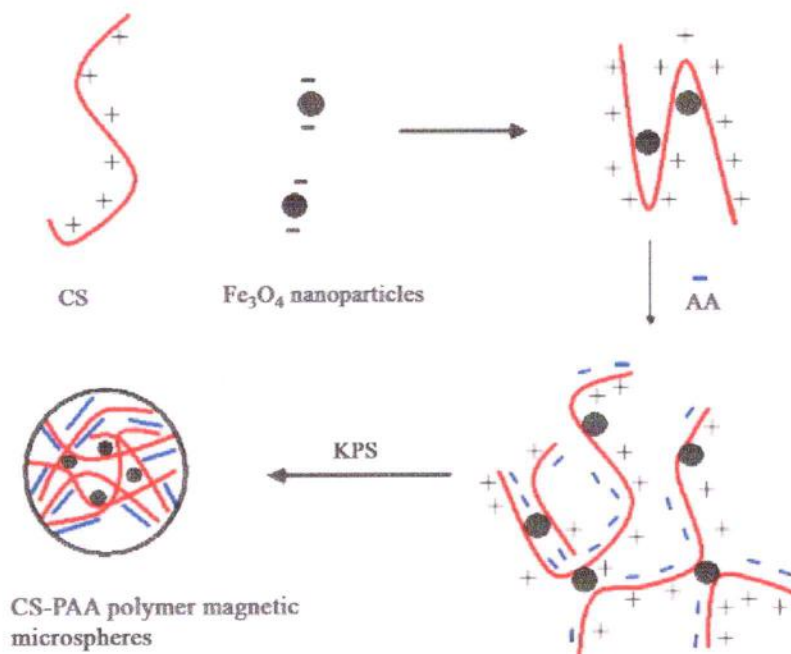


FIG. 3

Illustration of the formation mechanism of chitosan-polyacrylic acid- Fe_3O_4 composites (Wu et al., 2006).

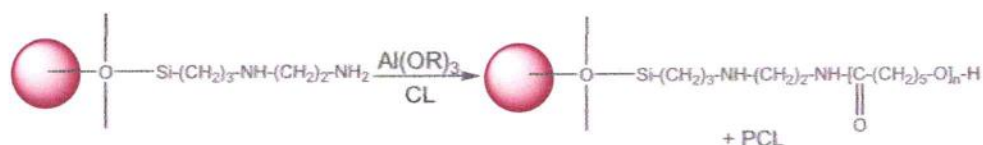


FIG. 4

The synthetic methodology for the ring-opening polymerization of caprolactone monomers from the surface of silane-functionalized Fe_3O_4 nanoparticles (Flesch et al., 2005).

1.1.3 Biomedical applications of functionalized magnetic nanoparticles

Nanosized magnetic particles are used in a variety of applications in ferrofluids, drug delivery, bioimaging, targeting, magnetic resonance imaging (MRI), separation of biochemicals, biosensors, biological cell labelling and sorting, and removal of toxic industrial waste (Wang et al., 2005). Most of these potential applications require surface functionalization of very small sized magnetic nanoparticles as a prior step before using them in practical applications. Applications of such composite materials are dependent on the biopolymer coated magnetite particles. Takafuji, Ide, Ihara, and Xu (2004) synthesized poly (1-vinyl imidazole)-grafted maghemite ($\gamma\text{-Fe}_2\text{O}_3$) particles (Fig. 6) and these composite particles were utilized for the separation and recovery of heavy metal ions (Cu^{2+} , Ni^{2+} , Co^{2+} , etc.) from industrial effluents.

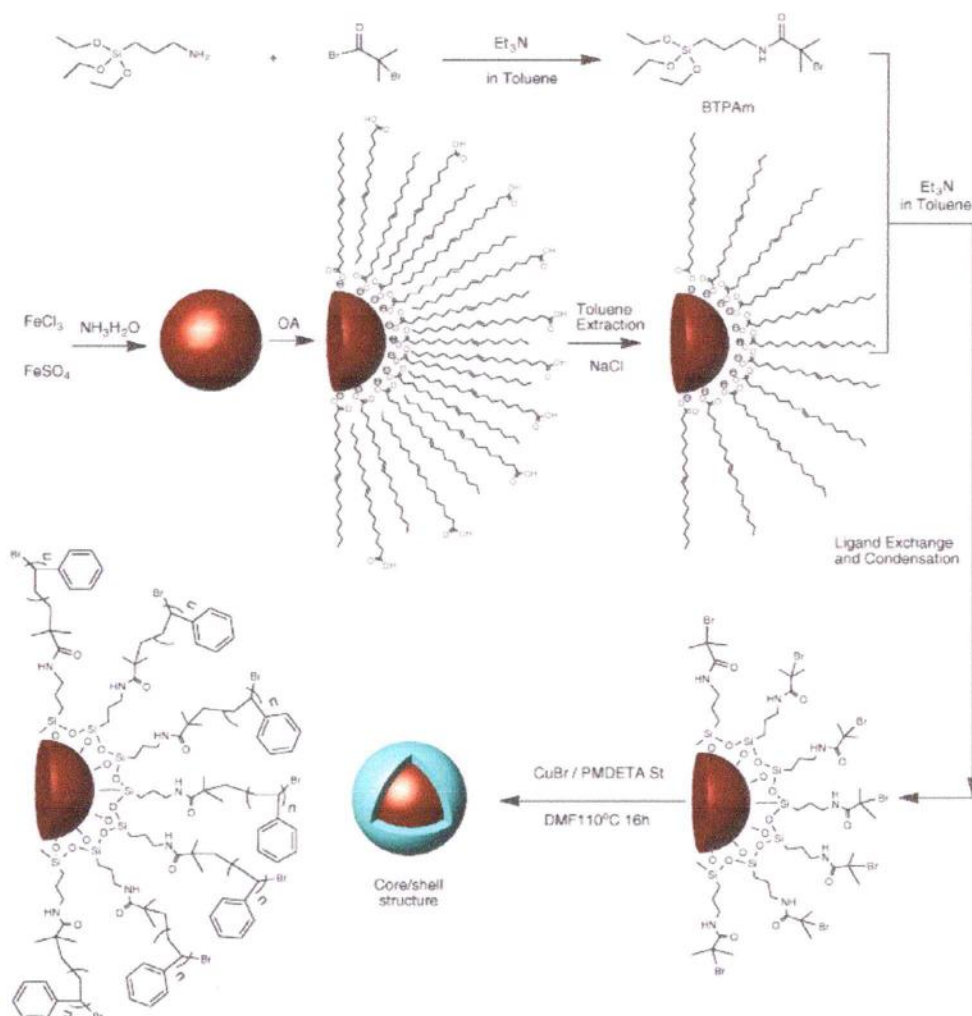


FIG. 5

Illustration of the synthesis route of polystyrene (shell) coated Fe_3O_4 (core) particles (Sun et al., 2007).

Yang, Park, Yoon, Huh, and Haam (2006) prepared poly (caprolactone) coated magnetic particles (Fig. 7) via an emulsion process and the composite was used as a drug carrier for targeted delivery. Other researchers (Wuang, Neoh, Kang, Pack, & Leckband, 2007) prepared Fe_3O_4 -polypyrrole composites which exhibit high sensitivity to relative humidity and a few of the common gases (N_2 , O_2 , and CO_2).

Among other inorganic nanoparticles, iron oxide (Fe_xO_y , $\text{Fe}_3\text{O}_4/\text{Fe}_2\text{O}_3$, magnetite/maghemite) NPs have received great attention due to their excellent magnetic, optical, electronic and biocompatible properties with wide-ranging applications in diverse areas. Fe_3O_4 displays exciting characteristics due to the presence of Fe cations in the two valence state such as the divalent ion (Fe^{2+}), and the trivalent ion (Fe^{3+})

8 Functionalized magnetic nanoparticles/biopolymer hybrids

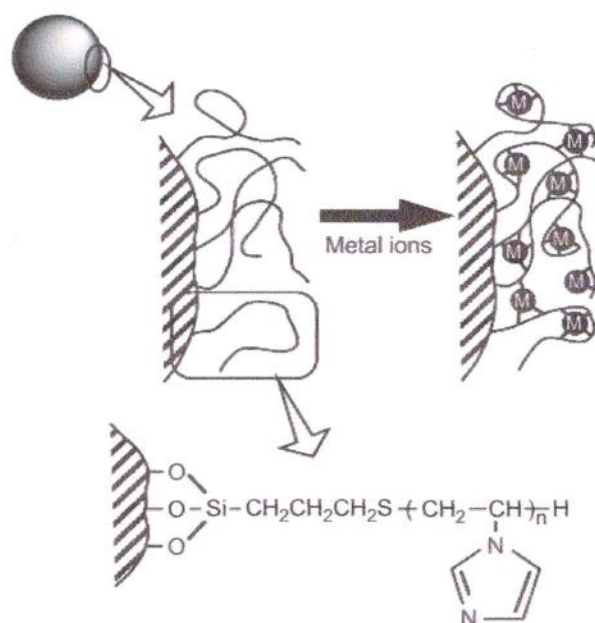


FIG. 6

Illustration of poly (1-vinyl imidazole)-grafted Fe_3O_4 nanoparticles (Takafuji et al., 2004).

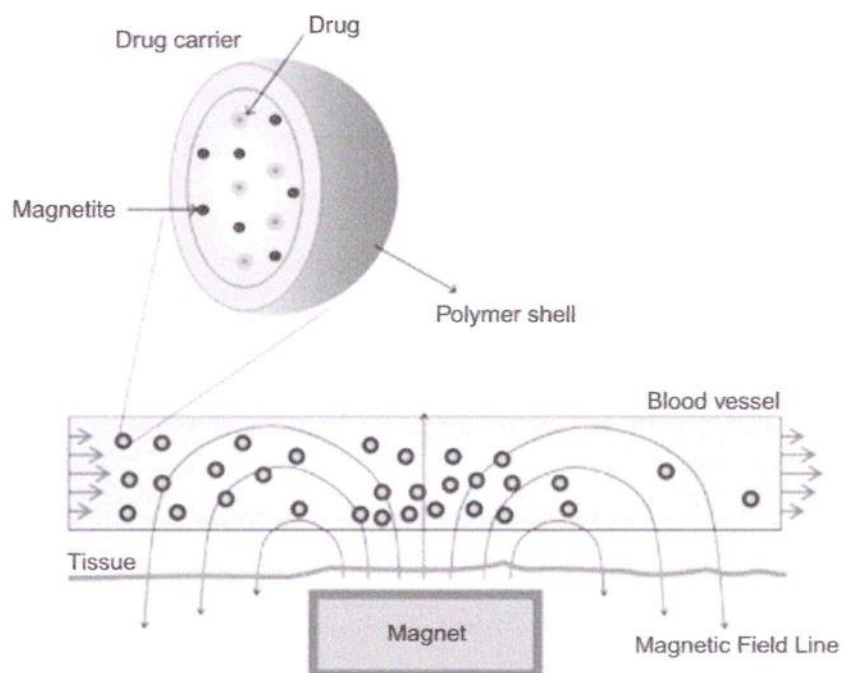


FIG. 7

The scheme illustrates the release of drug molecules by the Fe_3O_4 drug carriers (top). Magnetic nanoparticles are located inside the polymer shell and magnetic drug carriers break into the target zone and release the drug molecules (Yang et al., 2006).

(Fe_3O_4 could be described in the form of $[\text{Fe}^{3+}]_A[(\text{Fe}^{2+}, \text{Fe}^{3+})]_B\text{O}_4$, where A denotes tetrahedral sites and B for octahedral sites). The magnetic Fe_3O_4 ferrofluids have applications in various fields such as biomedical engineering, optoelectronics, catalysis, and nanophotonics due to their basic ferromagnetic behaviour. However, the small size Fe_3O_4 nanoparticles tend to easily agglomerate due to their anisotropic dipole-dipole attractions between particles. Therefore, it is necessary to prevent such agglomerates between particles. The surface coating of various biopolymers on the surface of Fe_3O_4 NPs can improve compatibility with the organic ingredients, significantly decreasing susceptibility to leakage and avoiding aggregation.

The magnetic biomaterials are a novel class of multifunctional materials that have characteristics of synthetic biopolymers and magnetic materials (ferri and/or ferromagnetic nanoparticles encapsulated in a biopolymer matrix). Such materials are designated as 'magneto-biopolymeric materials' (Chen et al., 2018; Wang et al., 2007). Such nanohybrid magnetic materials can be fabricated by the combination of nanoscale magnetite and a soluble biopolymer. The magnetic-biocompatible properties and other combinations are predicted due to the strong interactions between the magnetic particles and the polymer matrix. Fe_3O_4 /polymer composite nanospheres prepared by facile mini-emulsion polymerization method were and further functionalized with a cancer antibody and Herceptin.

2 Superparamagnetic nanoparticles (SPIONs)

Magnetic nanoparticles (MNPs) are widely used in biological applications as a platform for several immunoassays, drug delivery, drug targeting, bio-separation techniques like cell sorting, contrast agents for the magnetic resonance imaging systems and as heating intermediates for the therapy of cancer or hyperthermia which is mainly attributed to their unique feature of reacting to a magnetic force (Karimi, Karimi, & Shokrollahi, 2013).

Contrast agents can be defined as a medium to improve the visualization of the internal body structures through an X-ray based imaging system. The property of enhancing the visibility of an organ region leads to the term 'contrast enhancing agents' (CE). Iodine, barium is one of the radioactive compounds commonly used as a contrast enhancing agents in imaging techniques such as computed tomography (CT scanning), fluoroscopy and radiography. Other techniques in medical imaging include positron emission tomography (PET) and magnetic resonance imaging (MRI). MRI works based on the principle of change in magnetic properties of hydrogen nuclei in the nearest affinity of the contrast agent. Magnetic resonance (MR) imaging is a non-invasive diagnostic procedure with a resolution of about 25–100 μm . The relaxivity of the magnetic rotations in the water protons determines the sensitivity of MR imaging. In spite of the detailed images produced by MRI itself, a diagnosis purely based on the obtained images may not be correct, since the standard tissues and scratches show negligible or minor variations in the relaxation time. MRI contrast agents can aid the imaging technique to clarify images, for a better clinical interpretation.

The contrast arises due to different signal intensities in an MRI image coming from different volume elements. For example, fat, muscle and bone produce different signal intensities due to different concentrations of water protons. But, signal intensity also depends on the rate at which protons relax to the ground state from the excited state due to interactions with their surroundings and with other protons. A 'longitudinal' relaxation time, T_1 , is related to the transfer of energy from the excited protons to their surroundings and 'transverse' relaxation time, T_2 , is related to the exchange of energy between excited state and ground state protons. The relaxation rates, r_1 and r_2 , are the reciprocals of the times for the two processes.

The relaxation rates, $1/T_1$ and $1/T_2$ can be increased by varying degrees by different contrast agents and different applied magnetic fields. For example, Gd(III) complex based contrast agents tend to increase $1/T_1$ and $1/T_2$ by almost similar amounts, but T_1 weighted images typically give better images because of the dominance of the $1/T_1$ term in calculating the magnitude of the signal intensity. Contrary to this, ferrite particles tend to have a much bigger effect on the $1/T_2$ term and are usually used with T_2 weighted imaging (Paik et al., 2015).

Contrast agents can be of two categories such as (i) paramagnetic materials (e.g. lanthanides like gadolinium) that decrease the longitudinal (T_1) relaxation resulting in a brighter signal, and (ii) superparamagnetic iron oxide nanomaterials that affect the transversal (T_2) relaxation.

The paramagnetic complexes currently in use are gadolinium chelates, among which, Gd-DTPA is widely used. Gadolinium-based contrast agents improve the signal in T_1 -weighted imaging and are attentive on sensing the breaking of the blood-brain barrier (BBB) to track the variations in perfusion, vascularity, and flow dynamics (Nan et al., 2017). The major restriction of MR imaging is its low sensitivity which results in unclear diagnosis of abnormal tissues from normal tissues which can be considerably overcome by the use of nanoparticle agents such as MR imaging contrast agents (Ghasemian, Shahbazi-Gahrouei, & Manouchehri, 2015). Paramagnetic compounds like gadolinium and superparamagnetic nanoparticles such as iron oxides and ferrites are used as T_1 and T_2 contrast agents, respectively, in magnetic resonance imaging (MRI) serving as excellent diagnostic probes resulting in bright and intense signals (Im et al., 2013). There is an increasing need for engineered nanoparticles with a suitable coating material which may be a metal oxide, organic polymers or inorganic metals. These surface treatments enhance the probing efficiency of the nanomaterial by overcoming certain drawbacks such as low biocompatibility, solubility or dispersion in water solutions. The contrast efficiency of any magnetic nanoparticle to be applied in MR imaging can be influenced by several factors which include its size, surface area, magnetic spin, biocompatibility, toxicity and half-life.

2.1 Ferrite nanoparticles

It was first reported in 1978 that iron oxides can shorten the T_2 relaxation time (spin-spin relaxation time) of deionized water and later iron oxides were widely used as the magnetic resonance imaging (MRI) contrast agents. Ferrite nanoparticles are the most preferred among metal oxides for medical applications in the therapeutic

and the diagnostics fields due to inertness and physico-chemical properties that can be tuned by alternative synthesis parameters. The magnetic nano-size iron oxide is extensively used as an MRI contrast agent among the inorganic group due to its capacity to shorten T_2^* relaxation times in the liver, spleen and bone marrow, thus providing a solid contrast effect in T_2 -weighted images. Furthermore, the nanoparticulate characteristics exhibited by the nano-sized dimensions and the shape of Superparamagnetic iron oxide nanoparticles (SPIONs) allows diverse bio-distribution and opportunities beyond conventional imaging of chemical agents. SPIONs particles are very small, thermally agitated magnets in the carrier liquids, generally known as 'ferrofluids'. The property of superparamagnetism in SPIONs serves as an activation mechanism, and when the external magnetic field is detached, the magnetization vanishes, preventing the embolization of the capillary vessels (Laurent & Mahmoudi, 2011). Functionalized iron oxide nanoparticles along with the targeting agents were used for specialized imaging by the site-specific growth of nanoparticles at the target site of interest. The ferrofluids of Superparamagnetic iron oxide nanoparticles synthesized using sonication process showed high magnetization and crystallinity. These nanoparticles coated with an oleic acid as surfactant molecules and well dispersed in the chitosan matrix were investigated for the properties of the contrast agent in MRI. The different concentrations of ferrofluids were checked for agglomeration criteria. The ferrofluids showed good stability in the blood circulation as they did not agglomerate for 30 days. The results of T_1 - and T_2 -weighted MR images of these ferrofluids have equivalent potential to that of Resovist[®] (clinically approved superparamagnetic iron oxide based MRI contrast agent specifically for MRI of the liver) (Kim, Lee, Kwak, & Kim, 2005).

2.2 General synthesis protocols for ferrite nanocrystals

The synthesis of MNPs involves iron chemistry with nano-sized magnetite, iron-based nano-metal oxides, or iron alloys as core materials which could be carried out as a single-step procedure or as a sequential step process. Precipitations, solution combustion synthesis, reverse micelles, and thermal decomposition are some of the methods commonly employed in the synthesis of MNPs.

- (i) *Precipitation*: It is a basic method for the preparation of ferrous ions in an aqueous solution. Precipitation techniques can be broadly classified into two categories, namely, wet precipitation and chemical co-precipitation methods.

Wet precipitation: The nanoparticles are synthesized by manipulating the pH of the iron salt aqueous solution. One of the main disadvantages of this method is that the sizes of the resulting particles are large and it is greatly influenced by the pH parameter. Also, the volume of water required for the synthesis is large and so the scale-up process becomes problematic.

Co-precipitation: This method involves the preparation of Iron oxide particles (Fe_3O_4) by mixing two solutions each with a different stoichiometry of Fe^{2+} and Fe^{3+} ions and treating them with a suitable base.

- (ii) *Solution combustion synthesis (SCS)*: This method is frequently used when there is a need for highly pure, homogeneous, nanocrystalline powder. The SCS method utilizes fuels in the form of salt inorganic metal sulphates, nitrates, carbonates as oxidants and reducing agent fuels such as sucrose, glycine, and urea. SCS is based on the phenomenon that if a reaction is initiated using heat, an exothermic reaction occurs which is sustained by itself for a time period sufficient to synthesize the final product in the powder form. Also, the fuel-oxidant ratio plays a vital role in determining the morphology and the pore size of the nanoparticle. As the amount of fuel increases, the greater is the pore size of the resulting product. This method is cost-effective, consumes less time and energy resulting in extensive use for the fabrication of inorganic oxide nanoparticles (Mascolo, Pei, & Ring, 2013). Reverse micelles process can also be used to synthesis MNPs and the use of micelle formation occurs in a high concentration environment of amphiphilic surfactant molecules.

2.3 Surface-engineered superparamagnetic iron oxides (SPIONs)

The surfaces of SPIONs can be engineered to enhance various biomedical-related functions such as drug carrier characteristics, magnetic resonance imaging (MRI) contrast agents and hyperthermia (heat induction effect). The ferrite nanoparticles along with surface coatings in the form of ferrofluids find a major role in nanomedicine for molecular MRI. The core substance of the nanomaterial contributes to the contrasting ability while the biocompatibility and conjugation activity is rendered by the surface properties. A variety of biomolecules such as aptamers, polysaccharides, proteins, antibodies, and peptides can be covalently bound to the surface of iron oxide nanoparticles for their site-specific gathering at the targets of interest.

Most importantly, the biocompatible polysaccharides that are commonly used and preferred for coating/functionalizing the surface of MNPs are agarose, starch, carrageenan, chitosan, alginate, pullulan, dextran, heparin and hyaluronic acid. These polysaccharide agents are neutral or negatively charged (except chitosan which has a positive ionic charge) and requires few chemical modifications to enhance the gene interaction with the polymer surface coating on the MNPs (Uthaman, Lee, Cherukula, Cho, & Park, 2015). Some of the well-studied polysaccharides are listed in Table 1.

- (a) Alginates (Fig. 8) are anionic polysaccharides comprised of $\beta(1-4)$ linked D-mannuronic acid and $\alpha(1-4)$ linked L-guluronic acid residues that are found in the brown algal cell wall. Alginates are one of the preferred biomaterials, particularly in matrix supportive tissue repair and regeneration because of their high biocompatibility, chelating properties, and non-immunogenic characteristics.

Table 1 Properties and applications of polysaccharide-coated MNPs used for MR-imaging (Uthaman et al., 2015).

Polysaccharide	Occurrence	Charge	Functional groups	Surface modification for imaging purpose	In vitro/in vivo tests done
Alginate	Brown algal cell wall	-Ve	OH COOH	Alginate-poly-L-lysine-alginate (APA)	C2C12 myoblast cell line implanted into the abdominal cavity of mice
Chitosan	Exoskeletons of shrimp and other crustaceans (treated with NaOH)	+Ve	OH NH ₂	Chlorotoxin (CTX), Polyethylene glycol (PEG), Near-IR fluorophore (NIRF), Cy5.5	Brain Autochthonous medulloblastomas in genetically engineered ND2: SmoA1 mice
Dextran	Microbial product in wine	-	OH	FITC-derivatized Tat peptide	Haematopoietic and neural progenitor cells
Starch	Green plants	-	OH	Chelator DTPA	Male Fisher 344 rats induced with 9L-glioma brain tumours
Heparin	Animal tissues	-	OH OSO ₃ H	Polyethylene glycol(PEG) Gold-deposited Glycol chitosan Pluronic F-68	Tumour-bearing mice, induction of Squamous cell carcinoma(SCC-7) cells in male C3H/HeN mice by subcutaneous injection

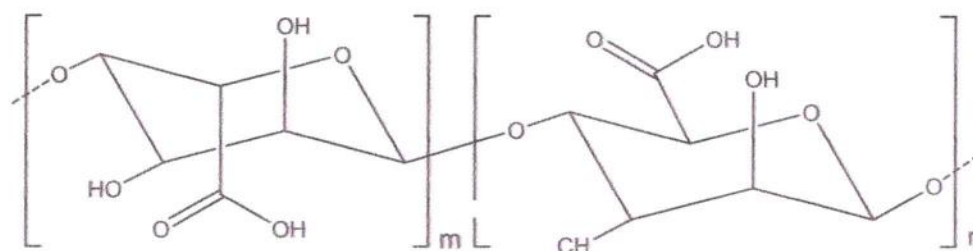


FIG. 8

The chemical structure of alginate.

Alginate-coated iron oxide nanoparticles can be synthesized by the following methods:

Method 1: (i) The gelation of alginate in an aqueous system containing ferrous ions, (ii) in situ precipitation of ferrous ion by alkaline treatment, and (iii) oxidation reaction of ferrous hydroxide using oxidizing agents such as O_2 or H_2O_2 .

Method 2: (i) Formation of the Fe_3O_4 particles through co-precipitation of ferrous (Fe^{2+}) and ferric (Fe^{3+}) ions by alkaline treatment and (ii) surface coating of the Fe_3O_4 particles with alginate.

The MNPs obtained by this method showed a core diameter of 5–10 nm and 193.8–483.2 nm after the alginate surface coating. The T_2 relaxivity of these SPIONs was higher than that of the clinically employed SPIONs, thereby proving the efficiency of the alginate-coated SPIONs as a negative MRI contrast agent (Tassa, Shaw, & Weissleder, 2011).

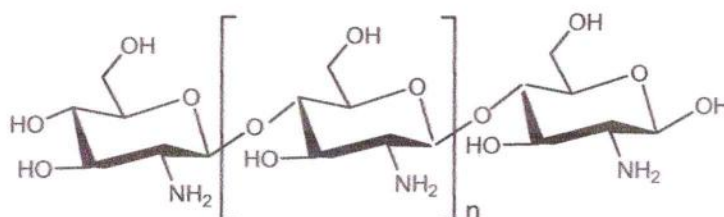
(b) Chitosan is a hydrophilic polysaccharide, a copolymer of a 2-amino-2-deoxy-D-glucose and 2-acetamido-2-deoxy-D-glucose unit with β (1–4) linkages usually attained by the deacetylation of chitin. Chitosan is rendered a biocompatible and stable particle in the presence of its functional amino ($-NH_2$) and hydroxyl ($-OH$) groups. The chemical structure of the chitosan allows the surface modification of SPIONs by physical adsorption and electrostatic interactions, thus eliminating the need for a cross-linker.

2.4 Synthesis of biopolymers-functionalized magnetic nanoparticles

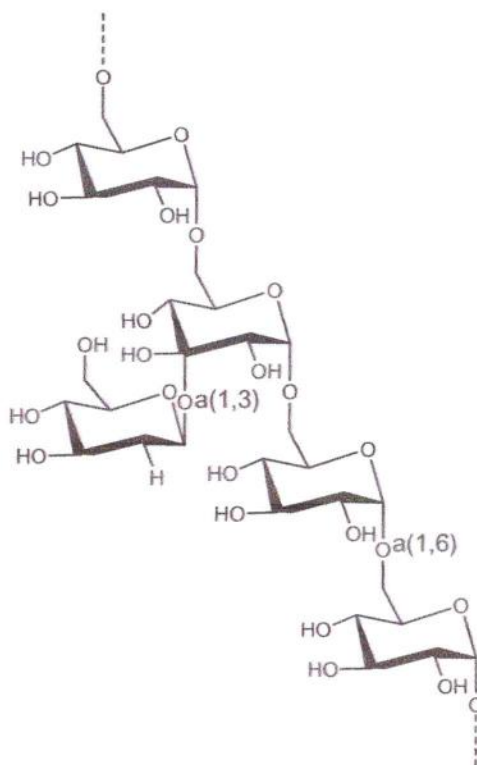
(i) In situ chemical co-precipitation of ferrous hydroxide by treating with an alkaline solution along with chitosan biopolymer (Fig. 9). (ii) Co-precipitation and then cross-linking.

Chitosan-coated iron oxide nanoparticles show high relaxivity which can be used as a potential MRI contrast agent for cell tracking (Tsai et al., 2010). Iron oxide nanoparticles modified with Polyethylene glycol (PEG)-grafted chitosan could be used as a nanoprobe with the capability of crossing the blood-brain barrier, target a brain tumour after modification by conjugation with chlorotoxin (a tumour-targeting agent) and a near infra-red fluorophore (Uthaman et al., 2015).

- (c) Dextran is a branched polysaccharide molecule composed of glucose molecules with a α -linked D-glucopyranosyl linear backbone (Fig. 10). Dextran-coated SPIONs are commercial clinical contrast agents for MRI applied in the nodal stage of cancers. The coupling of the dextran surface to the targeted ligands or labelled cells can be achieved using conjugation methods such as a robust bioorthogonal [4+2] cycloaddition reaction between 1,2,4,5-tetrazene (Tz) and *trans*-cyclooctene (TCO). To improve the functionality and the stability of dextran-coated magnetic particles, different functional groups may be coupled

**FIG. 9**

The chemical structure of chitosan.

**FIG. 10**

The chemical structure of dextran.

such as a carboxymethyl group that is cross-linked to epichlorohydrin. The cross-linked dextran-modified iron oxide particles (CLIOs) obtained by the cross-linking of a carboxymethyl functional group to epichlorohydrin, are found to be more stable than that of the dextran-coated SPIONs of the same diameter. The dextran-stabilized Fe_3O_4 NPs can be more effectively functionalized by conjugation with amine groups of biomaterials by epichlorohydrin treatment. The crosslinked Fe_3O_4 NPs conjugated with HIV-Tat proteins (CLIO-Tat) shows effective non-phagocytic cell labelling via activated macropinocytosis.

The antibody-conjugated CLIO was used in the in vitro targeted MR imaging of *E*-selectin in endothelial cells. The aminated cross-linked nanoparticles were made target specific by derivatizing the nanoparticles with a membrane translocation signal. The results proved that dual-labelled, dextran-modified MNPs can be utilized for the effective labelling of haematopoietic and neural progenitor cells, thus leading to in vitro single-cell visualization by MRI that can be applied in active molecular imaging which could effectively improve stem-cell based therapies (Nan et al., 2017; Uthaman et al., 2015). Dextran-coated superparamagnetic Fe_3O_4 NPs are the potential MR contrast agents for evaluating lymph nodes in the head and neck (Anzai, McLachlan, Morris, Saxton, & Lufkin, 1994). A recent study has shown that the Dextran sulphate-modified superparamagnetic Fe_3O_4 NPs can be applied as contrast agents for atherosclerosis imaging (You et al., 2014). Also, the non-invasive imaging of HER2/neu receptors using MRI can be efficiently aided with the help of targeted Herceptin-dextran Fe_3O_4 NPs (Chen et al., 2008).

(d) Starch is a polysaccharide containing repeating units of glucose joined by glycosidic bonds (Fig. 11). It consists of a functional hydroxyl group with a neutral charge and is a widely preferred material for the surface coating of MNPs.

Synthesis of starch-coated MNPs: Co-precipitation route followed by glutaraldehyde aided cross-linking of thiolated starch molecules (Cole et al., 2011).

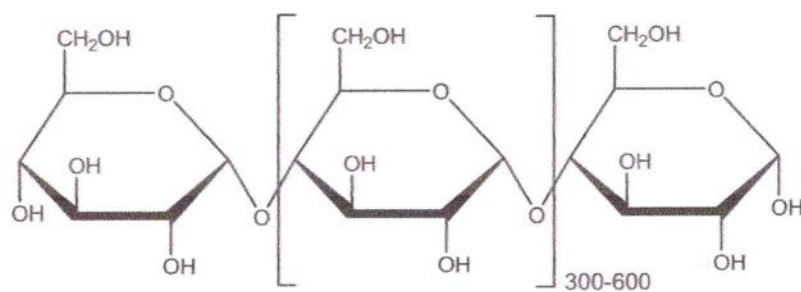


FIG. 11

The chemical structure of starch.

Polyethylene glycol functionalized, cross-linked starch-coated Fe_3O_4 NPs are widely used for improved magnetic tumour targeting (Tsai et al., 2010). The 5-carboxyl-fluorescein (FAM-A54) attached starch-coated Fe_3O_4 NPs (SIONs) shows specific affinity to the tumour cells as it gets accumulated in the hepatocellular cancerous tissue with more productivity than that of individual magnetic targeting or biomolecular targeting (Jiang et al., 2009).

- (e) Heparin is a polysaccharide consisting of Glucuronic acid linked to *N*-acetyl glucosamine (Fig. 12). It is an anticoagulant agent, and also has biological applications in MR imaging, drug delivery, and tissue engineering. The surface coating of MNPs with heparin enhances the hydrophilic characteristics of MNPs and therefore, facilitates the cellular attachment to the Fe_3O_4 NPs surface. Also, heparin-coated nanoparticles show higher stability and rapid internalization.

Synthesis of Heparin-coated MNPs: Alkaline coprecipitation—In this route, Fe^{2+} and Fe^{3+} ions are chemically co-precipitated in the alkaline solutions (NaOH, KOH, or NH_4OH). The synthesis is usually conducted at 70–80 °C or a higher temperature which is then followed by an in situ heparin surface coating.

Studies show that the Heparin-immobilized MNPs have been fabricated as tumour-targeting MRI agents due to their active interaction with the fibrinogen products in the tumour. Heparin-coated superparamagnetic iron oxide nanoparticles can be applied for in vivo MR imaging of human mesenchymal stem cells (MSCs) (Lee et al., 2012).

Other mixed metal-ferrites have been reported. For example, polyethylene glycol (PEGylated) manganese ferrite nanoparticles have shown excellent T_2 and r_2/r_1 values under low magnetic field. Also, the polymer shell of the PEGylated MNPs provides high stability in an aqueous system with increased crystallinity, magnetization values with long blood circulation times and minimized cytotoxicity (Pernia Leal et al., 2015). Also, the addition of Zinc ferrite into an inverse spinel structure such as Fe_3O_4 NPs is found to raise the net magnetic moment of the resulting mixed spinel structure which in turn enhances the T_2 relaxivity and improves the detection sensitivity of MRI (Barcena et al., 2008).

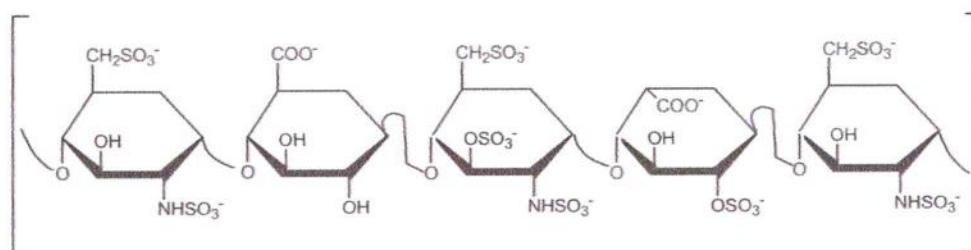


FIG. 12

The chemical structure of heparin.

2.5 The role of graphene oxide-ferrite nanoparticles in MR imaging

More importantly, the graphene oxide/manganese ferrite nano hybrids obtained by the thermal decomposition method has proven to be an effective T_2 -contrast agent as they show negligible cytotoxicity and hemolytic activity in *in vitro* and *in vivo* magnetic resonance imaging experiments (Thorek, Chen, Czupryna, & Tsourkas, 2006). The proton relaxivity value depends on the size, magnetic moment, spatial arrangement of nanoparticles, especially in the tissue environment that is infected. The framework of the nanoparticle needs to be controlled as an optimal arrangement for a significant increase in the proton relaxivity value. Graphene oxide serves as a suitable substrate for spatial distribution factor due to its hydrophilic, flexible and biocompatible nature on which nanoparticles with superparamagnetism can be organized in a controlled process. The structural and magnetic characterization of iron oxide nanoparticles containing different concentrations of graphene oxide studied using TEM analysis, XRD profile, XPS profile and Raman spectra revealed that the GO- Fe_3O_4 hybrid contained graphene oxide with the least extent of carboxyl group reduction and with larger spacing between the GO nanosheets to yield a very high transverse proton relaxivity value. Also, the cytotoxicity study of GO- Fe_3O_4 hybrid showed that this nanomaterial is biocompatible with normal cells while producing considerable toxicity in breast tumour cells, thus proving its efficacy as a theranostic agent (Venkatesha, Poojar, Qurishi, Geethanath, & Srivastava, 2015).

2.6 MRI for visualizing bacteria, virus and tissue infections

Soft tissue infections can occur in all age group people, particularly for elderly. Predisposing conditions such as the extremes of age, illicit drug abuse, immunosuppression, systemic diseases, peripheral vascular disease, trauma, burns, surgery, obesity, alcoholism, malnutrition, etc. It is clinically difficult to distinguish between disease techniques and the extent of disease. MRI is one of the techniques that evaluate soft tissue infections such as infectious cellulitis, superficial and deep fasciitis (necrotizing fasciitis, pyomyositis/soft tissue abscess, septic bursitis and tenosynovitis) (Chun, Jung, Baik, Jee, & Kim, 2018). Cellulitis is a superficial soft tissue infection which involves the skin and subcutaneous tissues. It is clinically analysed by tissue swelling, erythema, warmth, resulting from infection with gram-positive cocci. MRI of cellulitis shows thickening of the subcutaneous tissues, diffuse linear or ill-defined signal intensity of superficial soft tissue on fluid-sensitive sequences, and corresponding low signal intensity on T1-weighted sequences consistent with edema. Imaging after intravenous administration of contrast agent may show diffuse enhancement of the same areas.

Inflammation of superficial or deep fascial planes compatible with fasciitis is analysed by fluid tracking on imaging. It was found there was an enhancement of post-contrast imaging on post-contrast imaging with MRI (Struk, Munk, Lee, Ho, & Worsley, 2001). Pyomyositis is a pyogenic infection of skeletal muscle to abscess formation, which is a focal collection of inflammatory cells bacteria, and necrotic

tissue debris contained by hypervascular connective tissue. Healthy muscle is resistant to infection unless there is underlying trauma, systemic disease or metabolic abnormality. MRI delineates the extent of the process and identifies osteomyelitis or septic arthritis. Imaging properties include muscle enlargement with heterogeneous T2 signal hyperintensity with minimal hyperintensity on T1-weighted sequences in early phases, with T2 hyperintensity and a corresponding decrease in T1 signal intensity in liquefactive stages. MR imaging of an abscess shows a uniform to a slightly heterogeneous high-signal intensity focal lesion on fluid-sensitive sequences, with the corresponding intermediate to low signal intensity on T1-weighted imaging with peripheral enhancement on post-contrast sequences. Infective tenosynovitis is the result of penetrating trauma or extension of infection from adjacent tissues. MRI evaluates tenosynovitis. On MRI, hypointense T1W and T2W signal of fluid distending the tendon sheath is easily detected. The signal properties of the fluid can be changed when it contains debris, gas or blood.

Bacterial infection represents an increasingly serious problem in recent health care due to ageing populations, accumulating bacterial resistance to antibiotics, a higher rate of organ transplantation, etc. Infections vary in severity from self-limiting to potentially life-threatening, resulting in major morbidity and mortality, and increase of health care costs. MRI method has been used to detect and analyse brain abscess using CEST contrast inherently carried by bacterial cells (bacCEST) (Liu et al., 2017). In this process, Bacteria *S. aureus* and F98 and 9L glioma cells were injected stereotactically in the brains of F344 rats to form abscess and tumours. It was found that bacCEST MRI could detect the response of bacteria as early as 4 days after the antibiotic treatment in treated rats. Hence, it provides a new imaging method to detect, discriminate and monitor bacterial infection in deep-seated organs. Gadolinium-labelled aminoglycoside was developed and utilized as bacteria-targeting MRI contrast agent (Zhang et al., 2018). It efficiently targets bacteria over macrophage-like cells, indicates that it has the potential for imaging of bacterial infections in vivo. Therefore, MRI is preferred for clinical diagnosis due to its uses non-ionizing radiation and provides both spatial resolution and excellent penetration.

Gd-complex was loaded into the channel of tobacco mosaic virus (TMV), and the exterior was modified with silica particles (Bruckman, Randolph, Gulati, Stewart, & Steinmetz, 2015). It was found that the T1 relaxivities increased by threefold from 10.9 to 29.7 mm/s at 60 MHz compared to uncoated Gd-loaded TMV. In vitro assays and phantom MRI studies show efficient targeting and imaging of microphages, and an enhanced contrast-to-noise ratio was observed by silica-coated NPs. Thus, silica-coated protein-based contrast agent may offer potential candidate material for investigation of in vivo delineation of disease through macrophage imaging, distinguish sites of bacteria infection and non-bacterial infection (e.g. viral or fungal infections), biomarker detection, targeted bacterial imaging ranging from fundamental research on infectious diseases to diagnostic and therapeutics, and many in vitro and in vivo biomedical applications (Chen, Wang, & Li, 2016; Hingorani, Yoo, Bernstein, & Pagel, 2014).

2.7 Antibacterial activity of ferrite and its hybrid nanoparticles

It is known that ferrite NPs have unique characteristics such as high surface area, antimicrobial activity, porosity, elastic and magnetic behaviour and photocatalytic activity for the degradation of harmful chemical pollutants (organic hydrocarbons, cosmetics and organic dyes produced by industries such as textiles, leather, plastics, rubbers, paper). For biomedical applications, the magnetic ferrite nanoparticles require precise control of particle size, morphological structure, well dispersion, stabilizing colloidal dispersion in an aqueous environment and any other influencing parameters on these characteristics. Spinel ferrite nanoparticles with the formula MFe_2O_4 (where $M = Co, Mg, Mn$ and Zn) were synthesized using different methodologies such as microemulsion, high-temperature combustion, solid-state reactions, the chemical redox process, sol-gel process, chemical co-precipitation, high-temperature hydrothermal process, electrospinning, irradiation and microwave process. Their antibacterial properties were then investigated to fulfil the requirements of a drug delivery system so that antibiotic concentration could be minimized.

Maksoud et al. (2019) employed the citrate sol-gel method to synthesize metal-substituted spinel cobalt ferrite nanoparticles with the composition of $M_xCo_{1-x}Fe_2O_4$, in which $M = Zn, Cu, Mn$; $x = 0.0, 0.25, 0.5$ and 0.75 . The nanoparticles had an average pore radius, and pore volume of 1.84, 0.136 mL/g and a surface area in the range of 37.99–107.05 m^2/g . M-H hysteresis curves showed that, by replacing cobalt ions with other metal ions such as Zn, Cu, and Mn, the magnetic behaviour changed from ferromagnetic to paramagnetic. These nanoparticles were also investigated for their antibacterial and antibiofilm properties against some pathogenic bacteria (*Staphylococcus aureus*, *Enterococcus columbae*, *Aerococcus viridians*) that were isolated from medical operating room wall surfaces. The results of optimized and effective $Zn_{0.75}Co_{0.25}Fe_2O_4$ NPs (20 ppm) showed the activities of 15, 13 and 12 mm ZOI. Their antibiofilm generating activity factors were 63.7%, 57.9% and 45.5%, indicating that these nanoparticles have the potential for utilization in biological and medical applications. Sun et al. (2004) reported the synthesis of Fe_3O_4 nanoparticles by thermal decomposition of a reaction mixture containing an iron salt, 1,2-hexadecanediol, oleic acid, oleylamine and biphenyl ether to modify their surfaces with Ag nanoparticles for improved antibacterial activity. Another new strategy has been used to improve the antibacterial activity of ferrite nanoparticles for biomedical applications (Sanpo, Berndt, Wen, & Wang, 2013). It was observed that the substitution of spinel ferrite particles with transition metals can enhance the antibacterial ability and biocompatibility of nanoparticles.

Among various transition metals, doped ferrite NPs and copper-substituted ferrite NPs have the most effective antibacterial activity against *E. coli*. The ability for strong adhesion between a bacterial cell and a modified surface is controlled by various parameters such as the physico-chemical properties of the bacterium, physico-chemical characteristics of modified-ferrite NPs and environmental conditions under which the adhesion takes place (Bos, van der Mei, & Busscher, 1999). It was found that the amount of adhering cells on the glass surfaces decreased compared to transition metal-substituted cobalt ferrite NPs. The amount

of the adhered cells on the surface of NPs is in the order of $\text{Co}_{0.5}\text{Ni}_{0.5}\text{Fe}_2\text{O}_4 > \text{CoFe}_2\text{O}_4 > \text{Co}_{0.5}\text{Mn}_{0.5}\text{Fe}_2\text{O}_4 > \text{Co}_{0.5}\text{Cu}_{0.5}\text{Fe}_2\text{O}_4 > \text{Co}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$. The highest number of adhesion cells for $\text{Co}_{0.5}\text{Ni}_{0.5}\text{Fe}_2\text{O}_4$ is due to the difference in chemical composition, surface morphological nanostructure and roughness of NPs. The antibacterial properties of $\text{Co}_{0.5}\text{Ni}_{0.5}\text{Fe}_2\text{O}_4$ NPs (concentration of 1 g/L) were studied against *E. coli* and *S. aureus* with 10 repeated tests after culture incubation at 37°C. In comparison with the control (the sample of pure bacteria solution without ferrite NPs), Co-substituted ferrite NPs inhibit the growth of both bacteria. The rate that all ferrite NPs kill *E. coli* is higher than the rate *S. aureus* is killed. The antibacterial activity of Mn and Ni-substituted cobalt ferrite NPs are lower than that of pristine Co-substituted ferrite NPs. However, the antibacterial capability became strong when Cu and Zn were substituted into Co-ferrite NPs. This is due to changes that take place in the cell membrane morphology and the cytotoxic nature of Cu ions. Cu-ferrite NPs attach to the wall of the bacterial cell and penetrate through the cell membrane. The copper present in the NPs causes destruction of the bacteria cell wall, degradation and lysis of the cytoplasm, leading to cell death. Cu NPs have a large surface area that enhances bioactivity and makes them an effective bactericidal agent. Various ferrite nanoparticles-based antibacterial agents such as $\text{BaFe}_{12}\text{O}_{19}$, graphene oxide/ $\text{CoFe}_2\text{O}_4/\text{Ag}$, $\text{CoFe}_{1.9}\text{Bi}_{0.1}\text{O}_4$, Cr-substituted spinel copper ferrite NPs [$\text{CuCr}_x\text{Fe}_{2-x}\text{O}_4$], MgFe_2O_4 , Co-doped magnesium ferrite ($\text{Co}_{0.8}\text{Mg}_{0.2}\text{Fe}_2\text{O}_4$), Cr-substituted spinel copper ferrite [$\text{CuCr}_x\text{Fe}_{2-x}\text{O}_4$], Ce^{3+} doped CuFe_2O_4 , $\text{Ag}/\text{AgBr}/\text{ZnFe}_2\text{O}_4$, MFe_2O_4 (M = Mn, Mg)/reduced graphene oxide and polyrhodanine/ CoFe_2O_4 were synthesized through various chemical methodologies. Their antibacterial properties were investigated against *S. aureus*, *B. subtilis*, *E. coli*, *P. aeruginosa*, *S. marcescens*, *M. varians*, *A. flavus*, and *C. albicans* (Ansari, Baykal, Asiri, & Rehman, 2018; Ehi-Eromosele, Olugbuyiro, Taiwo, Bamgboye, & Ango, 2018; Elayakumar et al., 2019; Ghahfarokhi, Saravani, & Esmaeilzaei, 2017; Kirankumar & Sumathi, 2018; Kooti, Sedeh, Motamedi, & Rezatofghi, 2018; Sakho, Jose, Thomas, Kalarikkal, & Oluwafemi, 2019; Xu, Liu, Liu, et al., 2018; Xu, Liu, Xie, et al., 2018; Zachanowicz et al., 2018). These nanoparticles interact with the surface of bacterial cells and damage the cell membrane by the formation of pits, indentation, deformation and distortion of cell wall and membrane, leading to the death of cells.

3 Conclusions and future perspectives

The antibacterial agents are widely used in health care, food industry, hospitals for disinfection, and microbial control. Among various inorganic nanomaterials, magnetic-based functional nanomaterials exhibit excellent antibacterial properties. This paper discussed an overview of magnetic nanoparticles functionalized with various types of biopolymers, and inorganic metal or metal oxides to enhance the antibacterial ability. The antibacterial mechanism of various magnetic NPs-based hybrids are summarized.

The polymers-functionalized magnetic nanoparticles enable the delivery of therapeutic agents as well as in the imaging of the tumour tissues, thereby aiding in theranosis. The presence of functional groups on the surface-coated SPIONs can be used for bioconjugation with cell-targeting agents. Moreover, polymer surface modification of the magnetic nanoparticles enhances their stability, biocompatibility and concentration in *in vivo* circulation. Though polymers-modified magnetic particles seem to have substantial potency for concurrent imaging and therapeutic applications, there are several problems to overcome before employing this technique to clinical studies. For example, the research conducted in small animal models reveals greater potential for particle targeting than in larger animals and humans. This is due to more difficulty in the targeting sites located farther from the magnetic source.

There is an increasing need for the modulation and better functionalization of surface-engineered magnetic nanoparticles to modify or bypass the drawbacks posed by the SPIONs currently in use for MR imaging and antibacterial agents. Future studies must be focused on advancement in the use of superparamagnetic nanoparticles for nanoarticulation of the cells through cell-nanoparticle interaction.

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