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भारतीय स्वतन्त्रता संघर्ष के जनजातीय नायक

संपादक
आलोक कुमार चक्रवाल

7

स्व के आहुति में शहीद - वीर नारायण सिंह

-दिनेश कुमार मिश्र*
-हालसिंह देवांगन†

भारत के स्वाधीनता आन्दोलन से सम्बन्धित अनेक वीर सपूतों एवं शहीदों की जन्म स्थली के रूप में छत्तीसगढ़ की भूमि का विशेष स्थान रहा है। यह प्रान्त वर्तमान में भारत के मध्य क्षेत्र में स्थित मध्य प्रदेश के दक्षिण-पूर्वी भाग में अवस्थित है। छत्तीसगढ़ प्रान्त में इन वीरों की अनेक किस्से एवं कहानियाँ प्रचलित हैं जो आज भी लोगों के द्वारा बताए जाते हैं एवं कई ऐसे अमर गीत इनके लिए ही लिखे गये। भारत की आजादी के लड़ाई में देश के विभिन्न प्रांतों में जिस प्रकार स्वाधीनता के लिए जो संघर्ष हुआ इसका सीधा असर यहाँ के जनमानस के मस्तिष्क में भी हुआ अर्थात् छत्तीसगढ़ इससे अछूता नहीं रहा। यहाँ के लोगों में 'स्व' की भावना जागृत हुई। नतीजतन वे भी इसे अपना व्यक्तिगत कर्त्तव्य मानकर एकजुट होकर इस संघर्ष का हिस्सा बने।

1757 में हुए प्लासी के युद्ध से यह ज्ञात होता है कि भारत से अंग्रेजी सत्ता को उखाड़ने का यह प्रथम प्रयास था। लगभग अगले सौ वर्षों के दौरान भारत में ब्रिटिश शासन का काफी विस्तार हुआ। साथ ही हमें यह भी देखने को मिलता है कि देश के विभिन्न हिस्सों में इनके खिलाफ कई संघर्ष एवं आन्दोलन हुए। इन विपलवों में मीर कासीम का संघर्ष, पहाड़ी जातियों का संघर्ष, कोल संघर्ष, संथालों का संघर्ष, खासी संघर्ष, सिपाही आन्दोलन एवं बुन्देला आदि महत्वपूर्ण थे। इस प्रकार एक लम्बे समय तक इनके अत्याचारों एवं शोषणों के विरुद्ध आवाजे निरन्तर उठती रही। इनका परिणाम 1857 की क्रान्ति थी एवं एक दबी हुई चिंगारी ने एक विशाल ज्वालामुखी का रूप धारण कर लिया।

छत्तीसगढ़ एक अरण्य प्रदेश है। यहाँ आदिकाल से विभिन्न समुदाय के लोग निवास कर रहे हैं जिनमें वनवासी अथवा आज के आदिवासी कहे जाने वाले लोगों का बाहुल्य था। ये स्वतन्त्र एवं

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संपादक
आलोक कुमार चक्रवाल

Important Contribution of Tribes in Freedom Struggle

(With Special Reference to Mahli Bhagat)

-Dr. Nitesh Kumar Mishra*
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Abstract

This research paper is related to the tribal freedom fighter, who gave freedom to India. Tribal movement was first a religious and social reform movement which later transformed into a national movement. After thirty years of Birsa Munda movement, Jatra Oraon also started the Tana Bhagat movement in Oraon society. In which many tribal youth joined this movement in the influence of Gandhiji and made an important contribution to the freedom of India. One of these youths, who were influenced by the Tana Bhagat movement and traveled to the national movement, his name was "Mahli Bhagat". This paper also describes the Tana Bhagat Movement in detail. The research paper also include, especially the biography of Mahli Bhagat and the valuable contribution of his struggle and sacrifice in the freedom movement

Keyword - Padha self - government, Manki Munda self- government, Dhelki self - government, Manjhi Pargana self- government, Munda Andolan, Tana Bhagat Andolan, patriotism

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8
Thoughts Regarding Change in Caste System

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ABSTRACT

Indian caste system is a very complex and closed system. Many traditional, religious, political and ethnic theories have been given about its origin, but till date we have not been able to determine through which stages the development of this unique system took place. It is a fragmented and stratified division of society in which the work, position and marriage of man are pre-determined. In these sections there is a hierarchy of high and low in which the place of man is based on his birth. This is a strange institution, which had an impact not only on Hinduism but also on Islam and Christianity. Along with the negative side of the caste system, it also has some positive benefits. In the present time, the effect of modernization and globalization is seen on the caste system, in which inter-caste marriage is prominent. This paper highlights the positive, negative and changes taking place in the caste system.

Key words- *Caste System, Social Stratification*

I. Introduction

Today there are 3000 castes (refer book- Caste is social capital in India) and sub-castes in India, according to Hutton, an army is needed for the study of all these. There are many opinions about the origin of this institution. From Vedas, *Puranas* etc., many foreign and Indian scholars presented theories regarding its origin and development. There is a description of the caste system in the Rig-Veda, in which four castes were created from the four

organs, in Manu Smriti also a detailed discussion about this institution. Nesfield described profession as the basis of caste system, in which he told that the hierarchy of caste is determined on the basis of good or bad, high or low of profession. Risley considered the origin of caste as the cause of race while Ghurye linked the arrival of Aryans to the origin of caste system. In this way, there are many ideas regarding the caste system, but till now we have not been able to draw any conclusion. The people group was divided into four varnas on the basis of occupation - *Brahmin, Kshatriya, Vaishya and Shudra*, but when occupation was accepted as its birth right, and then caste hierarchy started which led to the emergence of the depressed or *Dalit* class and the feeling of untouchability.

Indian caste system is a closed system in which man gets his status innate. Many attempts were made to abolish or bring changes in the system, but all these did not have any special effect on the caste-system. The impact of the caste system was not only on Hinduism, but also on Islam and Christian religion, although the nature of the caste system in these two religions is not as it is in Hinduism. Even outside India, the caste system is seen in foreign countries like Nepal, Sri Lanka etc. The nature of the caste system in ancient India has been very frightening, with untouchability, high and low discrimination, and the mistreatment of the lower caste people by the so-called upper caste people. All this shows the negative side of the caste system. The nature of the caste system in ancient India has been very frightening, with untouchability, high and low discrimination, and the mistreatment of the lower caste people by the so-called upper caste people. All this shows the negative side of the caste system. In the present time, due to modernization, many policy and rules, there has been flexibility in the caste system, in which any person can do every work according to his ability caste does not have a role for his selection of work.

II. Review of Literature

Kumar Ashwini (2005) in his research paper "Theory of Uniqueness of Indian Caste System" has attempted to reflect the nature of caste hierarchy in pre-modern India which includes characteristics of caste system such as

restriction in food, restriction in marriage, choice of work. Written about restrictions etc. While Rao, Jasmine (2010) wrote in their research paper "The Caste System: Effects on Poverty in India, Nepal and Sri Lanka", the relationship between poverty and caste system in India, Nepal and Sri Lanka. She state that low castes still exist in Nepal. The people of the state cannot sit with the people of the upper castes. So far, they are doing less under bonded labor, only those with lower cast do menial jobs. Then Deshpande, Manali (2010) pointed out that the caste system is a closed system of stratification which is innate. In this arrangement the interaction of one group with another group is limited. Suresh Devnath (2016) in his research paper “Impact of cast system in India” told the Varna system to be the reason for the origin of caste system. In his research paper, describing the rules of Manu Smriti, untouchability, described the caste system as an obstacle in unity, democracy and social development. On the other hand Mary, S. Janet (2016) in their research paper "Shared Media Platform for the Eradication of the Evils of Caste Discrimination in the Education Institutions of India: A Case-study" describes the role of social media to replace caste discrimination in educational institutions. Sankaran et al. (2017) in their research article "The Role of Indian Caste System Inconsistent Norms on Status Representation" describes caste identity as a social identity in which a person is identified by the group he or she belongs to. Similarly Kapoor, Radhika (2018) told in their research paper that caste system is an integral part of society in India. Its structure, development, current status and changes have been described in India. While Gnana, Selvin Raj (2018) in his research paper "Caste system, Dalitization and its implications in contemporary India" mentioned the low economic status of pure and impure, who are considered as untouchables. At the same time, it was also told that in rural areas, they choose work and trade on the basis of birth and caste.

III. Objectives:

1. To study the views of different groups of people regarding the caste system.

2. Study of the relation of caste system with education, employment, area and age.
3. Based on the conclusion, give suggestions in the context of the caste system.

IV. Research Area & Methodology:

The present research has been conduct in three districts of Chhattisgarh, namely Mahasamund, Raipur and Gariaband, in which 185 people have been taken under Puposive sampling. Interview Schedule, non-participatory observation has been used for collection of primary data and internet, research papers and books have been used for collection of secondary data. MS Excel and SPSS16.0 versions have been used for the analysis of data.

V. Result & Discussion

Table No.1
Relationship of Education with Thoughts regarding change in caste system

S.N	Education	Thoughts regarding change in caste system								Total
		Good		Very Good		Normal		Not Good		
		N	%	N	%	N	%	N	%	
1.	litrate	2	11.11	1	5.5	5	27.77	11	61.1	18
2.	Primary	4	18.18	2	9.09	6	27.27	10	45.45	22
3.	Secondary	6	31.57	4	21.05	7	36.84	2	10.52	19
4.	high school	10	55.5	4	22.22	3	16.66	1	5.5	18
5.	higher secondary	2	9.52	7	33.33	11	52.38	1	4.76	21
6	Graduate	10	33.33	12	40	6	20	2	6.66	30
7	Postgraduate	9	28.125	11	34.37	8	25	3	9.37	32
8.	Illiterate	2	8	1	4	4	16	15	60	25

Table No.-1 shows the views of different educated class groups regarding the change in the caste system, in which maximum 61.1% of the people who only know how to sign themselves, do not consider this change to be good, while a minimum of 5.5% of the people considered very good. The maximum of 45.45% of the people who have taken primary education do not like the change of caste system while the minimum 9.09% of the people

consider this change to be very good. The thoughts of maximum 36.84% of the people who have taken secondary education are normal or indifferent, while according to the minimum 10.52% of the people, the change in this system is not good. This change is good for a maximum of 55.55% of the people who have studied up to high school, while this change is not good for a minimum of 5.5% of the people. Among the people who have studied up to Higher Secondary, maximum 52.38% of the people think about it as normal, whereas according to the minimum 4.76% of the people it is not good. Out of those who have completed graduation, maximum 33.33% is good for the people while the minimum 6.66% is not good for the people. It is very good for maximum 34.37% of the people who have completed post graduation while it is not good for minimum 9.37% of the people. Change in the caste system is not good for 60% of the illiterate people, while at least 4% of the illiterate people do not consider it good. As the anthropologist M.N.Srinivas, while describing the qualities of the Dominant caste, told that if a caste has a high population, economically and politically strong and strong socio-religious position in a particular area, then that caste is called Dominant caste. But later, along with the above qualities, higher education and administrative jobs etc. were also included in the characteristics of the Dominant caste. So we can say that caste hierarchy and untouchability can be eradicated by Higher education and Occupation.

Table No.2

Relationship of Age with Thoughts regarding change in caste system

S.N	Age	Thoughts regarding change in caste system								Total
		Good		Very Good		Normal		Not Good		
		N	%	N	%	N	%	N	%	
1.	18 or below 18	3	20	4	26.66	5	33.33	3	20	15
2.	18-23	8	29.62	9	33.33	2	7.4	4	14.81	27
3.	24-29	14	41.17	11	32.35	5	14.70	4	11.76	34
4.	30 -35	9	32.14	4	14.28	10	35.71	5	17.85	28
5.	36-40	6	23.07	6	23.07	5	19.23	9	34.61	26
6.	41-50	7	25	3	10.71	8	28.57	10	35.71	28
7.	Above 50	4	14.81	2	7.40	5	18.51	16	59.25	27

Table No.-2 shows the views regarding change in caste system in different age group in which maximum 33.33% of persons in age group of 18 or less than 18 have common ideas for change in caste system while minimum 20% of persons have ideas for change in caste system. This is not good in the age group of 18-23, maximum 33.33% people consider it very good while minimum 7.4% people think normal. In the 24-29 age group, maximum 41.17% people consider it good while minimum 11.76% people do not consider it good. The idea in this regard is normal for maximum 35.71% of persons in the age group of 30-35 while very good for minimum 14.28% of persons. It is not good for maximum 34.61% persons out of 36-40 age group. Maximum 35.71% people out of 41-50 age group don't consider it good while minimum 10.71% people find it very good. For the age group above 50 years, maximum 59.25% of the people do not consider it good while minimum 7.40% people consider it very good.

Table -5
Relationship of Area with Thoughts regarding change in caste system

SN	Area	Thoughts regarding change in caste system								Total
		Good		Very good		Normal		Very good		
		N	%	N	%	N	%	N	%	
1	Urban	31	32.64	28	29.48	25	26.32	11	11.58	95
2	Rural	14	15.56	9	10	11	12.23	56	58.95	90

Table number-5 shows the thought of change in the caste system of the people living in urban and rural areas, in which maximum 32.64% of the people in the urban area consider the change in caste system to be good while the minimum 11.28% of the people do not consider it good. | In rural areas, maximum 58.95% people do not consider this change to be good, while minimum 10% people consider it very good. As Ghurye said that there are still some people who want to bring back the old form of caste system, this data shows that illiterate, rural and old people want to maintain the existence of caste system.

Table No.3

Relationship of Employment with Thoughts regarding change in caste system

SN	Employment Status	Thoughts regarding change in caste system								Total
		Good		Very good		Normal		Not good		
		N	%	N	%	N	%	N	%	
1	Agriculture	6	17.14	7	20	18	51.42	4	11.42	35
2	Job	26	46.43	14	25	6	10.72	12	21.43	56
3	Trade	15	34.09	7	15.91	8	18.18	14	31.82	44
4	Wage	4	17.4	6	26.08	9	39.13	4	17.4	23
5	Unemployed	11	40.75	7	25.93	5	18.52	4	14.82	27

Table number-3 mentions the views of persons related to various employments in relation to the change in caste system, in which the maximum 51.42% of the people in the farming class are normal regarding change in cast system, while the minimum of 11.42% of the people do not consider it good. A maximum of 46.43% of the people in the job profession consider this change to be good while the minimum 10.72% of the people have a Neutral thought about it. Among the business class people, maximum 34.09% people consider it good while minimum 15.91% people consider it very good. A maximum of 39.13% of the working class have a Neutral thought about this change, while the minimum 17.4% of the people consider it good. Maximum 40.75% unemployed people consider this change to be good while minimum 14.82% unemployed people do not consider this change good.

Table No.4

Relationship of Education with Thoughts on the essentiality of caste system

S.N	Education	Thoughts on the essentiality of caste system						Total
		Essential		Not Essential		Normal		
		N	%	N	%	N	%	
1.	Educated	10	33.33	7	23.34	13	43.34	30
2.	Primary	8	38.09	7	33.34	6	28.57	21
3.	Secondary	11	42.3	5	19.23	10	38.47	26
4.	high school	6	33.33	9	50	3	16.66	18
5.	higher secondary	8	25.8	14	45.16	9	29.03	31
6	Graduate	6	28.57	11	52.38	4	19.04	21
7	Postgraduate	6	26.08	12	52.17	5	21.73	23
8.	Illiterate	10	66.6	4	26.66	1	6.66	15

Table number-4 shows thought about essentiality of caste system in different education group and uneducated people , in which maximum 43.34% of the educated persons are considered as sane, while the minimum 23.34% of the people do not find it necessary. A maximum of 38.09% of the people who have taken primary education find the caste system necessary while the minimum of 28.57% of the people think in this regard is normal. , A maximum of 42.3% of the people who have taken secondary education find it necessary, whereas according to the minimum 19.23% of the people it is not necessary. It is not necessary for maximum 50% of the people who have studied up to high school, while the idea of minimum 16.66% of the people is normal. A maximum of 45.16% of the people who have studied up to higher secondary do not consider it necessary, whereas according to the minimum 25.57% of the person it is necessary. The caste system is not necessary for a maximum of 52.38% of the people who have studied up to graduation, while the views of a minimum of 21.73% of the people are common in this regard. The caste system is not necessary for a maximum of 52.17% of the people who have studied up to post-graduation, while the idea of a minimum of 21.23% of the people is normal. Caste system is necessary for 66.6% of the illiterate persons, while the idea of minimum 6.6% of the illiterate person is indifferent in this regard.

VI. Conclusion & Suggestion: -

In the present research, it has come to the fore that people's education, employment and area are related to the caste system and the idea of change in it, to understand. Whether it is necessary in the society or not. Especially of education, because those who get higher education consider it necessary to change the caste system. Due to various elements of modernization, westernization, globalization and administrative rules, the complexity of caste system is gradually decreasing. The complexity and rigidity in the caste system led to the rise of untouchability, which is being eradicated at present due to the effects of higher education and urbanization. On the basis of the facts obtained, it can be said that the present young generation is in favour of change in caste

system due to the effect of constitutional and administrative law and higher education. Hence; In India, caste hierarchy and untouchability can be eradicated with proper education and awareness of equality.

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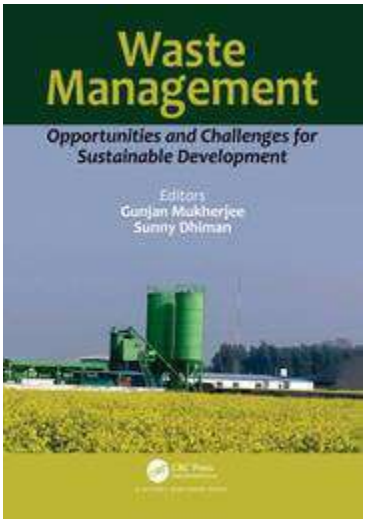

Chapter

Impact of Enzymes Based Treatment Methods on Biodegradation of Solid Wastes for Sustainable Environment

By *Nistala Shweta, S. Keshavkant*

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ABSTRACT

The day-by-day rise in the total amount of solid waste is becoming one of the major global environmental issues. Solid waste production is coupled with the different sectors like wastewater treatment plants, municipality, industrial, medical and pharmaceutical, domestic, agriculture, mining and other community activities. It is strongly associated with the increase in the air, water and soil pollution. It contaminates the environment, disturbs the ecosystem, and also influences the overall health of the human population. Hence, proper disposal, and treatment of solid wastes are essentially required. Degradation by the living systems/or biodegradation has helped in the proper management of the accumulated wastes to a certain extent. Further, developments in the technologies have introduced various new and effective methods for safer degradation of solid wastes. One such type is the application of enzyme extracts (known as enzymatic bioremediation) for the treatment of solid wastes. This Chapter emphasizes the types of solid waste, its disposal, fate in the environment, and toxicity. It also explores the different treatment methods and more specifically the enzyme-based degradation. The different types of enzymes involved in the degradation, their mechanisms of action, and case studies of few of the successfully treated wastes are also discussed.

DE GRUYTER

STEM

ESSENTIAL OILS

SOURCES, PRODUCTION AND APPLICATIONS

Edited by Rajendra C. Padalia, Dakeshwar K. Verma, Charu Arora and Pramod K. Mahish

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Contents

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Chapter 3
Sources and raw materials of essential oils

Abstract: Essential oils are the extracted products obtained from various parts of the plant using different extraction methods (distillation, enfleurage, and expression methods). It is a special ingredient in aromatherapy, which is a part of treatment. It contains specific or characteristic aroma of plants from which it is extracted. Because of this unique character, it has several pharmacological values in today's life. It can be removed from the dry and fresh parts of a plant using a suitable solvent or method of extraction. They have various therapeutic effects like mood enhancers, stress reducers, and treatment of headaches, but in higher concentration, they may show some side effects. Hence, it is mandatory to dilute it before use. This study suggests that more well-designed clinical trials are required to ascertain these plant products' efficacy and safety.

Keywords: extraction, essential oils, aromatherapy, distillation

3.1 Introduction

Essential oils are the extracted products obtained from various parts of plants using different extraction methods. Ethereal oil, volatile oil, or aromatic oils are synonyms of essential oil. It is a key ingredient in aromatherapy, which is a part of treatment. It contains a specific or characteristic aroma of plants from which it is extracted. It is a hydrophobic liquid containing a volatile compound with the nature of evaporation at room temperature. Essential oils are top-rated for use in medicinal and cosmetic fields [1].

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Chapter 6
Extraction, production, and encapsulation of essential oils

Abstract: This chapter describes various traditional and modern technologies that are available for the extraction of essential oils from medicinal and aromatic plants. This chapter also describes the principles and mechanisms of various essential oil extraction techniques, feasibility, factors affecting the extraction process, benefits, merits, and demerits. This chapter further describes various encapsulation techniques required for imparting stability to essential oils.

Keywords: Medicinal plants, Essential oils, Extraction methods, Encapsulation of oils

6.1 Introduction

6.1.1 Biodiversity hotspots

Biodiversity hotspots are those geographic areas that encompass rich collection of diversified species, but are endangered. Biodiversity hotspots are usually poorly maintained, and need conservation and preservation. A biodiversity hotspot is defined as an area that has 30% or less of its original natural vegetation found nowhere else on the planet. There are currently 36 such biodiversity hotspots in the world. Although these hotspots represent just 2.3% of the Earth's land surface, they support more than half of the world's plant species and nearly 43% of the bird, mammal, and reptile and amphibian species [1, 2].

Interestingly, India, which has just 2.4% of the world's land area, accounts for nearly 7–8% of all the recorded species, including over 91,000 species of animals and 45,000 species of plants. Due to the diverse climatic conditions, different varieties of the ecosystem, such as wetlands, forests, grasslands, marine and desert

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Pramod Kumar Mahish and Ashish Kumar

Chapter 7
Bioactivity of essential oils – anticancer, anti-HIV, antiparasitic, anti-inflammatory, and other activities

Abstract: Mushrooms are macrofungus and they have been widely used since ancient times as food. It has wealthy resources for various biologically active components; it is immensely valued for its functional and medicinal purposes because of its distinctive flavors and textures. Mushrooms have well-known nutritional value that can be compared to many vegetables and act as a substitute for meat. Some edible mushrooms are well-known sources of volatile oils. With various sophisticated equipment and standard procedures, a library of volatile and nonvolatile mushrooms has been generated. They play a significant role in antimicrobial, anticancer, anti protozoan, and other dimensions, benefitting the human health. The present chapter focuses on mushroom oils, and their extraction and quantification process – and their biological importance, in detail. The chapter will be the pathway for current research development and for future research.

Keywords: Biologically active components, nutritional value, volatile oils, anticancer

7.1 Introduction

Mushrooms are macrofungi, with spore-bearing structures, and are commonly found on the soil surface as saprophytes or parasites over their host. Mushrooms exist in

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Nagendra Kumar Chandrawanshi* and Shri Ram Kunjam

Chapter 11
Application of essential oils in alternative medicine

Abstract: Alternative medicine has gained much attention nowadays. It is also called a complementary therapy, and in this system, essential oils play a major role as a therapeutic agent for the treatment of various diseases. Whole plants as well as individual parts are the sources of essential oils, and various methods are used for essential oil extraction and purification. Essential oils are utilized in different way as alternative medicine such as aromatherapy, massage, and consumption. Essential oil can easily penetrate and show an effect on the affected area. This can be the most effective medicine for several problems like depression, headache, insomnia, indigestion, muscular pain, respiratory problems, swollen joints, and skin ailments. This chapter covers basic introduction of essential oils, its chemical constituents, sources, and extraction methods. It also discusses the use of essential oil as an alternative medicine and mechanism behind its works and its future aspects.

Keywords: Aroma, therapy, diseases, therapeutic, volatile

11.1 Introduction

Essential oils are aromatic chemicals abundantly found in oil glands or sacs located at various depths in fruit peels, particularly in the flavedo portion and cuticles [1]. Essential oils are fragrant, oily liquids extracted from various plant parts, such as

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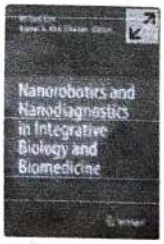

Nanorobotics and Nanodiagnostics in Integrative Biology and Biomedicine
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Smart Nanosensors for Pesticides and Heavy Metals Detection

Nilesh Satpute, Kamlesh Shrivas & Khemchand Dewangan

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Abstract

The excessive amount of pesticides and heavy metals residues in the environment nowadays has become a threat to global health. From a long time, pesticides have been used in crops, plants, and vegetation for pest-protection purposes in every step of the agriculture field. At the same time, heavy metals are used by numerous factories and industries for the manufacturing process. In this modern era of urbanization, we cannot even imagine a single thing

Chapter 6

Carbon dots in separation science

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6.1 Introduction

Carbon is the most abundant element present in nature. Recently, there is a great interest in using carbon at the nanoscale (nanocarbons) such as carbon nanotubes (CNTs), fullerenes, graphene, nanodiamonds, and carbon dots (CDs) for various technological and potential applications. CDs are a zero-dimensional nanocarbon recognized for their small size (1−10 nm) with unique and unusual fluorescence features. Generally, the research areas of CDs family comprise of carbon quantum dots (CQDs), carbon nanodots, graphene quantum dots (GQDs), and polymer dots [1,2]. They are chemically inert with large surface areas, and their surface can be easily functionalized with functional groups [3−5]. There is a wide range of applications of CDs in several fields, such as biosensing, drug delivery, clinical assay, and catalytic reactions [6−8]. In addition, CDs have been employed to separate chemical substances from various samples using chromatography, capillary electrophoresis (CE), and magnetic extraction and separation technologies.

Many researchers, industries, and scientists face the challenges of separating active medicinal compounds from plants, valuable chemicals from wastewater, toxic chemicals from environmental samples, etc. Especially, resource recovery, waste management, nuclear wastes separation, and separation of toxic and hazardous materials are the major challenges for the separation process. Some commonly used separation processes are solvent extraction, chromatography, electrophoresis, ion exchange, cell separation, electromagnetic separation [mass spectrometry (Ms)], etc. [9]. Solid-phase extraction (SPE), dispersive SPE (DSPE), magnetic SPE (MSPE), magnetic DSPE (MDSPE), etc., are involved in sample preparation, separation and preconcentration of target analytes from aqueous samples. The mean of sample preparation is to separate the analyte from complex sample matrixes to prevent the interference of other chemical substances present in the sample. However, the analyte content is very low in the matrix sample, and it is very time-consuming to separate. Thus it is essential to explore an efficient sample preparation method for separation and analysis. Generally, extraction and recovery of analytes are due to the electrostatic interaction, van der Waal forces, π−π interaction, and hydrogen bonding between analytes and functional materials used for the extraction [10]. Nowadays, nanomaterials in separation science have emerged as a solution and boon for all the above issues concerned. Specifically, nanocarbons-based materials have been extensively used to improve the efficiency of separation process and to reduce the consumption of more solvent and enhance selective separation, extraction efficiency, reproducibility, and recovery process.

In analytical chemistry, the separation process plays a crucial role in the method development. This chapter aims to study the use of CDs in various separation techniques, which help in the removal of heavy metals, biomolecules, and environmental toxicants, as given in Fig. 6.1. Here the use of CDs in the future is also summarized.

6.2 Properties of carbon dots related to separation processes

The applicability of CDs is versatile due to unique characteristics, high surface-to-volume ratio, chemical inertness, and less toxicity, which are responsible for improving sorption efficiency and good dispersion capability. Many functional groups are present on its surface, which attaches with adsorbents through selective coordination, hydrogen, covalent, etc., bonding for chromatographic separation [9]. Similarly, new reagents with higher efficiency and greater selectivity

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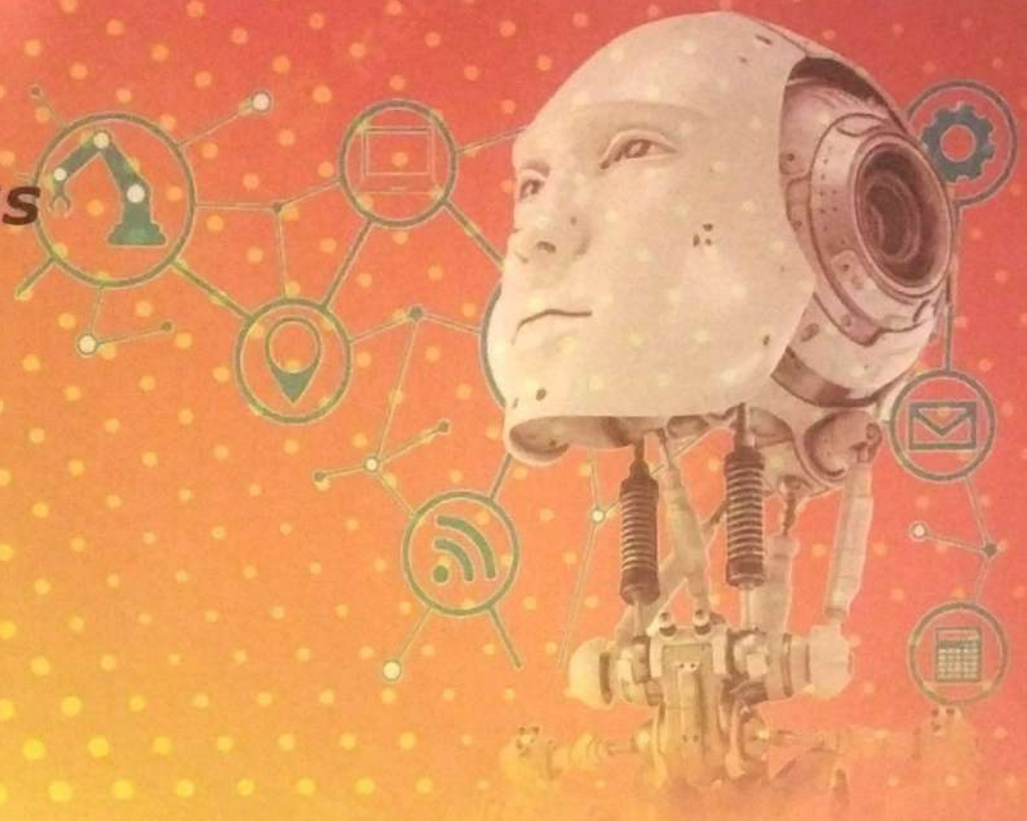

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A survey on Next-Generation Firewalls for Network Security

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ABSTRACT

Today the internet is an essential part of modern life. A network is a basic infrastructure for the internet and is a compulsory part of any organization nowadays. Dependency on the internet is going or increasing day by day. Under these circumstances, the failure of networks for even a single day is not tolerable. A firewall plays an important role on the internet and is a network security device that monitors, and filters network traffic based on an organization's beforehand established security policies. Firewall software includes Inbound and Outbound traffic flow rules. At its fundamental, a firewall is securing the barrier that sits between a private network and the public Internet. In this paper, we will describe the next-generation firewall, which uses well-advised detection techniques, AAA, IPS/IDS, Gateway antivirus, etc. to improve the ability to detect advanced threats and unknown threats. To overcome the deficiency of conventional firewalls, the concept of a distributed firewall has been proposed. We also discuss the disparity between the security and performance of conventional firewalls and next-generation firewalls.

KEYWORDS

Next-Generation Firewall, NGFW, Firewall, Network Security.

1. INTRODUCTION:

Nowadays, the Internet is a basic need for companies, small or big who are seeking ways of doing business globally. The number of internet users has exponentially increased due to the rapid evolution of the internet all over the world. People are using the internet from various devices. In such a situation for using the internet, for network security Firewall devices play a vital role. It means that security issues on Internet become remarkable. Companies are seeking methods of protecting their network and websites against viruses and attacks from outside and inside. Firewall device is splendid solutions for Internet security. Firewall setup on private network sites in companies, organizations, and at houses are no longer a too difficult thing. Today on the market open-source Firewall solution is also available for home use and it's become basic need for home network security. Is there a notable performance loss while applying a protected environment using a Firewall for the Internet connection? So the performance of a Firewall has to measure and looking for the best fit. So, what degree of security should we look forward to without losing the network performance? This type of question arises for network security concerns for every needed firm or organization. IPsec is one of the important security mechanisms and that is an express part of the universal network policy. Research on this area has some attempts in the past. In the present paper, we will describe how the New Generation Firewall becomes more popular rather than a traditional Firewall for those companies and organizations which are looking for a better network security solution for a secure network.

This paper is contributing:

- Provide motivation and need for a next-generation firewall for network security.

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policy. Instead, these credentials can be getting through out-of-band. In this paper, the authors present the design and implementation of a distributed firewall. The tools used are OpenBSD, an open-source UNIX operating system. The authors conclude that the various shortcomings of the traditional firewalls have been fixed by using distributed Firewalls, as listed by the authors.

2.4 Vinit Agham: et.al. suggested a methodology that Unified Threat Management (UTM) is the latest trend in the internet security market. It is the improvement of a firewall, it has the capability of intrusion detection and prevention, load balancing, content filtering, spam filtering, data leak prevention, and Gateway level anti-virus by many systems. UTM has features of AAA service as Accounting, Authorization, and Authentication, allowing such configuration policies that identify users directly by the username, IP addresses, MAC address, Email, and other information which is previously saved on the system. It is a powerful hardware firewall that provides stateful and deep packets from IP spoofing attacks, access control, user authentication, and network and application-level protection. The author suggests that the paper explored the development of UTM functionality, and prove how it is better in comparison with the ordinary firewall and VPN solely.

2.5 Maraj, Arianit Jakupi, Genc Rogova, Ermir Grajqevci, Xheladin et.al. suggested a methodology that Cyber attacks are becoming more and more advanced, getting access to sensitive data. These types of attacks are causing considerable damage such as financial losses, service disruption et cetera to various organizations. The authors suggested in this paper that Penetration testing techniques have to be done in order to test the security of the network. This technique is alike the hostile attackers use, in order to take control of various systems, with one difference; this type of test is officially authorized and allowed. The authors suggest that practical part of this paper would analyze firewall and other protective functions. The authors suggested that the Firewalls analyzed are Threat Management Gateway (TMG 2010), Adaptive Security Appliance (ASA) as well as NGFW. The authors use for testing such firewall systems with DoS (Denial of Service) attacks simulation.

2.6 Asghari, Vahid Amiri, Shima Amiri, Shabnam: et.al. suggested a methodology that in this era as network environments become complicated and threats of cyber and network increase, organizations use a vast variety of security devices against threats. For perfect and centralized action, a variety of security features need to be merged into a unified security package. Unified threat management (UTM) is a broad network security solution, that integrates firewall, virtual private networking, URL filtering, etc. like security services in a single appliance. The authors elaborate that PfSense is an alternative to UTM. PfSense is a customized FreeBSD (Unix-like operating system). Particularly used as a stateful firewall and router. The authors' statements about the firewall they used in this paper have many packages extend its capabilities like Squid3 package as a proxy server that caches data and SquidGuard. It also has a redirector for the squid3 proxy server and access controller plug-in. In this paper, in order to optimize our bandwidth consumption by implementing UTM based PfSense platform they use the Squid3 proxy server and SquidGuard proxy filter to avoid extreme amounts of unwanted uploading/ downloading over the internet by users. They started to define firewall and their types of it, PfSense platform for security stability and reducing the cost.

2.7 Chen, Zhen Dong, Wenyu Li, Hang Zhang, Peng Chen, Xinming Cao, Junwei et.al. suggested a methodology for cloud computing infrastructure related internet security through open source firewall system in the data center. Small organizations are empowering themselves to quickly build Web and mobile applications for lots of users by taking advantage of the scale and flexibility of

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shared cloud infrastructures by cloud computing. There are multiple tenants in the data centers who save their data and applications in shared data centers. Authors focused on different security requirements of different multiple tenants of the data centers. The authors have proposed a system implementation of vCNSMS. It is a collaborative network security prototype system. vCNSMS is used in a multi-tenant data center for network security. State-of-the-art network security in data center networks: Authors suggest that in data centers traditional security devices like Firewalls, WAF, IDS, Anti-Virus, and other devices are deployed separately to keep track of the inside and outside networks are facing new challenges in the large-scale data center network environment.

(1) In multi-tenant cases, the network boundaries are blurring.
(2) The deployment location of traditional security devices also has new changes.
(3) Security requirements of tenants vary.
(4) The migration of the virtual machine results changing of the security domain.

The authors focus on Network Security in data centers. For virtualization of VMware NSX is used in such an environment where all the devices are in virtual mode network is complicated. Authors conclude that with different network policies and security requirements vCNSMS can deploy on an SDN-based virtualization network in a data center for flexibility and scalability to protect multiple tenants.

2.8 Cubukcu, Ceren, Cantekin, Cem et.al. suggested a methodology that by the Covid-19 pandemic people forced changes in their daily routines. The demand for the internet and digital technologies are more active by individuals and businesses. Everyone is aware of digital threats due to digitalization. For the internet, security firewalls should be used. The firewall sits between the internal and the external networks. Choosing the right firewall for each network is also not so easy. The authors studied that a fuzzy-AHP (Analytic Hierarchy Process) model has been introduced to find a suitable firewall. This approach is used in multi-criteria decision-making (MCDM) problems.

2.9 Khummanee, Suchart Saisangchan, Umaporn Somsuk, Kritsanapong Atsawaraungsuk, Sarutte et.al. suggested a methodology that the throughput performance of firewalls depends on the implementation speed of beforehand policy and verify rules. Internet Protocol Version 6 (IPv6) and IPv4 rule-set memory requirements vary. The author suggested a methodology to execute rules for IPv6 a high-speed firewall named FW6. FW6 consumes optimal O(nbit) memory for 64-bit architectures[9]. Results are based on real performance evaluations in conjunction with other high-speed firewalls, and processing time, memory consumption, and throughput are taken as comparing metrics. The authors presented that the trials of FW6 improve throughput performance across all test variables over IPSets by 0.44% (mean) and 0.39% (median). As a result of a minor performance increase by FW6 over IPSets. Authors conclude that as a result FW6 can be used to replace previous high-speed firewalls.

2.10 Aktürk Cemal, Cubukcu Ceren et.al. suggested a methodology to find out the most suitable firewall, a new linear decision-making model is proposed, and the estimates are completed according to this new model. Multi-objective optimization on the basis of ratio analysis (MOORA) is compared with this model. The study of the authors distinguishes from other studies by proposing a new solution that ranks the firewall alternatives using linear and MOORA approaches [10]. MOORA approaches are used in many fields before but not in Information technology. The authors suggest that the MOORA approach offers the latest and most practical recommendation related to a decision-making problem.

2.11 Zapechnikov Sergey, Miloslavskaya Natalia, Tolstoy Alexander et.al. suggested a methodology that the introduction part of this

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paper describes the capabilities of traditional firewalls as packet filtering, network and port address translation, URL blocking, stateful inspection, VPN, IPS, SSL, SSH, QoS, bandwidth management, reputation-based malware detection, sandboxing and external application control, etc. The Next-Generation Firewall has the ability to understand the applications-behavior and properties of DPI (Deep Packet Inspection). The DPI technology is also effective for buffer overflow attacks, DoS, and DDoS. The authors offer an analytical model of the two-face finite queuing system, a simulation of the system and the authors show the numerical results, verifying analytical models.

3. CONCLUSION:

In accordance with a short review of various papers, it seems that we have immense possibilities can develop a new generation firewall with advanced features such as AI-based firewall. As new threats are becoming more powerful and making our applications vulnerable to attack we need more powerful techniques to carry on the development. We also need to always keep an eye on recent advancements in firewall approaches and on recent threats so that we could overcome the drawbacks of threats.

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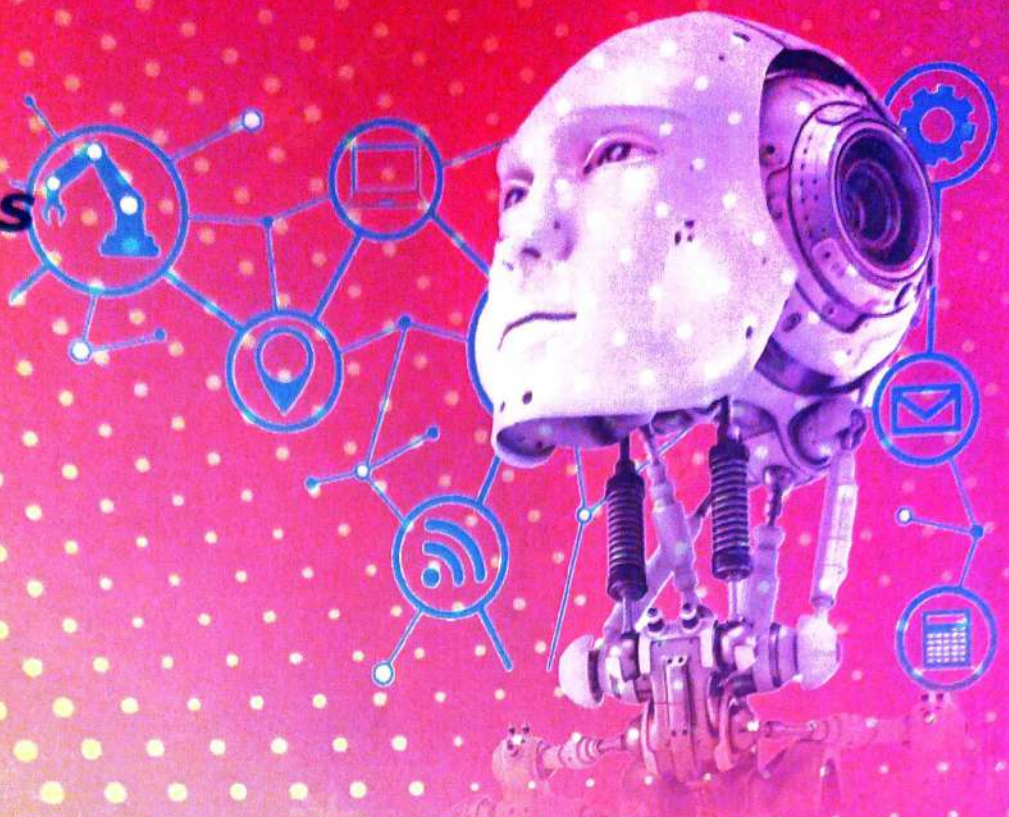

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Optimization of RPL Protocol to Increase Network Lifetime in IoT

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Abstract - Internet of things (IoT) is the new age of networking and communication technology which faces various problems and challenges during research. Traditional protocols may not fit for effective communication in IoT, so we just consider low-power and lossy (LLN) network, these networks aid connections among actual-world objects, which include home automatic switching devices and embedded sensors, and their net connection. A standard route protocol, called the RPL, to address specific structures and limitations of these networks. In this paper we apply objective function into the RPL protocol which improve the performances of network which is an enhancement of the Routing Protocol for Low power and lossy networks (RPL). Simulation results indicate that the proposed RPL routing protocol can reduce overall network energy consumption, balance network energy consumption, which reflect network lifetime.

Keywords — Internet of things, Routing, RPL, Performance evaluation, NS-3.

I. INTRODUCTION

Internet of Things (IoT) is an emerging research area of last few years and it is a future internet technology. IoT enables the machine- to-machine communication that able to exchange the data between them and take the decision accordingly without involvement of human [1][18]. IoT was first reported in 2005, by the International Telecommunication Union (ITU) stating the future society will be a "ubiquitous network society" where lots of smart objects can be connected to the internet [17] Since the beginning of the concept IoT, the design of a routing protocol to meet its requirement became necessary [18].

Networking devices are characterized by limited hardware resources such as low processing capability, little memory, low power and limited communication capabilities such as short range, low bitrate and short frame size. The common communication technologies for IoT are IEEE 802.15.4, Low Power Wi-Fi and these types of networks are called Low Power and Lossy Networks (LLNs) [2]. Due to the limited resources and weak connection links, the probability of having disconnections in the network is pretty high. This would lead to consequent loss of packets and more amount of energy consumption in the nodes for re-transmitting the packets. These challenges should be controlled with employing efficient communication technologies and protocols. Meanwhile, the existing routing procedures between the network devices is an important issue. To this end, the Internet Engineering Task Force (IETF) designed a routing standard for the low power embedded devices, which are operating in environments with lossy links. This standard is known as the Routing Protocol for Low-power and Lossy-network (RPL) [3]. The RPL routing protocol meets the requirements for LLN routing, in addition to providing open and accepted technical standards for wireless sensor networks to satisfy the requirements for future applications. Thus, the RPL protocol also needs to address excessive and unbalanced energy consumption and other bottleneck problem [4].

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To this aim, we propose in this paper the enhanced RPL routing protocol.

This paper is organized as follows. Section II presents an overview and background of Internet of Things and its routing issues and mechanism of RPL based protocol. In III general and existing protocols of IoT and the relevant works RPL also describe the proposed RPL and section IV describe the performance evaluation respectively. Finally, we draw conclusions and we suggest further perspectives in section V.

II. ROUTING MECHANISM FOR ENERGY EFFICIENCY

1.Routing in Internet of things

Kavin Ashton proposed the term "Internet of Things". He illustrate that "The Internet of Things has the potential to change the world, just as the Internet did[5][6]. The commonly accepted definition is given is, "IoT allows

Figure 1. Internet of Things.

people and things to be connected Anytime, Anyplace, Anything and Anyone ideally using any path/network and Any service"[7]. Sensor nodes in IoT (called things) are equipped with low-capacity batteries, weak bandwidth, and limited processing units, besides that, IoT offers huge number of applications that generate enormous amount of data. Such limitations and problems pose multiple issues: the storage and the security of this data, and also its routing to destination[8]. Many factors affect the communication process some are related with the devices and its manufactures, networks, connectivity, communication range and another one is addressing mechanism so the routing protocols are required to prolong the battery lifetime by reducing the energy consumption.

2.Routing protocol for IOT

Numerous routing algorithms have been designed to execute efficiently in IoT network to overcome the various challenges posed by the constrained environment. There are many available protocols for IoT networks. This section discusses the standard and non-standard routing mechanisms, and routing protocols designed specifically for IoT scenarios. In table 1 we have shown here protocols for the datalink, network, and transport/session layers. The datalink layer connects two IoT elements which generally could be two different sensor devices or one of the sensors and one of the gateway devices that connects a set of sensors to the Internet. Frequently there is a need for multiple sensors to communicate and aggregate information before accomplishment to the Internet. Specific protocols have been designed for routing among sensors and are part of the routing layer. The session layer protocols enable messaging among various elements of the IoT communication subsystem [9].

Table 1. Protocols in IoT

Session layer		MQTT, SMQTT, DDS, CoPS
Network layer	Encapsulation	6LowPAN, LO, Therad.....
	Routing	RPL, CORPL, CARP,CTP, LOADng
Datalink layer		WiFi, Z-wave, ZigBee Smart, ANT+, 802.11ah, LTE-A, LoRaWAN

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Table 2 Survey of routing protocols for IoT

S no.	Routing Protocol	Key Features
1	CTP	1 Collection tree-based distance-vector protocol. 2 Forms only upward routes towards the root. 3 Packet Delivery ratio is better for smaller networks.
2.	RPL	1 Proactive distance vector source-based routing. 2 Both upward and downward routes are available. □ Lower end to end delay and Increased control overhead due to proactive nature. 3 Path length is comparatively more as compared to LOADng routing.
3.	LOADng	1 Reactive protocol based on AODV routing approach. 2 Packet delivery ratio drops if there is growth in network size. 3 Memory consumption is less and delay is more due to proactive nature. 4 Reduced packet size results in high control overhead.

Now Table 2 describe the survey among CTP, RPL and LOADng Routing Protocols.

3. RPL protocol-based mechanism

A. RPL Overview

RPL was designed to be the Routing Protocol for Low power and Lossy network and the Iot. RPL is an IPv6 routing protocol and a distance-vector Routing Mechanism. RPL primarily supports multipoint-to-point traffic, with reasonable support for point-to-multipoint traffic and basic features for point-to-point traffic. It works under the assumption that the network contains a sink node with greater computing ability and energy resources than the rest of the nodes in the network.[10] It constructs a Destination Oriented Acyclic Graph (DODAG) whose root is the sink node, directing all traffic towards the sink node. Each node in the DODAG emits DODAG Information Object (DIO) messages containing information about its identity and rank in the DODAG. Because the DIOs are sent proactively and the network topology is explored in advance, RPL can be classified as a proactive protocol. However, the frequency of DIO decreases over time, reducing unnecessary control overhead once the DODAG has stabilized. When the optional Destination Advertisement Object (DAO) messages are used, RPL is able to perform both bidirectionality checks and multipath routing from the sink node to individual routers. The trade-off for this is an increase in control traffic and memory usage. RPL is the only one of the protocols presented which may also employ source routing. This occurs when it is operating in non-storing mode [11] .

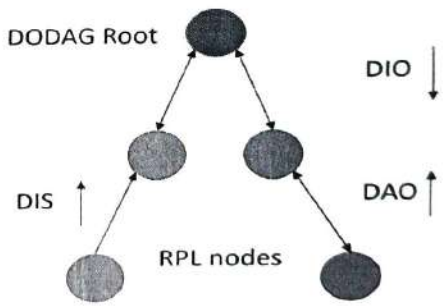

Figure 2 Control massages in RPL [12]

The RPL uses an objective function to select the best parents. Up to here, the group working on RPL called ROLL, has defined two OFs: Objective Function Zero (OF0), and Minimum Rank with Hysteresis Objective Function (MRHOF) [13].

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OF0 works by calculating the rank R(N) using equation (1)

$$R(N) = R(P) + \text{rank increase} \quad (1)$$

R(P) is the parent rank (received in DIO), and rank increase represents the quality of the connectivity in relation to the selected metric

MRHOF aims to optimize the routes by calculating the rank using a hysteresis function (2)

$$\text{Rank} = \text{Function (Path cost)} \quad (2)$$

Where Path cost is the sum of the selected link metric and the path cost of the parent [13]. Since 2010, RPL is attracting the academia and research community, and it is under active investigation. Several works and researches have been presented; the following section gives some IoT existing routing protocols and some protocols based on RPL[8].

B. Related work

There are many protocols available for IoT environment. Here we have briefly discussed energy efficient RPL protocol issues in LLN with their existing work.

Ali Hassan et'al [19] proposed an improved routing metrics for RPL protocol in LLN. This composite metric built on the combination of residual energy (RES), expected transmission count (ETX) and battery depletion index (BDI). This gives improvement of the network lifetime and decreases the battery depletion. However, this work is not given the preferences to link quality (ETX)[1].

RPL, its World wide web of Devices' Connectivity Specification... Or Will It be? [21], In this article there is a problem with Connectivity among both Low (energy) power & lossy as well as Internet of things being integrated. Solution is IPv6 is the latest important feature, the RPL has quickly become the IoT router protocol, which includes the protocol In side this region, the International organization for standardization has developed a layer that fits just above IEEE 802.15.4 PL & Data - link layers. The disadvantage is LPWANs provide Short – range communication(" Article Enhancing Energy Efficiency Using RPL Protocol in LLN," 2022).

Oana Iova et al. in [20] proposed a multi-parent routing mechanism in RPL in order to maximize the overall lifetime of the network by taking care of the bottleneck nodes. In this work, authors presented a DODAG based on the ELT (Expected Lifetime) metric to denote the residual time of the node, and to detect the most energy constrained nodes. The virtue of this work is that it supports the multipath routing to improve the routing QoS [8].

A Mobility-Aware OF (MAOF), which tries to enhance the RPL in case of mobility conditions is proposed in [22]. While, the MRHOF computes the rank of a node with the ETX metric and then selects the best parent based on the minimum rank, in the MAOF, in addition to the rank of the parent node, other metrics such as the least Euclidean distance between the nodes and their parent node, ETX, ELT, and RSSI are also considered. MAOF has solved the problem of the long Listen-only period by the Dynamic Trickle (D-Trickle) algorithm. To the best of our knowledge, MAOF is the only available mobility-aware OF in the literature, which requires significant modifications to be adopted by mobile IoT applications.

The scholars in [23] have proposed the Smart Energy Efficient Objective Function (SEEOF). SEEOF develops the Estimated Remaining Life Time (ERLT) to select the greatest parent of the node to forward its data to the sink. ERTL metric counts the remaining energy and the lifetime of the parent; then, if the node detects the parent node's remaining energy is low, it selects another path to avoid disconnection. One of the enhanced versions of the RPL protocol in mobile networks is Mobility Enhanced RPL (ME-RPL) [24].

As shown from the above discussion also reviewing some another, we conclude that every solution has some limitations. This is the base of

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my motivation for doing this research and we proposed RPL routing protocol.

III. PROPOSED METHODOLOGY

1. General RPL Protocol

RPL is energy efficient protocol that improve the network lifetime using various matrix.

A. Expected Transmission Count (ETX)

It is a link metric and used to predict the quality of link based on transmission and retransmission. The ETX metric formula calculates from Equation (1) and (2)[1].

Link ETX

Link ETX represents the forward and reverse data delivery of link [14]. The link ETX calculates from Equation (3).

$$ETX(ni) = \frac{1}{df * dr} \quad (3)$$

Where

df (The forward data delivery) =Probability of data packets, successfully arrived at the recipients.

dr(Reverse data delivery)= probability that the ACK packet received successfully from the recipient[14].

Route ETX

Route ETX uses to find link quality of particular path Px. The Route ETX calculates from Equation

$$ETX(px) = \sum_{i=1}^{n} ETX(ni) \quad (4)$$

B Load

Network data traffic is an amount of data transfer across the network at given amount of time. Load balance is a technique and it is used to balance the traffic across network. It is mainly concentrated on number of child present in each parent node [15][16]. The participant node selects the parent node based on a smaller number of child accumulated parent node in the DODAG. The traffic load calculates from equation (5) and (6).

a. To calculate the Load In RPL, load of Path(x) calculation is based on the cumulative of node traffic or child set.

$$Load(path(x)) = \sum_{M=1}^{n} Node\_trafficload(M) \quad (5)$$

b. To calculate the Node Traffic In RPL, node traffic calculates from children count of the respective parent node

$$Node\_trafficload(M) = \sum_{i=1}^{n} children\_count \quad (6)$$

C Battery Depletion Index (BDI)

Battery depletion Index (BDI) indicates that how much percentage of energy depleted from battery present in the node. The residual energy calculates from initial energy and remaining energy of the node [19]. The residual energy calculates from equation (7)

$$REP(Mi) = \frac{Eremaining}{Einitial} \quad (7)$$

The residual energy is a remaining energy in the node Mi and it is represented in terms of 0 to 1. The BDI calculation is calculated from Equation(8)

$$BDI(Mi) = (1 - REP(Mi)) \quad (8)$$

The BDI follows the productive rule and BDI of Path Px calculates from Equation(9)[15]

$$BDI(Px) = \prod_{i=1}^{N} BDI(Mi) \quad (9)$$

2. Proposed routing protocol

A. Objective Function

In DODAG, the parent selection is based on DODAG rank. The DODAG rank calculates from Min hop rank increase and objective function. The objective function takes issues like loop freeness, data load in upward and downward routing and bottle neck near sink node. The proposed RPL is evaluated the performance and fine tuned the weight values. Moreover, it provides the better efficiency, where the weight values are w1,w2 and w3=1/3.

$$\min OF(LB, BDI, ETX) = w1 \times Load(\text{Pi}) + w2 \times BDI(Pi) + w3 \times ETX(Pi) \quad (10)$$

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B Rank Calculation

In PRPL, DODAG rank calculates from parent rank and rank increase value. The rank increase calculates from equation (12) that is step value added into MinHopRankIncrease. The MinHopRankIncrease default value is 256 [10]. The step value calculates from objective function and it is denoted in Equation (10). The rank calculates from Equation(11-14)

$$Step = w1 \times Load(Pi) + w2 \times BDI(Pi) + w3 \times ETX(Pi) \quad (11)$$

$$Fixed\_Point\ or\ Rank\_increase = Step + MinHopRankIncrease \quad (12)$$

$$Rank\ (N) = Rank\ (Parent\_Node) + Rank\_\ increas(13)$$

Finally, the Rank calculation based on the below equation (14)

$$Rank(N) = floor(Rank\ (N)/MinHopRankIncrease)\ (14)$$

Proposed Algorithm

```
1.    Input
      Node N, PNID, SN_PID, BestP_Rank=∞;
2.    Output
3.    Preferred_P(N)
4.    for Preferred_P ∈ Parent _List do
5.  Rank (Node) ←Rank (PN) + Rank
_Increase;
6.Rank_ Increase ←Step+MinHopRankIncrease;
Step= w1× Load (Pi) + w2×BDI (Pi) +w3×
ETX(Pi);
7.    If BestP_Rank>=Prefered_PRank (P)
then
8.    BestP_Rank←Prefered_ParentRank (P);
9.    end if
10.   end
11.   while Prefered_PRank (P) = BestP_Rank
do
12.   SN_PID←Preferred_PID;
13.   end
```

VI. SIMULATION AND RESULTS

In this section we present, discuss and evaluate the performance of the proposed RPL protocol using the NS-3 simulator. Presently, there have been several software platforms that support the implementation of the RPL, like NS-2, OMNeT++, JSim, COOJA, etc.

TABLE III CONFIGURATION AND PARAMETERS FOR THE SIMULATION

Simulator Parameter	Values
Simulator	NS-3
OS	Ubantu 20.4
Simulation duration	10 min.
Data Packet Timer	60 sec
Routing Protocol	RPL
Number of nodes	RPL routers = 60 DODAG root =1
Area	200mX200mX200m
RPL Parameter	minHopRankIncrease=256

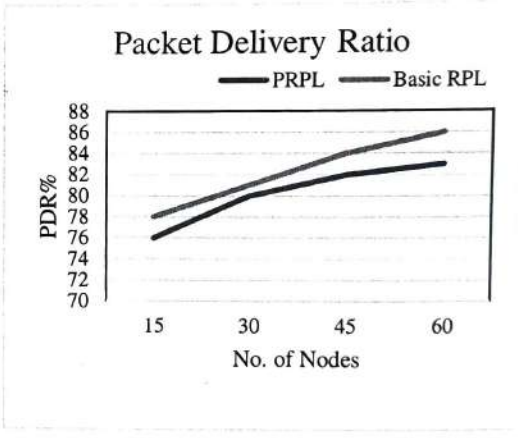

Figure 3 Number of Nodes Vs. Packet Delivery Ratio

To analyze the performance of PRPL and Basic RPL routing, the number of nodes varies from 15 to 60. Above Figure 3 illustrates that the packet delivery ratio of all the works escalates the packet delivery ratio by increasing the number of nodes from low to high over Network area.

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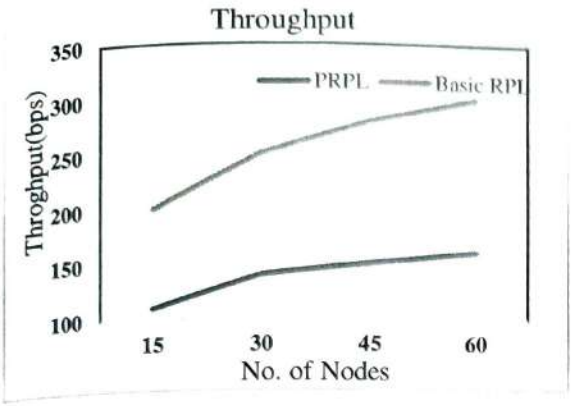

Figure 4 No of nodes Vs Throughputs

Figure 4 shows the throughput results of PRPL, and Basic RPL routing by varying the number of nodes from 15 to 60. The PRPL increases the throughput by varying the number of nodes from low to high

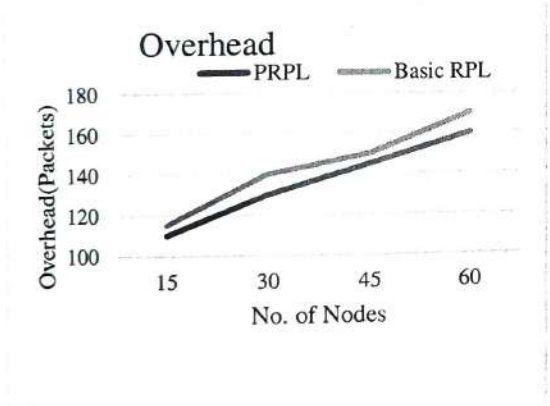

Figure 5 Number of Nodes Vs. Overhead

Figure 5 depicts the overhead results of PRPL, and Basic RPL routing protocols obtained by varying the number of nodes from 15 to 60. All the works experience increased routing overhead with the increase in the number of nodes.

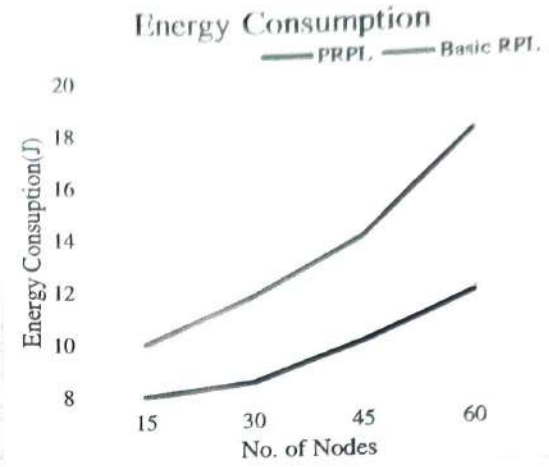

Figure 6 Energy consumption for 60 nodes

The figure 6 shows that the energy consumption increases with the increase in the number of nodes.

V. CONCLUSION AND FUTURE WORK

In this paper, we proposed a new routing protocol (PRPL). It deploys an objective function, which considers the metrics load, BDI and ETX, step to calculate the rank, The route with minimum value for the objective function will be the shorter route with less traffic, which is selected to send the data to DODAG root. Using the NS3 simulator, We compared the performance of proposed RPL with basic RPL. The simulation result shows that PRPL provides the better performance in terms of network lifetime, packet delivery ratio and end-to-end delay compared to basic RPL and it has also improved the amount of energy consumption in the nodes by at least 4%.

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Energy Efficient RPL Protocol for IoT-Network Layer

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Abstract— One of the biggest problems with the Internet of Things (IoT) is energy conservation because there are so many resource-constrained devices connected to the network. Routing is a key component of IoT when it comes to extending network lifetime. RPL, also known as the IPv6 routing protocol for low power and lossy networks, serves as the default routing protocol in IoT. It serves as the defining characteristic of nodes with a finite number of resources (like energy, memory, processing power, and bandwidth). The standard RPL routing protocol does not account for the potential for some loaded nodes' batteries to drain faster than those of other nodes while balancing energy consumption during the process of selecting the preferred parents. The original RPL routing protocol also uses more control packets than is necessary, which consumes a lot of energy inside the nodes and shortens the life of the network. This research study created an Energy aware RPL routing protocol for IoT networks based on the Jelly Fish Optimization Algorithm (JFO) to select the parent from the direction of the destination node in networks. The suggested protocol enhances the DODAG. Several experiments were performed to evaluate the efficacy of the proposed RPL routing protocol.

Keywords:IoT, RPL, EOF, Energy Efficiency.

I. Introduction

One of the finest ways to create a future with complete automation is through the Internet of Things (IoT). The IoT is a collection of various little items including smart gadgets, routers, sensors, etc. [1], [2]. The main issue is energy preservation because IoT nodes are energy-constrained [3]. Data packets are typically routed via the Routing Over Low Power Lossy Network (RPL) protocol in the Internet of Things [4]. However, it also requires more energy to exchange control packets with the development of the Destination Oriented Directed Acyclic Graph (DODAG) [5], [6] as shown in fig.1.

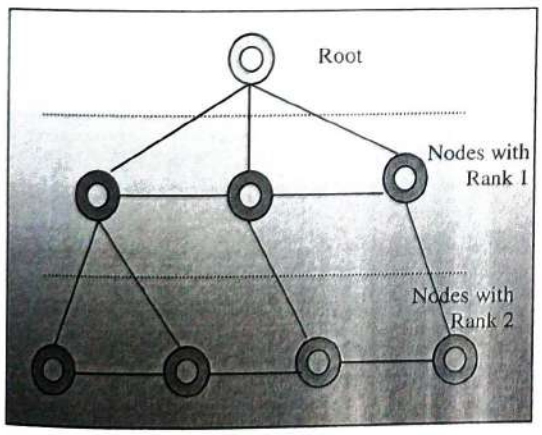

Fig.1 DODAGin RPL-IoT

Due to the fact that DODAG is built on the exchange of four control packets, including the DODAG Information Object

- DODAG Information Solicitation (DIS)
- DODAG Information Object (DIO)
- Destination Advertisement Object (DAO)
- DAO-Acknowledgement (DAO-ACK)

RPL chooses the best next hop node for routing by often exchanging the aforementioned control packets. Each node uses more energy as a result of this control packet overhead, directly affecting the overall network lifetime. Also, the wrong parent selection results in packet losses, congestion between network nodes, consumes more energy, and prolongs the network convergence time. A strategy for choosing parents is recommended in this protocol.

To cop up with these problems, optimal parent node selection is presented as solutions by many authors [7] - [9]. Most of them considered residual or remaining energy as Objective Function (OF) and selected optimum parent node upon following characteristics:

- Remaining Energy
- Load
- Control Overhead
- Remaining Packets and so on

On the other hand, nature inspired algorithms (or) bio-inspired algorithms getting enormous responses to handle many research problems in IoT [10], [11]. Such algorithms

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include firefly optimization, ant colony optimization etc. But, the main issues still faced by RPL-IoT are,

- High Energy Consumption
- Control Packet Flooding
- High Latency
- More Packet Loss
- Communication Overhead

This research designs an algorithm to solve above mentioned issues. In fact, these challenges motivated this research to design the following major contribution,

- An energy-efficient RPL is designed to enhance energy optimization.
- Jelly Fish Optimization (JFO) is presented for optimal parent selection upon traditional RPL.

1.1. Paper Organization

The rest of this paper is organized as follows: Section II surveys brief literature for predicting research gap. Section III states the major problem this paper deals with. In section IV, the proposed work is detailed with necessary algorithms. Section V evaluates the proposed work through extensive simulations. In section VI, the overall contribution of this paper is concluded with future research direction.

II. Literature Survey

A deep reinforcement learning (DRL)-based intelligent routing method is suggested for IoT-enabled wireless sensor networks (IoT-enabled WSNs) in [12]. This scheme said to drastically minimize delay and extend network lifetime. The suggested algorithm partitions the whole network into a number of distinct and unequal clusters, with each partition determined by the amount of data currently being processed by the sensor node. This helps to considerably reduce the risk of the network failing prematurely. With the help of ns3, a comprehensive experiment on the proposed algorithm is carried out. The experimental findings are compared with algorithms that are considered to be state-of-the-art in order to demonstrate that the suggested scheme is effective in terms of the number of living nodes, the delivery of packets, the energy efficiency, and the communication delay in the network. Of course, this study improves energy efficiency it becomes more complex for large-scale networks as DRL is complex.

The problems associated with both resource allocation and routing in order to present an energy-efficient, congestion-aware resource allocation and routing protocol (ECRR) for an IoT network uses hybrid optimization techniques [13]. The first contribution of the ECRR technique that was offered is to use data clustering and a metaheuristic algorithm to allocate large-scale Internet of Things devices and gateways in order to lessen the overall amount of congestion that exists between these entities. The second contribution is the development of a queue-based swarm optimization method for the purpose of selecting a superior route for a future route based on numerous restrictions. This helps to make the route discovery mechanism more effective. The ECRR technique that has been proposed has been implemented in the Network Simulator (NS-2) tool, and the results of the simulation have been compared with those of the existing techniques that are considered to be state-of-the-art in terms of energy consumption, node lifetime, throughput, end-to-end delay, packet delivery ratio, and packet overheads. Though optimization algorithm is a best choice for routing, swarm intelligence stuck in local optimal which limits the optimal parent selection.

Fuzzy algorithm is used for optimal parent node selection in RPL-IoT [14], [15]. An effective Objective Function known as Fuzzy RPL (RPL-FZ) has been suggested to achieve quality of Service (QoS), it is essential to have rapid communication between nodes, low energy consumption, and reliable data delivery. In light of this, RPL-FZ utilizes important metrics such as the Residual Energy of Node, Delay, and ETX (Expected Transmission count) in order to determine the best routes to take. In order to obtain a single metric known as Quality for each neighbor node, the metrics are combined with a technique known as fuzzy logic. The neighbor who has the highest value for Quality is the one picked to serve as the best parent in order to transmit sensed data to the collection unit. The COOJA simulator is utilized to carry out network simulations, and the proposed objective function RPL-FZ has been incorporated into the Contiki operating system. When compared to single-metric-based standard objective functions like OF0 and MRHOF, the performance evaluation shows that RPL-FZ achieves a 7% higher Packet Delivery rate, an 8% lower energy consumption, and an 8% lower latency. All of these improvements can be attributed to RPL-FZ's ability to consume 8% less energy. Fuzzy function only considers either or state (0 and 1) other intermediate states are not considered while framing OF.

An energy efficient optimal parent selection in RPL (EEOPS-RPL) is performed by using firefly optimization algorithm to extend the lifespan of the IoT network [16]. In EEOPS-RPL, each node in the network is considered to be firefly and also calculates the current location of firefly, attraction of the fireflies, random function, velocity, and the globalbest values in the network. Residual energy and expected transmission count are attractiveness parameters and distance is a movement parameter to choose the optimum parent in the destination oriented DAG for data transmission. The simulation is conducted using COOJA. The EEOPS-RPL provides better performance in comparison to the efficient parent selection for RPL (EPC-RPL) and the E-RPL. The EEOPS-RPL improves the packet transmission ratio and lifespan of the network by 2% to 5%, and 5% to 10%, respectively. Firefly algorithm becomes more complex during parameter setup which means overall parent selection process becomes complex.

The topic of energy consumption is the primary focus in which a priority-based and energy-efficient routing method known as PriNergy is proposed [17]. The method is predicated on the Routing Protocol for Low-Power and Lossy Networks

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(RPL) model, which establishes routing based on the contents of the packets. When sending data to its destination, each network slot uses specific timing patterns, taking into account other factors such as network traffic, audio data, and image data. By utilising this method, the robustness of the routing protocol can be improved, which will ultimately lead to congestion being avoided. The proposed PriNergy method has been shown to reduce overhead on the mesh, end-to-end delay, and energy consumption, as demonstrated by the results of experimental testing. Combining all metrics to compute OF is hard in this procedure.

A multi-objective algorithm is designed to select optimal IoT node for routing [18]. It determines the most effective path for the transmission of packets from the source to the sink or the base station. The model that has been proposed takes a method that consists of two steps. In the first step, a trust model is used to select the cluster heads (CHs), which are the individuals responsible for managing the data communication between the base station and the nodes in the cluster. In addition, a novel hybrid algorithm that determines the routes for data transmission is proposed. This algorithm combines a particle swarm optimization (PSO) algorithm with a genetic algorithm (GA). GA consumes more time while PSO provides local optimal solution. Combination of PSO and GA results in local optimal solution with higher latency.

A routing protocol that is suitable for networks with low power and high loss is developed [19]. The proposed protocol adds a new rank value in order to construct an appropriate destination-oriented directed acyclic graph for the source node to use when sending packets to the destination node. This allows the source node to communicate more effectively with the destination node. The proposed rank value is primarily derived from the expected transmission count, which is typically implemented as a representation of the link quality. In addition, we use the amount of energy that has been left over as the metric for determining which node should be chosen to act as the relay for the packet on its way to the destination node.

III. Problem Statement

From extensive literature survey the main objective of proposed RPL-IoT network can be defined as follows:

$$Minimize\ \{E_L \&\& P_L\}$$
$$Maximize\ \{Lifetime\}$$

To minimize energy consumption and minimizing packet loss P_L while increasing network lifetime is still major problem due to non-optimal parent selection and OF formation.

IV. Proposed RPL

This research paper presents RPL-IoT environment with n number of IoT nodes as $\{N_1, N_2, .., N_n\}$. The proposed environment follows DODAG topology as in fig.2. DODAG construction follows same procedure with lower control packet overhead. Initially, the proposed RPL protocol constructs DODAG with restricted control packets and optimal parent is selected by JFO algorithm.

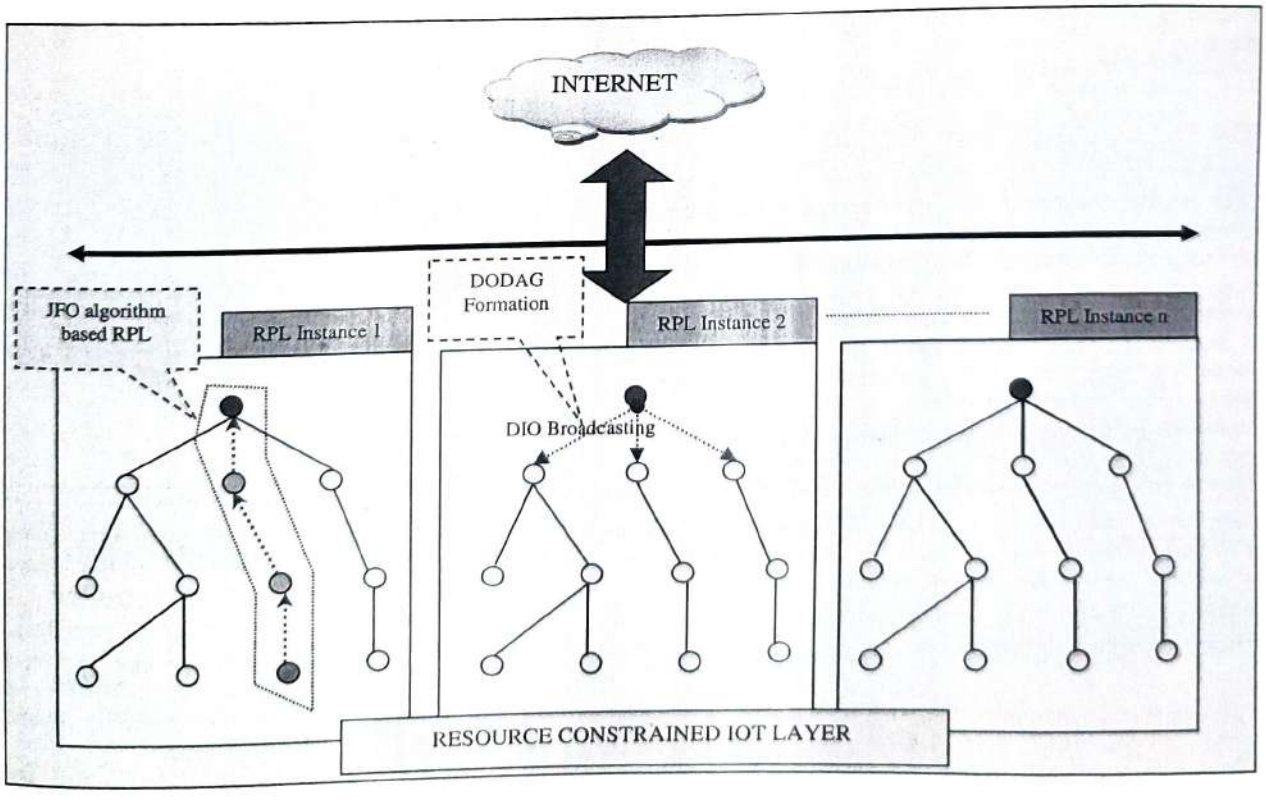

Fig.2 Proposed RPL based IoT Topology

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4.1 DIO Restriction in Proposed RPL

During construction of DODAG, root node initializes broadcasting of DIO message to all child nodes in the network. However, this increases the control packet overhead. Also, forwarding DIO message frequently drains energy level of the IoT nodes. Thus, the proposed RPL restricts the DIO broadcasting by setting up rank based forwarding. In proposed RPL, the root node forwards the DIO message only for nodes with lower rank (i.e.) all other nodes will not receive the DIO message initiated by root node.

4.2 JFO for Parent Selection

JFO strategy is a metaheuristic algorithm that gets its name from the way jellyfish behave. The following actions are included in the process that jellyfish go through to find food [20]:

- The movement of individual jellyfish within the swarm.
- The pursuit of the ocean current in order to develop a bloom of jellyfish.

The following set of idealized principles is taken into consideration by the JSO algorithm:

- The time control procedure is responsible for coordinating the transition between the jellyfish's two more advanced movements (i.e., the movements inside the swarm and following the ocean flow).
- Jellyfish are more likely to congregate in places where there is a significant quantity of food readily available.
- The amount of food that can be discovered is determined by the location as well as the related target function.

The implementation of the JSO strategy requires random initialization to begin with so that the solutions can be distributed evenly across the search span of the problem that is being presented. In the end, each potential solution is examined, and the abundant source of food is determined to be the location that offers the greatest potential for improved fitness. After that point, the movement of each jellyfish is updated either toward the current of the ocean or toward progression within the swarm according to the time control component. Because ocean currents carry large amounts of nutrients, jellyfish are drawn to follow them. The path of the ocean current (also known as $\overrightarrow{drift}$) is determined by taking the average of the vectors of all of the jellyfish in the ocean and applying them to the jellyfish that is currently in the most advantageous position. The value of $\overrightarrow{drift}$ can be calculated using the following formula:

$$\overrightarrow{drift} = \frac{1}{m}\sum \overrightarrow{drift_k} \quad (3)$$

$$= x^* - a_c u' \quad (4)$$

Here, x^* defines the jellyfish having current best solution and m is number of jellyfishes, u' is the mean position and a_c is the attraction co-efficient. At each iteration, the position of jellyfish is updated as,

$$x_k(t+1) = x_k(t) + rand(0,1) \times \overrightarrow{drift} \quad (5)$$

The direction of the movement is described as follows,

$$dir = \begin{cases} x_m(t) - x_k(t); & ff(x_k(t)) \geq ff(x_m(t)) \\ x_k(t) - x_m(t); & ff(x_k(t)) < ff(x_m(t)) \end{cases} \quad (6)$$

Where ff is the fitness function that is formulated by EOF. Over iteration, the optimal solution is obtained by JFO algorithm. The possible solutions (i.e.) available parent nodes are initialized in JFO algorithms as $\{P_1, P_2, .., P_m\}$. Each parent is evaluated by formulated EOF and optimal parent (P_{opt}) is selected for routing. The detailed algorithm is depicted as below.

Algorithm 1: Proposed RPL based routing

Input: $N_1, N_2, .., N_n$
Output: P_{opt}

1. Start
2. //Construction of DODAG
   Find Rank for N
   $if(rank = Low)$
   Forward DIO
   $Else$
   Drop
3. //JFO based Routing
   Initialize $P_1, P_2, \dots, P_m$
   For all $N \in P_m$
   Compute EOF
   $EOF \rightarrow ff$
   Compute $\overrightarrow{drift}$
   Update movement
   Find P_{opt}
   End For
4. //Data Transmission
   Forward $data \rightarrow P_{opt}$
5. End

As data is transmitted to P_{opt} with highest remaining energy and delivery rate, the data is successfully transmitted to the destination. Also, the network lifetime is extended.

V. Performance Evaluation

5.1 Simulation Setup

The performance of proposed RPL is evaluated through simulations in ContikiOS Cooja simulator. The simulation setup is depicted in table.1.

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Table.1 Simulation Setup

Parameter	Value
Simulation Area	100*100m
Topology	RPL DODAG
n	100
E_I	100J
Packet Size	32 KB
Population Size	100
Number of Iteration	100
Packet Interval	1ms
Number of Packets	400
Simulation Time	100s

5.2 Comparative Analysis

Proposed RPL is analyzed in terms of energy consumption and packet delivery rate (PDR). To evaluate the performance of proposed RPL is compared with conventional RPL under aforesaid performance metrics.

Analysis on Energy Consumption

Energy consumption is defined as the ration between initial energy level and final energy level of the nodes in network. Here, energy consumption is analyzed for 7 nodes in the network.

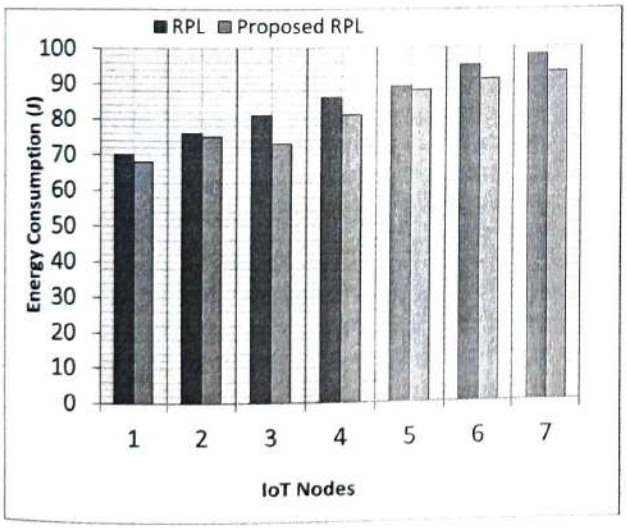

Fig.3 Analysis on energy consumption

In fig.3, the energy consumption is analyzed for 7 nodes. For node 1, RPL protocol consumes 70J while proposed RPL consumes only 68J. Similarly, for node 7, RPL protocol consumes 98J while proposed RPL consumes only 93J. In conventional RPL, huge control messages are transmitted which further increases the energy consumption. However, the proposed RPL protocol uses EOF and JFO algorithm for optimal parent selection. That uses the lesser energy for data transmission.

Analysis on PDR

PDR, or packet delivery ratio, is calculated by comparing the total number of packets produced by the network to the total number of packets that are successfully delivered to the destination.

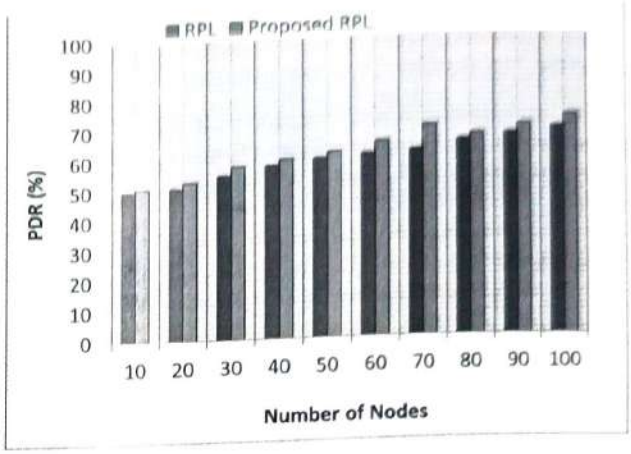

Fig.4 Analysis on PDR

In fig.4, PDR is analyzed in terms of number of nodes. With increase in number of nodes, PDR is approximately static and proposed RPL achieves more successful delivery as compare to conventional RPL and more packet loss happens in conventional RPL due to node death, overhead and non-optimal parent selection. From this analysis, it is clear that, proposed RPL with EOF selects optimum parent node which improves the overall network performance.

Table.2 Summarization of results for Energy Consumption

No. of Node	RPL	Proposed RPL
1	70	68
2	76	75
3	81	73
4	86	81
5	89	88
6	95	91
7	98	93
AVG.	**85**	**81.285714**

Table.3 Summarization of results for PDR

No. of Node	RPL	Proposed RPL
10	50	51
20	51	53
30	55	58
40	58	60
50	60	62
60	61	65
70	62	70
80	65	67
90	67	70
100	69	73
AVG.	**59.8**	**62.9**

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In table.2 and 3, the overall result is summarized with average reports. In all aspects, proposed RPL outperforms with conventional method.

VI. Conclusion

In this paper, a new approach that formulates RPL is presented with novel objective function called EOF. This paper minimizes control packet overhead by restricting DIO message broadcasting. With the new EOF, JFO algorithms selects optimal parent node for data transmission. The extensive simulation shows better performance in energy consumption and PDR. In future, this research work can be extended with other research factors including security or Quality of Service in IoT.

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Efficient Techniques for Improving Quality of Service in IoT: A Review

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Abstract: The Internet of things, are made with sensors, processing ability, software, and other technologies that collect and exchange data with other devices and systems over the Internet or other communications networks. It is also responsible for growing big data every day. Big data is produced by the various evolving internet of things (IoT) devices. The amount of data sent to the cloud or fog would take a lot of network bandwidth. As a consequence, the IoT network could be vulnerable to network congestion. Integration of IoT with various systems has brought solution to many problems. Furthermore, some IoT implementations need multimedia data transmission with various Quality of service (QoS) standards. This paper includes various study of Quality-of-Service parameters of IoT devices and enhancing parameter of QoS. Quality of Service (QoS) metrics play very important role in developing models for implementation of communication algorithms in different layers but they need to be defined clearly before they are understandable and these metrics help in expressing their requirements. These metrics are defined based on Computing, Communication and Things which are three of the foundation stones of the IoT paradigm.

Index Terms: IoT, Quality of service, parameter of IoT, Sensors.

I. INTRODUCTION

The internet of things, sometimes known as "IoT," has become increasingly popular in recent years. "It's an idea that has the potential to change not only how we live but also how we work," Author says [1]. Kevin Ashton developed the Internet of Things (IoT) as an unique paradigm in the realm of wireless sensor networks and communication in 1999, which has not only benefited ordinary people but also provided a vast potential for academics, researchers, and industries in a variety of ways. RFID (Radio Frequency Identification) technology enables communication across devices and between people and gadgets by integrating short-range sensors in network-enabled items or devices [2]. These devices generate massive amounts of data on a regular basis, which must be stored, analyzed, and shared in a timely and effective manner.

Smart item connection with an existing network and calculation in the current context using available resources The Internet of Things relies heavily on network resources. Cisco has just the phrase "Internet of Everything (IoE)" was coined by him. It was characterized as "The Internet of Things" as an extension of IoT. The Internet of Everything (IoE) connects people, processes, data, and other resources. things that will make networked connections more useful and relevant Turning information into actions is more valuable than ever before. that develop new capabilities, provide more immersive experiences, and for businesses, this is a once-in-a-lifetime opportunity. Individuals, as well as nations" [3]. However, before this vision of IoE can become a reality, significant technological and social hurdles must be discovered and handled. The interoperability of devices and making them more adaptive and autonomous while guaranteeing privacy and security for potential users [4] is the primary challenge of this evolving paradigm, which will aid in providing IoT support in the form of services to ordinary people.

We looked through the IoT literature and, to our knowledge, there isn't a single book that covers and describes numerous QoS measures related to IoT. The lack of such a document impasse both IoT service providers and IoT service customers' active involvement. That is why, in order to uncover multiple QoS measures, we combed through many IoT applications and literature. This work's main contribution is a collection and definition of several QoS indicators to aid IoT service providers, customers, researchers, and professionals.

IoT is still growing, and most contemporary IoT designs are developed with WSN in mind. In [5], the authors show a five-layer design that incorporates the object layer (which includes physical devices at the bottom), the object layer (which includes physical devices at the bottom), and the object layer (The service management layer, the object abstraction layer, and the object abstraction layer. The business layer is on top of the application layer.

Perception Layer: This layer consists of sensor and actuator devices that detect and respond to physical changes such as temperature, humidity, light etc.as appropriate. Actuator Sensor devices monitor the environment and communicate data on a regular basis. data to the top layer that has been sensed the enormous volume of information This layer generates the information indicated above. Communication Actuator Sensor devices use a variety of technologies, including Bluetooth and ZigBee are unable to send data packets directly to the internet,

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and To do so, you'll need a gateway. This layer generates both useful and useless data. They were transmitted to the upper layer without being analyzed [6].

Application Layer: The application layer is responsible for the data's final administration and presentation in the form of smart homes, smart transportation, smart education, smart health-care, and other types of smart applications [7][8].

Network Layer: In the Internet of Things, the network layer connects everything and allows them to be aware of their environment. Objects can share data with connected things via the network layer, which is critical for intelligent event management and processing in the IoT[9][10].

II. QoS Metrics in IoT

QoS aids in the management of a system's capabilities and resources in order to provide IoT services. It helps service providers to provide users with clear visibility into their services, as well as their performance and usability. Service Level Agreements (SLAs) between IoT service providers and IoT customers can be enforced via QoS. QoS metrics will help customers to identify best IoT service for its application and will also deal with the optimization of service quality.

we have identified major QoS metrics related to all the three components of IoT.

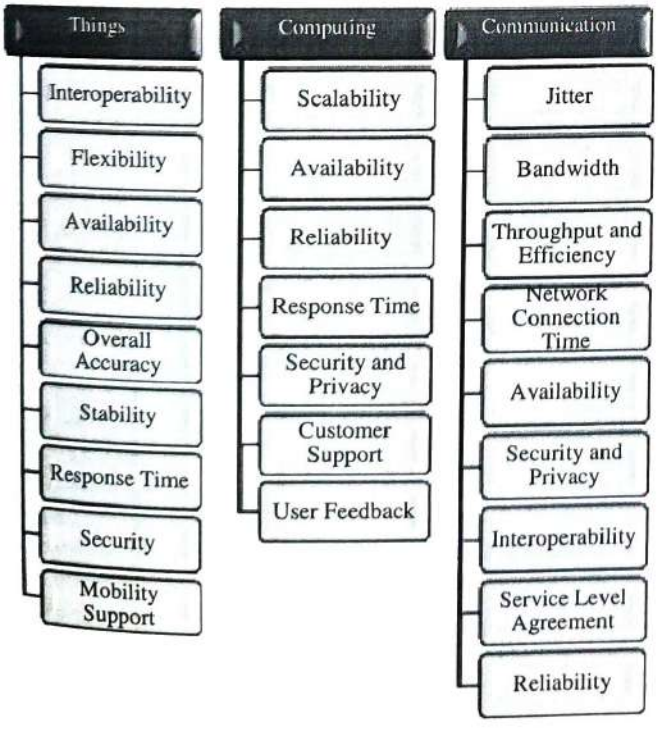

Figure1: QoS Metrics in IoT

A. QoS Things

The Internet of Things offers a massive pool of sensors-embedded items that are RFID-enabled and implicitly connected to a smart network [46].The following are the quality parameters of things, i.e., sensors that have been identified as adding a new dimension to IoT applications.

Interoperability: Interoperability is described as a sensor's capacity to communicate information and resources with other sensors regardless of their configuration or architecture.There is no universal standard for measuring interoperability. However, there are three measures that can be used to assess interoperability: potential measure, compatibility measure, and performance measure [11].

Availability: Things availability refers to the ability of a sensor embedded device to recognize and gather data. To offer better operational service, the system should be able to promptly recover from hardware or software failures. IoT devices will only function well if they are widely accessible [12].

Stability: Long-term stability is defined as the constancy of sensor output over time. Depending on the nature of the sensors, the decline in stability could be caused by component ageing, increased noise, or other factors [12].

Response Time: This is the time it takes for the sensors to alter their output state in response to a change in input parameters. Low-response-time sensors are ideal for all applications [10].

Range: Sensors are intended to operate within a specified range. The physical specifications of the sensors' minimum and maximum ranges are defined for proper operation. The sensors may be damaged or generate erroneous readings if the range is exceeded. While some sensors perform well even when the range is exceeded with simple tweaks, others do not. Sensors with nominal range adjustability are appreciated [13].

Security: Google Cloud IoT Core is a public service supplied by Google that offers full-stack security for billions of heterogeneous devices scattered throughout the globe. It allows for the secure and dependable ingestion, connectivity, and management of data from a wide range of sources .For safe communication, security credentials such as correct device registration, identity authorization, and authentication are required [14].

Mobility Support: This is a broad phrase that encompasses all aspects of IoT device operation. The mobility of sensor nodes is divided into two categories: strong mobility and weak mobility. If a node fails or goes out of service for any reason, it is considered to have weak mobility, whereas nodes that move freely in the network due to physical causes such as wind or water are considered to have strong mobility [15].

A. B. QoS Computing

Cloud computing is a key component of the Internet of Things, as it scales applications that generate large amounts of data and improves efficiency. To reduce the amount of load on

the network, computations can also be done at the fog or edge. Considering the importance of computing for IoT, we've developed several QoS measurements that will allow customers to evaluate service providers (whether cloud, edge, or fog) based on these quality metrics.

Scalability: Scalability is defined in computing applications as the ability to produce maximum throughput in the shortest amount of time. More users will necessitate highly scalable compute capacity, which can be scaled by adding resources with overhead on the system. In general, scaling can be done both horizontally and vertically, with vertical scaling being preferred [16].

Reliability: Reliability refers to a system's ability to recover and self-configure in a changing environment. In sensor technology, a bit error might occur, causing the device to malfunction. Reliability should be considered throughout system deployment and architecture to ensure long-term usability of the systems or devices [17].

Response Time: The time between submitting a request and receiving a response from the service is known as response time. It is dependent on both the infrastructure and the application that has made the request [18].

Security and Privacy: As one of the physical components of IoT, the cloud node or edge node is exposed to threats and attacks such as adding erroneous data, limiting network availability, unauthorized accessing of the user's personal information, and so on. When it comes to computer security, the confidentiality and integrity of the data must be ensured at the computing node. As stated in, certain security measures such as crypto algorithms and key management, physical security support, network security support, and data support are taken into account when assessing the trustworthiness of computer services [19].

B. QoS Communication

Communication networks are responsible for transferring real-time data and applications around the world in the IoT ecosystem. Delay sensitive and delay tolerance applications are both possible. However, in order to meet the needs of various IoT applications, it is necessary to improve the quality of network services by adding value to them. The following sections go through the many quality measures that can be found in a communication network.

Jitter: Jitter is an unfavorable consequence generated by unequal deviations in data packet transit time intervals. Rather of remaining constant, the time between packets fluctuates. Inadequate queuing, network congestion, or a configuration error can all produce jitter in a network. Even jitter can cause packet loss and network congestion. For a quality network connection, the network service provider should provide sufficient bandwidth and likely latency, which can assist reduce jitter [20].

Bandwidth: Bandwidth is the quantity of data that may move over a network in a given amount of time, while the actual network speed (also known as throughput) may be substantially lower. It is measured in megabits per second (Mbps).It is preferable to access a network with a large amount of accessible bandwidth [21].

Throughput and Efficiency: The number of data packets sent or received via the network is measured by throughput and efficiency. It can be described as the amount of bandwidth that a network has available, measured in bits per second (bps).The throughput of the network drops as network latency increases [20].

Network Connection Time: Server Connection Time is the amount of time it takes for a server to respond to a data request from another device. When the server's request is not served within a certain amount of time, a connection timeout can occur [21].

Availability: Availability is defined as the proportion of time the network is active and functioning when it is required for use. It is usually calculated in "scales of nine." Both the Internet connection and the VPN tunnel have an impact on communication availability [22].

Security and Privacy: It's not easy to meet customers' demands for security and privacy. To provide the requisite level of security and privacy, some technologies have been developed. In [28], outlined a few Privacy Enhancing Technologies (PET) that include: (i) VPNs, (ii) Transport Layer Security (TLS), (iii) DNS Security Extensions (DNSSEC), (iv) Onion Routing, and (v) Private Information Retrieval (PIR). These can be used to gain a better understanding of privacy.

While network security is the action done to protect the communication channel's accessibility and integrity, as well as the information moving via it. To keep the network secure, a variety of encryption techniques are used [16].

Service Level Agreement (SLA): Network service providers issue SLAs that outline how the provider and customer will negotiate services as outlined in the agreement. The user will require a tool to assess the providers' ability to utilize their services. SLA may be measured using a tool called OcularIP [23]. It adjusts to the network's changing demands and investigates any anomalies that arise.

Reliability: The connection between the origin and destination node pairs can be used to express communication reliability. Only if the communication medium guarantees that the information will be delivered to the intended user without loss or security breach is it considered dependable. If and only if the communication network provides acknowledgement even if information delivery fails, it is said to be trustworthy. Group Communication System (GCS) frameworks such as IS-IS, Appia network, and Quick Silver scalable multicast are some of the frameworks that give robust reliability establishment [23].

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III. LITERATUREREVIEW

There are various existing surveys on various quality of service and issues in IoT. Diya Thomas et al. discuss node scheduling for IoT-based surveillance applications. An efficient barrier scheduling approach must satisfy the fundamental QoS needs of smart surveillance applications, such as coverage, connection, and energy efficiency, as well as this execution plan in the event of node failures caused by unexpected battery depletion. In such cases, this research presents a fault-tolerant barrier scheduling technique that meets the surveillance applications' QoS needs. The approach is based on a fully weighted dynamic graph model. The author created two novel heuristics for fault tolerance and recovery. Extensive simulation studies are undertaken to analyze and compare this scheme's performance and efficacy. On the other hand, this research proposes a fault-tolerant energy-efficient A data aggregation method gathers and aggregates data packets to reduce power consumption, traffic congestion, and network lifetime [24].

A hybrid Quality of Service-Aware Data Aggregation (QADA) scheme is proposed in this paper. This technique combines the advantages of cluster and tree-based data aggregation schemes while also addressing some of their major drawbacks. In terms of power consumption, network lifetime, and bearing increased traffic loads, simulation findings reveal that QADA surpasses cluster and tree-based aggregation techniques [25].

According to safed and sayid, the Internet of Things (IoT) is a new technology topic in which all devices such as smartphones, smart TVs, medical and healthcare devices, and home appliances are used to generate data. In the IoT arena, several service composition difficulties, particularly related to Quality of Service (QoS) factors, have been identified due to the variety of services. Because this is an NP-hard problem, various meta-heuristic approaches have been used to tackle it so far. Depending on the needs of consumers, a wide range of services can be integrated into the IoT [26].

We have presented an effective method based on a Hidden Markov Model (HMM) and Ant Colony Optimization (ACO) to address the service composition issue while improving QoS in this study. To forecast QoS, the HMM has been trained. The Viterbi method was used to improve the emission and transition matrices. We used the ACO algorithm to perform the QoS estimation and discovered an acceptable path. In comparison to prior techniques, the results demonstrated the efficacy of the new method in terms of availability, reaction time, cost, dependability, and energy consumption [6].

In this regard, it is proposed to use an improved teaching learning-based QoS-aware services composition method (ITL-QCA) to quickly identify a composition that is close to optimal. It has fewer tuning parameters than evolutionary computation and swarm intelligence-based techniques, and it can explore the composition search space well. This allows for high QoS compositions without the need for hard tuning parameters. The ITL-QCA algorithm outperforms previous service composition algorithms in terms of composition optimality and execution time in a large-scale environment [26].

Zhang et al. developed a service composition strategy based on a flower pollination algorithm. This technique arranges services based on inconsistent QoS criteria, increasing both user and QoS parameters. A new fuzzy-based QoS-aware mathematical model is used to evaluate manufacturing service composition options. An elite replacement method and switching probability are added to the flower pollination algorithm to find a solution. Vote-based classification was tested using C# and a personal computer. According to this study, end-user satisfaction is high. However, this procedure consumes little energy [5].

Sofiane HAMRIOUI claims that Within the Internet of Things (IoT) context, fair and efficient energy use among devices, as well as the time spent transferring data, are key restraints. We focus on the use of coalition game theory to encourage device collaboration and the performance of multipath routing to satisfy service quality goals (QoS). In this research, we introduce RACD (Routing Method based on Cooperation between Devices), a new routing algorithm that optimizes energy usage and link delay during routing [27].

RACD has used principles like multi-metric routing and coalitional game theory. RACD enables different coalitions to choose the quickest and most efficient route. Also, the game's core and Shapely are used in our method. Our proposed routing algorithm was compared to two other routing systems, ELDR and MAODV, using simulations to assess its performance.

These devices send traffic to the Internet via LTE networks or multi-hop transmissions to a dedicated gateway. Obtaining both types of connectivity for IoT end devices would be excessively costly. A cost-effective IoT infrastructure would instead rely on low-cost wireless transceivers with varying transmission characteristics to forward/relay traffic to a gateway, with only gateway devices fully equipped with such capabilities. Each IoT device has its own QoS requirements. A low-cost, QoS-aware IoT infrastructure requires careful network planning. To meet the QoS standards, the planning problem is formulated as an ILP.A lower-complexity heuristic approach was seen to give solutions that were close to the ideal ones in cases where we tracked optimal solutions with ILP. A variety of performance evaluation findings show the proposed algorithms' usefulness in terms of network cost and efficiency [24].

IV. QOS ENHANCING PARAMETER

Software Defined Network: SDN has the ability to allow greater use of the network, offer quicker software, and expand functionality rapidly. However, the various creative and operational capacities of the network are predicated on the wisdom (i.e., making good decisions) of the SDN controller, who is ultimately under the supervision of the global controller. However, for SDN-based network approaches, the controller usually utilizes network measurements and interpretation only at the size currently implemented. The new SDN network architecture is not designed with national or large-scale

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infrastructure details or application outcomes in mind. Clearly, this reduces the SDN network's capability and adaptability [28].

- **scalability:** It is a multi-dimensional topic with varying meanings in different systems. In some systems, it involves running numerous apps on many CPUs, whereas in others, it means resource optimization. No consensus exists on its definition or content. Scalability refers to the controller's performance in handling flow requests, the installation of flow rules in forwarding tables, and the response delay. Scalability is achieved by physically dividing the control plane into horizontally distributed or hierarchically arranged controllers. The scalability of hybrid SDN control depends on the central SDN controller's performance and the interoperability between traditional distributed control and centralized SDN controller [29].
- **Reliability:** A system's dependability refers to its capacity to perform without error. SDN reliability refers to both control and data plane resilience. It involves maintaining network operations even when the primary controller fails in SDN control plane and resilient connectivity between forwarding nodes in SDN data plane. Controller failures can be caused by hardware issues, software errors, or race conditions between controller units. In centralized SDN controllers, a simple monitoring software module and backup controller can provide control plane fault tolerance, however in distributed SDN controllers, consistency and performance difficulties arise. In hybrid SDN control, legacy dispersed control is resilient, while centralized controllers require backup controllers. To ensure data plane dependability, SDN controllers must provide flow tables with backup routes for all traffic flows [30].

Load Balancing: There are various techniques for Load Balancing, which can enhance the various QoS parameters. The technique of balancing network traffic over many servers is known as load balancing. This guarantees that no one server is overburdened. It's time-consuming to reconfigure the network in reaction to flaws, problems, loads, and fluctuations. Traditional networking routes traffic through a series of routers and switches using integrated hardware and software. These are used to connect the control and data planes in a perpendicular manner [31]. An efficient and proper load balancing can lead to reducing the response time, the number of involved resources, packet loss ratio, overload and so on. Moreover, it can increase scalability, reliability, packet delivery ratio, network lifetime as well [32].

One of the most essential features of IoT is the traffic management of millions of emerging heterogeneous devices. The rapid evolution of IoT, as well as the various QoS needs of its many traffic classes, necessitate the development of an integrated IoT resource management framework. Furthermore, the Internet of Things suffers from a lack of well-informed systems for balancing the load on its servers. Given the resource limits and large traffic volume, the author demonstrated that balancing the load of IoT servers while concurrently fulfilling the QoS of IoT traffic is an NP-hard task. As a result, this study developed a novel SDN-based IoT control and management framework that supported load balancing and QoS at the same time. In this regard, we created a predictive and proactive controller with OpenFlow, sFlow, time-series analysis, and fuzzy logic modules. The proposed framework, which included Open vSwitch, Floodlight controller, and Kaa IoT servers, was built in an actual testbed. The suggested framework's suitable performance is demonstrated by high throughput and low response time while utilizing server resources optimally [33].

In this research developed a load balancing and compute offloading methodology for multi-user, multi-task, multi-tier mobile-edge cloud computing systems, in which mobile device users (MDUs) are efficiently redistributed to balance the load while lowering total communication costs. Furthermore, we built a new security layer that combines ECG (electrocardiogram) signal features into the AES cryptographic algorithm's regular encryption and decoding stages to protect supplied data. Additionally, to reduce the system cost in terms of energy and temporal demands, an integration of computation offloading, resource allocation, and security models is written as a binary linear problem. Furthermore, a low-complexity safe load balancing and computation offloading (LBCO) method was created to provide all of the facts needed to make the best offloading option. Comparing the proposed LBCO algorithm (with or without the addition of a security layer) to the local execution and computation offloading model in terms of system overhead, numerical results showed that the proposed LBCO algorithm (with or without the addition of a security layer) can allow for a significant reduction. In terms of energy and time demands, the price is high. Furthermore, A secure LBCO algorithm with a low level of complexity was created. give all pertinent information in order to arrive at the best conclusion The choice to offload has been made [34].

Security: The Internet of Things (IoT) is also boosting Cyber Physical Systems (CPS). Real-time monitoring and response to environmental changes is standard procedure in CPS. Security flaws in important public infrastructure systems (e.g., power grids, transportation networks) have far-reaching ramifications. This study does not address the specific security issues that CPS faces, which have their own distinct features [35].

[36] shows a security architecture in which each node is connected to a domain controller via an embedded virtual switch. This controller is located at the network's edge, where it serves as a domain controller and authenticates network devices.

There will be a sink node inIoT based WSN(IWSN) that collects sensing data from all sensor nodes. Nonetheless, the three most important criteria for ensuring data forwarding from each node to a sink are coverage, connectivity, and energy consumption. In this paper, the Adaptive Coverage and Connectivity (ACC) system is proposed, which aims to consider three objectives for problem formulation at the same time. The proposed scheme's first step is to create adaptive coverage among the sensor nodes. Following that, it maintains

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network connectivity for as long as possible while covering a vast sensing area [37].

Power Efficiency: IoT is a conceptual grouping of technical characteristics that allow not only the interconnection of useful devices, but also the environmental control of valuable experiences. The Internet of Things (IoT) may be thought of as a network of interconnected settings that a user can both control and be controlled by. Electrically powered sensors, controllers, and other devices fill the world around us. When it comes to renewable energy and efficiency, the Internet of Things (IoT) has a direct influence [38].

The distance between the receiver and the transmitter, the packet arrival time, the packet size, the maximum queue size, the maximum transmission number, and the transmission power level are all setup settings for each sensor node that receives and sends information. Various indicators such as delay, received signal strength, connection quality, successful packet delivery, noise level, and the number of retransmissions will be affected by all of the above elements. The network's energy usage will be reduced by determining the relationship between these two sets of parameters and optimizing them. In this way Energy efficiency help for better QoS [39].

In the research, based on the MATLAB simulation results, the proposed WSN QoS-based energy-efficient protocol beats average threshold energy-efficient routing, Developed Distributive Energy-Efficient Clustering, and Enhanced Developed Distributive Energy-Efficient Clustering by 10.00 percent, 26.00 percent, and 63.00 percent, respectively, on the parameters of throughput and network lifetime. As a result, the study concludes that the protocol is well-suited and well-positioned for designing WSNs in real-world and real-time scenarios. In terms of future research, it is suggested that academic investigations expand on this paper by evaluating the extent to which the proposed protocol design can provide system privacy and security [40].

TABLE 1:LITERATURE REVIEW OF ENHANCING QOS USING SDN

	Author	Parameter	Description
1.	Kavita Jaiswal, Veena Anand	End to end delay, PDR, Throughput, Energy Consumption, Network Lifetime	Author proposed design which is energy efficient routing protocol. The protocol considers three parameters to select the optimal path, i.e., lifetime, reliability, and the traffic intensity at the next-hop node. Simulation is performed in network simulator ns2. The result shows a better energy efficient routing method.[47]
2.	Om Jee Pandey et. al	Packet Transmission, Residual energy, Avg Data Latency, Bandwidth	Author proposed method updates the Q matrix of the network at varying discrete time instants and selects relay devices in such a way that maximizes the cumulative reward value between selected device-gateway pairs. The proposed method perform good in both the simulated LPWAN testbed and real field data sets.[48]
3.	Jia-Ming Liang	Packet Loss, Jitter, Power Consumption, Avg Sleep Ratio	The Author addresses the DRX/DTX optimization, by asking how to maximize the sleep periods of devices while guarantee their QoS, especially on the aspects of traffic bit-rate, packet delay, and packet loss rate in IoT applications. Efficient schemes to optimize DRX/DTX parameters and schedule devices' packets with the base station are proposed. The schemes is to balance the impacts between QoS parameters and DRX/DTX configurations.[49]
4.	Waheb A Jabbar et. al.	Energy Cost, Throughput, End to end delay, Jitter	This protocol uses a node rank according to multicriteria node rank metric (MCNR). The MCNR metric is utilized by a new link quality assessment function for multiple-route computation. It is also adopted to select a multipoint relay (MPR) set of nodes by using an energy and QoS-aware MPR selection mechanism for flooding topological information. The simultaneous consideration of energy and QoS parameters can benefit the tradeoff between QoS and energy awareness.[50]

5.	Shikhar Verma et. al.	Energy Consumption Packet Loss Rate	we devise novel models to estimate PAD, PLR and energy consumption for MIDs, specifically for the group paging mechanism. Based on the proposed models, we formulate an optimization problem with the objective to minimize energy consumption of MIDs while providing required PAD and PLR. Extensive numerical results presented verify the effectiveness of the proposed method, and the mathematical models demonstrate the superiority of our proposed approach over random grouping approach concerning significant energy consumption of MIDs. [51]

Routing: In Internet of Things, routing methods have a significant impact on the overall network performance, including throughput, power consumption, latency, and transmission rate, among other things. In sensor networks, there are excess of algorithms that have been suggested, all of which are geared at improving network performance [41].

The suggested method enables efficient and robust route estimates with minimal latency from source to destination. It also makes optimal use of bandwidth, which improves the WSNs' QoS [42].

Analytical and simulation tests were used to evaluate the suggested solution's improvements. Three primary network performance measures were examined in the experiments: channel utilization, network latency, and packet delivery ratio. As a result, our model successfully accomplishes the goals of our research by increasing packet prioritizing, resource usage, quality of service (QoS) support, and (IPsec) security protocol performance [43].

TABLE 2::LITERATURE REVIEW OF ENHANCING QOS USING ROUTING

	Author	Parameter	Description
1.	Jennifer S. Raj, Dr Abul Basar	Throughput ,power consumption,life span,delay, PDR	Proposed methodology that uses the concatenation of clustering with neural and simple fuzzy rule based system supported by the shortest route determination to provide with an energy efficient and enhanced routing capabilities for IOT with WSNs ensures to have a route entrenchment with reduced power consumption and improvised QOS metrics. The performance analysis is done with regard to the packet delivery ratio, energy consumption, sensor network life time and delay to evidence it perfect functioning.[52]
2.	M. Sivaram et.al	Throughput ,Route Discovery, delay	QoS-aware a routing protocol, called RDBTMA protocol (Retransmission Dual Busy Tone Multiple Access), improved from existing DBTMA protocol aim enhancing performance and support QoS for MANET. The focus of this research proposes two elements, include busy tones and RTS/CTS dialogues (Ready To Send/Clear to Send) and a fast retransmission mechanism when the collision occurs between packets. [53]
3.	Sadia Din et. al.	Packet Size, mobility.	proposed a new routing protocol, called BTA-GRP (Beaconless Traffic-Aware Geographical Routing Protocol) for VANET in smart cities. This protocol is improved from geographic-based routing protocols. The focus of this work is taken traffic density, distance and direction into account routing cost function to select a fit route. Simulation results show that the proposed protocol outperforms in terms of packet delivery ratio, delay time, routing overhead compared with existing routing protocols in other mobility and density scenarios in smart cities environment.[54]
4.	Ram Mohan Chintapalli, Venugopal reddy	Throughput ,PDR, Energy	Proposed a hybrid multi-metric optimization routing protocol, called M-LionWhale for secure routing in MANET. The focus of research proposes to combine the lion algorithm (LA) into whale optimization algorithm (WOA) to forming

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	ananthu la		M-LionWhale. To making-decision select optimal route and support QoS, this work also proposes a fitness function with five parameters include energy, distance, link lifetime, delay, and trust.[55]
5	Ibrahim Kacem et al	PDR, Capacity, Avg Delay	Proposed a routing protocol based on Fuzzy Petri Nets and Ant System, called SynFAnt protocol (Synchronized Fuzzy Ant System) aim to find the optimal route for MANET. The focus of this work uses the fuzzy synchronized Petri net, specifically is a synchronized fuzzy transition to the modeling of the making-decision function. Then, the ant algorithm is used to find the optimal route. Simulation results show that the SynFAnt protocol improves significantly in terms of packet delivery ratio, throughput, delay time, and support QoS compared to the other existing routing protocols. [56]

Mobility Management: Mobility management protocols have developed from host-based to network-based. Both sorts of solutions are prevalent, but their presence is dependent on the nature of the systems being installed. In host-based protocols, the mobile node (MN) is involved with mobility-related signaling, whereas network-based protocols shield the host by transferring mobility-related signaling to network entities. The characteristics of the Internet of Things lean toward network-based solutions. The vast range of solutions developed to obtain improved performance clearly demonstrates superiority in performance while simultaneously addressing concerns such as extended handover latency, intensive signaling, and packet loss, all of which impact QoS for real-time applications [44].

This method can mix packet data with infrastructure-specific information and forward packets without knowing what they contain. Furthermore, it can track and predict mobile node location trajectories and adapt to new paths, allowing consumers and producers to move throughout the network with ease and increasing network stability [45].

TABLE 3 LITERATURE REVIEW OF ENHANCING QOS USING MOBILITY MANAGEMENT

	Author	Parameter	Description
1	Awais Ahmed et al	Blocking probability, Device lifetime, No of connection	The proposed scheme is composed of two phases. Firstly, the MNs perform handover triggering based on the optimization of the Receive Signal Strength (RSS) from an access point/base station (AP/BS). Secondly, the network selection process is performed by considering the cost and energy consumption of a particular application during handover. Moreover, if there are more networks available, then the MN selects the one provided with the highest quality of service (QoS). The proposed scheme efficiently optimizes the handoff related parameters, and it shows significant improvement in the existing models used for similar purpose.[58]
2	Hossein Fotouhi et al	probability of Handoff, signal Strength Indication	This paper highlights the need for mobility support in future Internet-of-Things (IoT) applications, outlining an innovative architecture - dubbed as MobiFog. MobiFog builds on separated data and control planes, where the latter is managed by a Software-Defined Network (SDN) controller. in this paper we use the RPL protocol. Overhearing in the APs enables them to notify the SDN controller about the status of their links to mobile nodes, enabling the SDN controller to proactively update the RPL parent list in the mobile nodes. We also provide a probabilistic analysis.[59]

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3	Shuai klang et al	Energy Consumption	This paper studies energy minimization under a joint graph mobility and backscatter communication model. With the joint model, the mobility management and power allocation problem unfortunately involve nonlinear coupling between discrete variables brought by mobility and continuous variables brought by communication. Despite the optimization challenges, an algorithm that theoretically achieves the minimum energy consumption is derived, and it leads to automatic trade-off between spending energy on moving versus on communication in the UGV backscatter system. [60]
4	Ioannis Kosmopoulos et al	Throughput, Signaling Cost	This paper proposes an energy aware mobility management scheme for supporting modern services in 5G network architectures. The discussed scheme implements both the VHO initiation, the Network Selection and the VHO execution. [61]
5	Iliar Rabet et al	Buffer Time, congestion Time, Reception ratio, end to end delay	Author address SDMob, which is a lightweight SDN-based mobility management architecture that integrates an external controller within a constrained IoT network. SDMob lifts the burden of computation-intensive filtering algorithms away from the resource-constrained nodes to achieve seamless handoffs upon nodes mobility. The current work extends our previous work, by supporting multiple mobile nodes, networks with a high density of anchors, and varying hop-distance from the controller, as well as harsh and realistic mobility patterns.[62]

V. CONCLUSION

IoT services are capable of linking numerous smart items to the internet, making life safer and more comfortable by lowering expenses and risks. Given the importance of IoT in everyday life, QoS measurements in the IoT ecosystem must be defined and centralized. Because IoT is made up of three components: Things, Computing, and Communication, this study identifies multiple QoS metrics relevant to each component. The main contribution of this study is the identification and definition of QoS measures in a variety of contexts. This study assists IoT service providers in more comprehensively describing their offerings, as well as fostering healthy competition among IoT service providers. This work aids IoT clients in comprehending their requirements for IoT services. Furthermore, when building models for various difficulties, researchers and experts must consider the Quality-of-Service component. This effort will also assist them in considering crucial and relevant QoS indicators.

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Chapter 10

Cognitive IoT sensors for smart industrial and biomedical applications

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Abstract

Cognitive Internet of Things (IoT) sensors are advanced sensing devices that incorporate artificial intelligence (AI) and machine learning (ML) algorithms to process and analyze real-time data from various sources. These sensors are widely used in smart industrial and biomedical applications for their ability to provide real-time information and improve operational efficiency. In industrial applications, cognitive IoT sensors can be used to monitor production processes and provide predictive maintenance. In biomedical applications, they can be used to monitor patient health and improve diagnosis and treatment. With the continued growth of the IoT and advancements in AI and ML, the use of cognitive IoT sensors is expected to increase in both industrial and biomedical applications in the coming years. This book chapter presents the innovative approach to decision making in healthcare and industrial settings, focusing on the handling of data transmission, trade, and record keeping through a cost-effective preservation method. The chapter serves as an overview of cognitive sensors and the current state of IoT in smart industries. It also delves into the impact of cognitive sensors on the operations of hospitals and industrial organizations, and explores the use of these sensors to understand the reasons behind resistance to smart products among both producers and consumers. AQ1

10.1 Introduction

Cognitive Internet of Thing (IoT) sensors are smart sensors designed to improve the efficiency and performance of industrial and biomedical applications. These sensors use artificial intelligence (AI) and machine learning (ML) algorithms to

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process and analyze data, and can be integrated into IoT systems to provide real-time monitoring and control. Applications of cognitive IoT sensors in industry include predictive maintenance, quality control, and process optimization, while in biomedicine, they can be used for patient monitoring, disease diagnosis and treatment, and telemedicine [1–4]. Cognitive IoT is an advanced form of IoT that uses AI and ML to process and analyze the data generated by IoT devices. The goal of cognitive IoT is to create smart, self-learning, and autonomous systems that can interact with their environment, learn from it, and make decisions based on that knowledge [5–7]. Cognitive IoT enhances the traditional IoT by incorporating cognitive computing capabilities, such as speech recognition, image and pattern recognition, and natural language processing (NLP), to improve the intelligence, efficiency and performance of IoT systems. Applications of cognitive IoT can be found in various domains such as smart homes, industrial automation, transportation, and healthcare [8–11].

The basic function of cognitive technology is to enhance human intelligence by simulating human thought processes and decision-making abilities. This is achieved by using AI techniques such as ML, NLP, computer vision, and expert systems [12–15]. Cognitive technology helps automate complex and repetitive tasks, provides insights from large amounts of data, and makes more informed decisions. It can also learn from experience and continuously improve over time, enabling it to adapt to new situations and perform increasingly complex tasks. A machine starts producing data for analysis once it is connected to a cognitive computing system. A computing scheme is a set of instructions and procedures that dictate how a computer or network of computers should process, store, and manage data. The computing scheme can determine how data is organized, how algorithms are executed, how data is transmitted, and how different components of the system interact [16–21]. There are several types of computing schemes, including: *Centralized computing*: this scheme involves a single, central computer that manages all data and processing in the system. *Distributed computing*: this scheme involves multiple computers working together in a network, each processing a portion of the data and communicating with each other to reach a common goal. *Client–server computing*: this scheme involves a central server that manages data and processing and a number of client computers that request data and services from the server [15–17,21]. *Cloud computing*: this scheme involves remote servers that provide data and processing resources over the Internet, allowing users to access the resources they need without having to manage their own infrastructure [19]. Each computing scheme has its own advantages and disadvantages, and the best scheme for a particular application depends on the specific requirements and constraints of the system. Basic function of cognitive machinery is represented in Figure 10.1.

A. Architecture of cognitive sensor
   The architecture of a cognitive sensor is a layered structure consisting of three main classes: *Sensory class system*: This class is responsible for capturing raw data from the physical environment using various sensory modalities such as cameras and microphones [20–22]. *Preprocessing class system*: This class

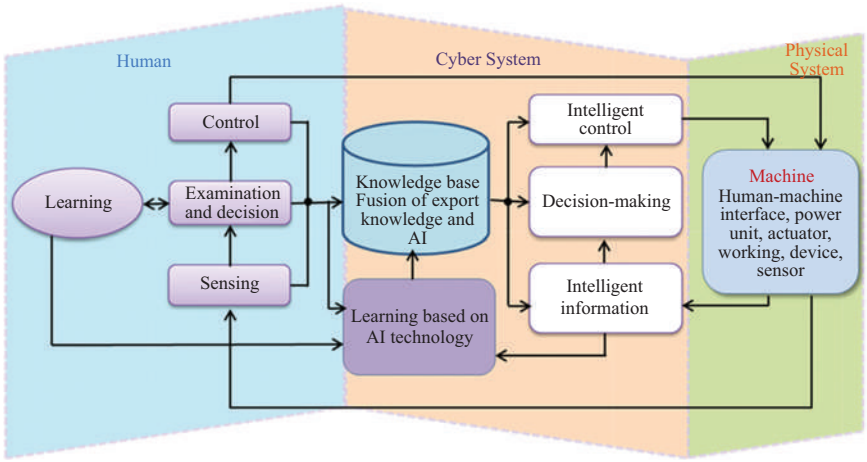

Figure 10.1 Basic function of cognitive technology [14]

performs initial processing on the raw data obtained from the sensory class system. This includes tasks such as noise reduction, data normalization, and feature extraction. *Logical class system*: This class processes the preprocessed data and performs higher-level tasks such as object recognition, scene understanding, and decision making. This class is responsible for creating a semantic representation of the data and making inferences based on that representation. Each class in the architecture is designed to perform specific tasks and the overall system is designed to perform complex cognitive tasks. The three classes work together to provide a complete and integrated solution for capturing, processing and making decisions based on sensory data represents the various components and processes involved in the technology [23–27]. Some common elements that may be included in a visual illustration of cognitive technology are: *Sensors*: represented as input devices that capture data from the physical environment. *Data processing*: represented as a series of blocks that perform various data processing tasks such as data normalization, feature extraction, and semantic representation. *Machine learning models*: represented as decision making blocks that use statistical models to make predictions based on the processed data. *Knowledge base*: represented as a database of knowledge that is used by the cognitive technology to make inferences and decisions. *Output devices*: represented as devices that present the results of the cognitive technologies processing to the end-user, such as a display or a speaker [28–31]. Overall, the visual illustration of cognitive technology aims to provide a clear and concise representation of the various components and processes involved in the technology, and how they interact with each other to perform complex cognitive tasks.

Cognitive work refers to the process of using cognitive technology to perform tasks that require human-level intelligence, such as decision making, problem solving, and pattern recognition [32–36]. *Flexibility*: cognitive work is highly

flexible, allowing the technology to perform a wide range of tasks, and adapt to changing conditions and requirements. *Fully automatic*: in many cases, cognitive work is performed fully automatically, without the need for human intervention, allowing for increased efficiency and accuracy. *Accuracy*: cognitive technology is designed to perform tasks with high accuracy, by using statistical models and machine learning algorithms to process data and make predictions. *Intelligence*: cognitive work is performed with human-level intelligence, by using models that capture the underlying patterns and relationships in the data. *Adaptability*: cognitive technology is highly adaptable, allowing it to learn and improve over time, based on new data and experience [37,38]. This enables the technology to continuously improve its performance, and stay up-to-date with the latest advancements in the field. Overall, cognitive work provides a highly efficient and accurate solution for performing tasks that require human-level intelligence, by leveraging the power of advanced machine learning algorithms and statistical models. Figure 10.2 shows the visual illustration of cognitive technology.

B. Briefly on decision theory

Decision theory is a branch of mathematics and economics that deal with the study of decision making under uncertainty. It provides a framework for modeling and analyzing decisions, by taking into account the uncertainty and risk associated with different outcomes. The theory defines a set of formal methods for representing and analyzing decision problems, including methods for determining the optimal decision, given the available information and constraints. The goal of decision theory is to help individuals and organizations make better decisions, by providing a systematic and scientific approach to decision making. Decision theory covers a wide range of topics, including

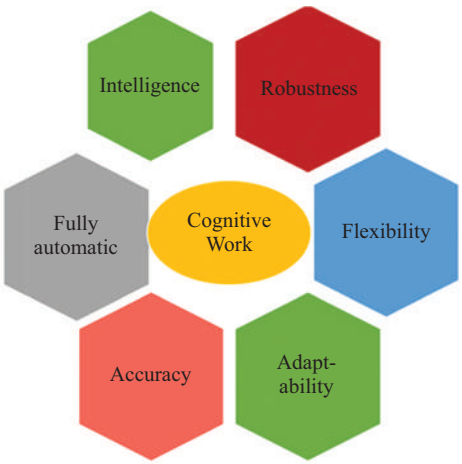

Figure 10.2 Visual illustration of cognitive technology

decision under uncertainty, risk assessment, utility theory, game theory, and multi-criteria decision analysis. It is widely used in a variety of fields, including finance, engineering, medicine, and operations research. Overall, decision theory provides a valuable tool for improving decision making in complex and uncertain environments, by helping individuals and organizations make informed and rational decisions [39]. A decision often involves selecting one of two or more possibilities. Since it is simpler for an individual to move from a choice to action than for an organization, decision-making theories have tended to be formed from studies of individual behavior rather than organizational behavior [40–42]. In [43], Brunsson and Hansson provide an example of a decision in their book, "Organizing Reason: Decisions, Bounded Rationality, and Organizing." The example they provide is a simple decision problem, where a manager is faced with the choice between two alternatives: investing in a new product line or not. The manager must consider the potential benefits and costs of each alternative, and make a decision based on the information available to them. In this example, Brunsson and Hansson illustrate how decision theory can be used to analyze and evaluate the different options, taking into account the uncertainties and risks involved. They show how the manager can use decision theory to determine the optimal decision, based on the available information and constraints, and how they can use it to evaluate the potential outcomes of each alternative. The example provided by Brunsson and Hansson demonstrates the power of decision theory in improving decision making, by providing a structured and systematic approach to decision making under uncertainty. It highlights the importance of considering the different factors that influence a decision, and the role of decision theory in helping individuals and organizations make informed and rational decisions [45–48]. Brunsson, a Swedish organization theorist, provides several explanations in his work on organizations and decision making. Some of the key explanations provided by Brunsson include: the role of rules and routines in organizations: Brunsson argues that rules and routines play a crucial role in shaping organizational behavior and decision making. He shows how rules and routines can both facilitate and constrain decision making, and how they can influence the way that organizations approach decision problems. The concept of organizational rationality: Brunsson introduces the concept of "organizational rationality," which refers to the way that organizations make decisions based on the available information and constraints. He argues that organizations are not always rational in the traditional sense, but instead have their own unique form of rationality that is shaped by the rules, routines, and practices that they have developed over time. The importance of symbolic actions in organizations: Brunsson highlights the role of symbolic actions in shaping organizational behavior and decision making. He shows how symbolic actions can be used to convey meaning and influence decision making, and how they can play a crucial role in shaping the way that organizations perceive and respond to decision problems [49–51]. Overall, Brunsson's work provides valuable insights into the dynamics of organizational decision making, and the role of

rules, routines, and symbolic actions in shaping organizational behavior and decision making. His explanations help to deepen our understanding of the complexities of decision making in organizations, and the ways in which organizations approach decision problems.

10.2 IoT outline

A. The significance of the Internet
   The progress of the Internet has been significant since its inception in the late 1960s. The following are some key milestones in the evolution of the Internet [52]. The creation of ARPANET in the late 1960s: ARPANET was the first computer network and the precursor to the modern Internet. It was created by the US Department of Defense and was designed to allow researchers to share information and collaborate on projects. The development of TCP/IP in the 1970s: Transmission Control Protocol/Internet Protocol (TCP/IP) was developed in the 1970s and became the standard communication protocol for the Internet [27,29,53–56]. It allowed computers to communicate with each other, regardless of their location or operating system. The creation of the World Wide Web (WWW) in the 1990s: WWW was created in the 1990s and transformed the Internet from a network of computers into a global network of information. The WWW allowed users to access and share information using a web browser, making it much easier to navigate the Internet. The rapid growth of the Internet in the 2000s: the early 2000s saw a rapid increase in the number of Internet users, as well as the development of new technologies and services, such as broadband, social media, and e-commerce. The Internet became an increasingly important part of everyday life, as people used it for communication, entertainment, and business. The rise of mobile Internet in the 2010s [57–60]. The rise of smartphones and tablet computers in the 2010s has dramatically changed the way that people access and use the Internet. Mobile Internet has become increasingly widespread, making it possible for people to access the Internet from anywhere, at any time [60,61]. Overall, the progress of the Internet has been rapid and transformative, and has had a profound impact on society, commerce, and communication. The Internet continues to evolve and grow, and it is likely that it will continue to play a central role in our lives for many years to come.
B. IoT sensing
   IoT sensing refers to the use of sensors in IoT devices to collect data about the physical world and transmit it over the Internet. IoT sensing allows devices to interact with their environment, gather data, and share that data with other devices and systems. Examples of IoT sensing include: *Environmental sensors*: these sensors measure temperature, humidity, air quality, light levels, and other environmental factors, allowing devices to respond to changes in their environment. *Motion sensors*: these sensors detect movement, allowing devices to respond to physical activity and respond accordingly. *Location sensors*: these

sensors use GPS, Wi-Fi, or other technologies to determine the device's location, allowing it to respond to its location. *Biometric sensors*: These sensors measure biometric data, such as heart rate, blood pressure, and other physiological parameters, to provide health monitoring and wellness tracking. *Image and audio sensors*: These sensors capture images and audio, allowing devices to respond to visual and auditory information. IoT sensing enables a wide range of applications, such as smart homes, wearable devices, industrial automation, and connected vehicles. It also plays a crucial role in the development of smart cities, allowing cities to monitor and respond to changes in their environment in real-time [62]. There are three types of the primary technologies that integrate "Things" into IoT ecosystems: Radio Frequency Identification (RFID): RFID is a wireless technology that uses radio waves to communicate between a tag and a reader. It enables devices to identify and track items in real-time, making it a key technology for supply chain management, inventory management, and other applications [48–50]. *Wireless Sensor Networks (WSN)*: WSNs are networks of interconnected sensors that communicate wirelessly. They enable devices to collect and transmit data about their environment, providing valuable insights for applications such as industrial automation, smart homes, and smart cities [51,52]. *Mobile computing*: Mobile computing technology enables devices to connect to the internet and communicate with other devices and systems using wireless networks. Mobile computing is a key enabler for the IoT, as it provides a platform for IoT devices to access cloud services, process data, and interact with other devices and systems [53–56]. IoT sensing plays a crucial role in various industries, including: *Manufacturing*: IoT sensors can be used to monitor production lines, collect data on machine performance, and track inventory levels in real-time. This helps manufacturers optimize their production processes and improve overall efficiency [27,29,57]. *Healthcare*: IoT sensors can be used to monitor patients' health conditions and track vital signs such as temperature, heart rate, and blood pressure. This helps healthcare providers make informed decisions about treatment and improve patient outcomes [58–60]. *Agriculture*: IoT sensors can be used to monitor soil moisture levels, crop growth, and weather conditions, providing farmers with valuable insights into the health of their crops. This information can be used to optimize irrigation and other agricultural processes [60–63]. *Energy and utilities*: IoT sensors can be used to monitor energy usage in buildings, track energy consumption. These technologies are critical for building an IoT ecosystem, as they provide the connectivity and communication capabilities required for devices to interact with each other and share data [63–66]. Development of the IoT for industry is represented in Figure 10.3. There are several ways in which the IoT can be improved for the industry: *Security*: as more and more devices are connected to the IoT, security remains a major concern. Improving the security of IoT systems is crucial to protect against hacking and other cyber threats. This can be achieved through the use of encryption, secure communication protocols, and regular software updates. *Interoperability*: ensuring that IoT devices and systems can communicate and work together seamlessly is crucial to the success of

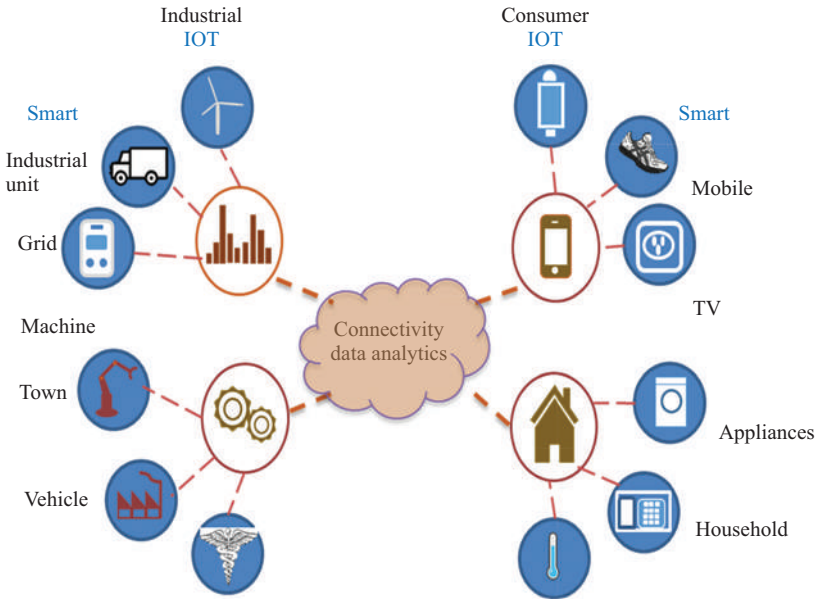

Figure 10.3 The development of the IoT for industry

the IoT in industry. Improving interoperability will make it easier for organizations to integrate IoT solutions into their operations and realize the full potential of the IoT. *Scalability*: as the number of IoT devices continues to grow, it is important that IoT systems are scalable and can handle the increased load. Improving scalability will ensure that IoT systems can continue to function effectively as more devices are added. *Data management*: collecting, storing, and analyzing large amounts of IoT data requires a robust data management infrastructure. Improving data management will ensure that organizations can effectively harness the power of IoT data to drive business value [67–69]. *Cost-effectiveness*: IoT solutions can be expensive, and reducing costs is crucial to ensure that they are accessible to organizations of all sizes. Improving cost-effectiveness will make it easier for organizations to adopt IoT solutions and realize the benefits of the IoT. By addressing these areas, the IoT can be improved and become even more valuable for the industry.

10.3 Smart industrial

Smart industrial refers to the application of advanced technologies, such as AI, ML, IoT, and robotics, in the industrial sector to increase efficiency, productivity, and competitiveness. The term "SMART" refers to the ability of these technologies to make operations more "intelligent," that is, more automated, connected, and data-driven. The goal of smart industrial is to create a more

flexible, adaptive, and sustainable industrial system [70,71]. "Towards Smart Factory for Industry 4.0" refers to the trend towards the integration of advanced technologies in manufacturing processes to achieve greater efficiency, flexibility, and responsiveness. The concept of the smart factory is a key aspect of Industry 4.0, the fourth industrial revolution, which aims to create a more automated, connected, and data-driven industrial system [72–75]. A smart factory leverages technologies such as the IoT, AI, ML, and robotics to create a fully integrated, real-time system for monitoring and controlling production processes. This results in a more agile and responsive manufacturing system, capable of quickly adapting to changing market conditions, customer demands, and supply chain disruptions [76–79]. The goal of a smart factory is to create a more flexible, adaptive, and sustainable industrial system, one that can respond quickly to changing market conditions and customer demands, while reducing costs, increasing efficiency, and improving product quality.

The industrial IoT (IIoT) with ML refers to the integration of ML algorithms into the IIoT ecosystem. The IIoT is a network of connected devices and machines that communicate with each other to automate industrial processes. By combining the power of machine learning with the IIoT, organizations can create more intelligent, adaptive systems that can improve efficiency, productivity, and competitiveness [80,81]. ML algorithms can analyze vast amounts of data generated by connected devices and machines to identify patterns and make predictions about

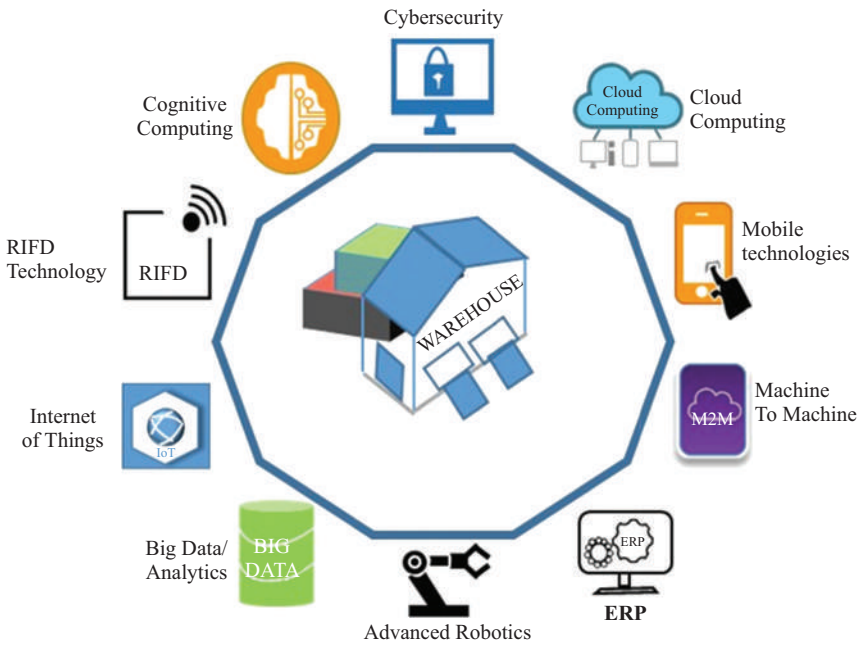

Figure 10.4 Architecture of smart industry

future events. This can help organizations to optimize production processes, improve quality control, and reduce downtime. In a smart factory, for example, ML algorithms can be used to predict maintenance needs based on sensor data, optimize production schedules based on real-time demand and supply chain data, and improve energy efficiency by adjusting processes based on real-time energy consumption data [82–85]. By integrating ML into the IIoT ecosystem, organizations can gain a competitive advantage by leveraging the power of data and analytics to create a more intelligent, adaptive, and efficient industrial system.

10.4 Biomedical

Cognitive computing in biomedical refers to the use of AI and ML algorithms to process and analyze large amounts of biomedical data to support decision making and improve healthcare outcomes [86–89]. Applications of cognitive computing in biomedical include: (1) drug discovery and development. (2) Predictive analytics for patient outcomes. (3) Medical imaging analysis. (4) Electronic medical records management. (5) Clinical trial design and optimization. (5) Personalized medicine and precision health.

These applications help to identify new targets for drug development, predict patient outcomes, improve medical imaging analysis, and optimize the delivery of care to patients.

10.5 Issues and challenges

Issues and challenges in cognitive technologies include (1) bias and fairness: ensuring that AI systems do not perpetuate existing biases and discrimination. (2) *Explainability*: understanding how AI systems make decisions and ensuring accountability. *Data quality and privacy*: ensuring that data used to train AI systems is accurate, diverse, and respects privacy rights. (3) *Regulation*: navigating the complex regulatory landscape around AI and ensuring compliance with relevant laws and ethical principles. (4) *Security*: protecting AI systems from cyber-attacks and ensuring the privacy and security of sensitive data [90]. *Talent and skills*: attracting and developing the necessary talent and skills to build, deploy, and manage AI systems. *Integration with existing systems*: integrating AI systems with existing processes, technologies, and organizational structures. *Ethical considerations*: ensuring that AI systems are aligned with ethical and moral values, such as transparency, accountability, and respect for privacy. (5) *Scalability and sustainability*: ensuring that AI systems can handle increasing amounts of data and computational complexity over time.

(A) Requirements for intelligent equipment

The ability to learn from data and improve over time. *Real-time processing*: the ability to process large amounts of data in real-time and make decisions quickly. *Data integration*: the ability to integrate data from multiple sources and formats, such as sensors, databases, and the cloud [91–94]. The ability to

communicate and share data with other systems and devices. The ability to handle increasing amounts of data and computational complexity over time. *Human–machine interface*: a user-friendly interface that enables human operators to interact with the equipment and monitor its performance. *Security and privacy*: the ability to protect sensitive data and ensure the privacy and security of users. The ability to function reliably and consistently, even in challenging environments or under adverse conditions. The ability to provide value for money, taking into account both the initial cost of the equipment and its ongoing operational expenses. The ability to comply with relevant standards and regulations, such as safety standards, data privacy laws, and ethical guidelines.

(B) Nanotechnology-based method

Nanotechnology-based cognitive sensors are advanced sensors that utilize nanotechnology to enhance their capabilities. These sensors have the ability to self-learn, adapt, and process information in real-time, making them useful in a range of applications, such as smart homes, wearable devices, and robotics. They can detect, analyze, and respond to changes in their environment and make decisions based on that information [95–98]. The miniaturization of these sensors enables them to be integrated into smaller and more complex systems, resulting in more efficient and effective sensing capabilities. Nanotechnology-based smart industries are industries that utilize nanotechnology to improve their processes, products, and overall operations [99–101]. Some examples of nanotechnology applications in industries include: *Healthcare*: nanotechnology is used in the development of advanced medical devices, such as nanoscale sensors for monitoring vital signs and targeted drug delivery systems. *Energy*: nanotechnology is used in the development of solar panels, fuel cells, and batteries, to increase their efficiency and storage capacity. *Manufacturing*: nanotechnology is used to enhance product performance, improve material strength, and reduce production costs. *Information technology* [102–106]: nanotechnology is used to improve the performance and functionality of computer components, such as hard drives, processors, and memory chips. *Environmental protection*: nanotechnology is used to develop more efficient and effective water filtration systems, air purification systems, and to clean up toxic waste sites [107,108]. Overall, nanotechnology is helping smart industries to increase efficiency, reduce costs, and improve sustainability.

(C) Data-driven fabrication

Data-driven fabrication refers to a manufacturing process where data, such as CAD models, simulation results, and sensor readings, is used to drive the production of a product. This technology allows for the integration of data into the production process, enabling real-time adjustments and customization of products based on data analysis [109]. In industry, data-driven fabrication has the potential to revolutionize manufacturing by improving efficiency, reducing waste, and enabling mass customization. Some examples of its applications include: *Additive manufacturing (3D printing)*: using data from CAD models, 3D printers can produce complex parts and structures with high accuracy and

minimal waste [110]. *Precision manufacturing*: data from sensors and simulation results can be used to guide the production process, ensuring high precision and consistent quality. *Smart factories*: data from sensors and production equipment can be analyzed to optimize production processes and identify areas for improvement. *Personalized products*: data from customer preferences and usage patterns can be used to produce customized products that meet individual needs. Overall, data-driven fabrication is enabling industry to produce high-quality products faster and more efficiently, while reducing waste and improving sustainability.

10.6 Conclusions

In conclusion, cognitive sensing is playing a critical role in the development of smart industries. By utilizing advanced sensors that can self-learn, adapt, and process information in real-time, smart industries are able to improve efficiency, reduce costs, and enhance their overall operations. With the integration of nanotechnology and data-driven fabrication, smart industries are able to produce high-quality products faster and more efficiently, while reducing waste and improving sustainability. Cognitive sensing is a rapidly growing field with immense potential, and its continued development will likely bring about numerous new applications and advancements in the future. As such, smart industries that embrace and incorporate cognitive sensing technology will likely be well-positioned for success in the coming years. By utilizing advanced sensors that can self-learn, adapt, and process information in real-time, the biomedical field is able to improve patient outcomes and advance the field of medicine. Cognitive sensors are being used to develop innovative medical devices, such as nanoscale sensors for monitoring vital signs, targeted drug delivery systems, and implantable devices. These devices are helping to provide continuous monitoring and treatment, reducing the need for invasive procedures and improving patient comfort. In addition, cognitive sensing technology is enabling the development of personalized medicine, where treatments are tailored to the unique needs and characteristics of each patient. This is accomplished by using data from sensors and other sources to better understand patient conditions and make informed treatment decisions. Overall, cognitive sensing technology is helping to advance the biomedical field and improve patient outcomes, and its continued development will likely bring about numerous new applications and advancements in the future.

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Chapter 10

Cognitive IoT sensors for smart industrial and biomedical applications

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Fabrication and characterization of $CsSnI_3$ perovskite layer for solar cell applications

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ABSTRACT

Research of lead-free perovskite solar cells has gained speedy and growing attention with urgent intent to eliminate toxic lead in perovskite materials. The environmental friendliness and excellent thermal stability proves of stable perovskite Cesium Tin Iodide ($CsSnI_3$) as one of the promising materials for their potential application in solar field. In this paper, fabrication and characterization of $CsSnI_3$ perovskite layer has been reported. Fabrication of $CsSnI_3$ perovskite layer was made by spin coating method. One step coating processed $CsSnI_3$ layer have characterized by X-ray diffraction (XRD) and field-emission scanning electron microscopy (FESEM). Optical properties of layer have investigated by Vis-NIR spectrophotometer. It reveals that $CsSnI_3$ perovskite layer possess good absorption in the visible spectrum. XRD result confirms the crystal structure of orthorhombic phase with dominating peak at 27.5^0 ($2*\Theta$) corresponding (202) planes. Dense distributions of polycrystalline $CsSnI_3$ perovskite layer were recorded by FESEM images.

Keywords: Perovskite solar cells, fabrication, characterization, XRD, FESEM

1. INTRODUCTION

Perovskite solar cells (PSCs) have surpassed the power conversion efficiency (PCE) of 25%, marking a significant advancement in the conversion of solar energy to electricity[1]. Modern high PCE cells based on a perovskite photon absorber with lead incorporation have a structure of ABX_3 [A = Cs, MA (CH_3NH_3, methylammonium), or FA ($NH{=}CHNH_3$, formamidinium); X = I, Br, Cl. In ABX_3 structure, B indicates Pb metal which is widely used. But due to toxicity concerns for both humans and the environment, the exclusion of the heavy metal Pb is the essential task. However, when it is removed the effectiveness of these high-performing PSCs decreases. Pb-based halide perovskites are also being investigated for use in other applications, such as light-emitting diode (LED), photodetectors, solar cells, and transistors, because of their excellent optical and electrical qualities[2]. However, due to its toxicity, the usage of the Pb element could seriously hinder large production and commercialization. Additionally, the band gap (Eg) values of Pb-based halide perovskites are larger than the ideal Eg (1.34 eV) calculated from the Shockley-Queisser limit for single-junction solar-cell applications, ranging from 1.5 to 2.4 eV. As a result, it is essential to continue developing Pb-free halide perovskite materials with lower Eg. Many Pb-free halide perovskite derivatives have recently been investigated as alternatives, including ordered double perovskites ($A_2(I)(III)X_6$), layered Sb-based halide perovskites, molecular halide perovskites, and divalent Sn^-, Mn^-, and Ge^- based halide perovskites ($A(Sn, Mn, Ge)X_3$).. They are direct analogues of Pb-based halide perovskites with a three-dimensional crystal structure, and they also have narrower Eg values ranging from 1.2 to 2.2 eV. Among these, Sn-based halide perovskites is a particularly interesting alternative[3,4,5]. Moreover, among all the Pb-free halide perovskite materials, Sn-based halide perovskite solar cells have the greatest PCE of nearly 9%[6,7]. Due to the oxidation of Sn^{2+} to Sn^{4+} ions under an ambient-air condition, the stability and PCE of these PSCs are lower.

2. METHODOLOGY

Perovskite films can be synthesized by the solution method, vapor deposition method, compositional method, or crystal growth method. In the solution method, perovskite material is spin-coated by the one-step or two-step method.

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Making a perovskite layer is easier and less expensive with the solution approach. We utilized the following procedure to make the light-absorbing perovskite layer in a single step. In the one-step method, perovskite layers like a $CsSnI_3$ precursor solution is obtained by dissolving CsI and SnI_2 in suitable solvents at a certain stoichiometric ratio. The $CsSnI_3$ solution is directly spin-coated on a FTO/ glass substrate and annealed at a certain temperature to obtain a perovskite layer/FTO/glass substrate. The performance of the device would be impacted by crystal defects. The solvent employed, annealing temperature, and annealing time may affect the perovskite layer's crystal quality and characteristics. In the one-step deposition method, it is difficult to control the morphology and thickness of the perovskite crystal layer[8]. Liang et al. developed a two-step sequential deposition method in which a saturated methanol solution of PbI_2 was spin-coated onto the TiO_2/substrate[9]. A PbI_2-coated substrate was immersed in a 2-propanol solution containing MAI for a suitable length of time and dried at a suitable temperature to get a perovskite layer onto the substrate. The reaction between the PbI_2 and MAI produced the perovskite layer. The duration of the time spent dipping and the amount of MAI solution used to create the perovskite layer affect its morphology and optoelectronic characteristics.

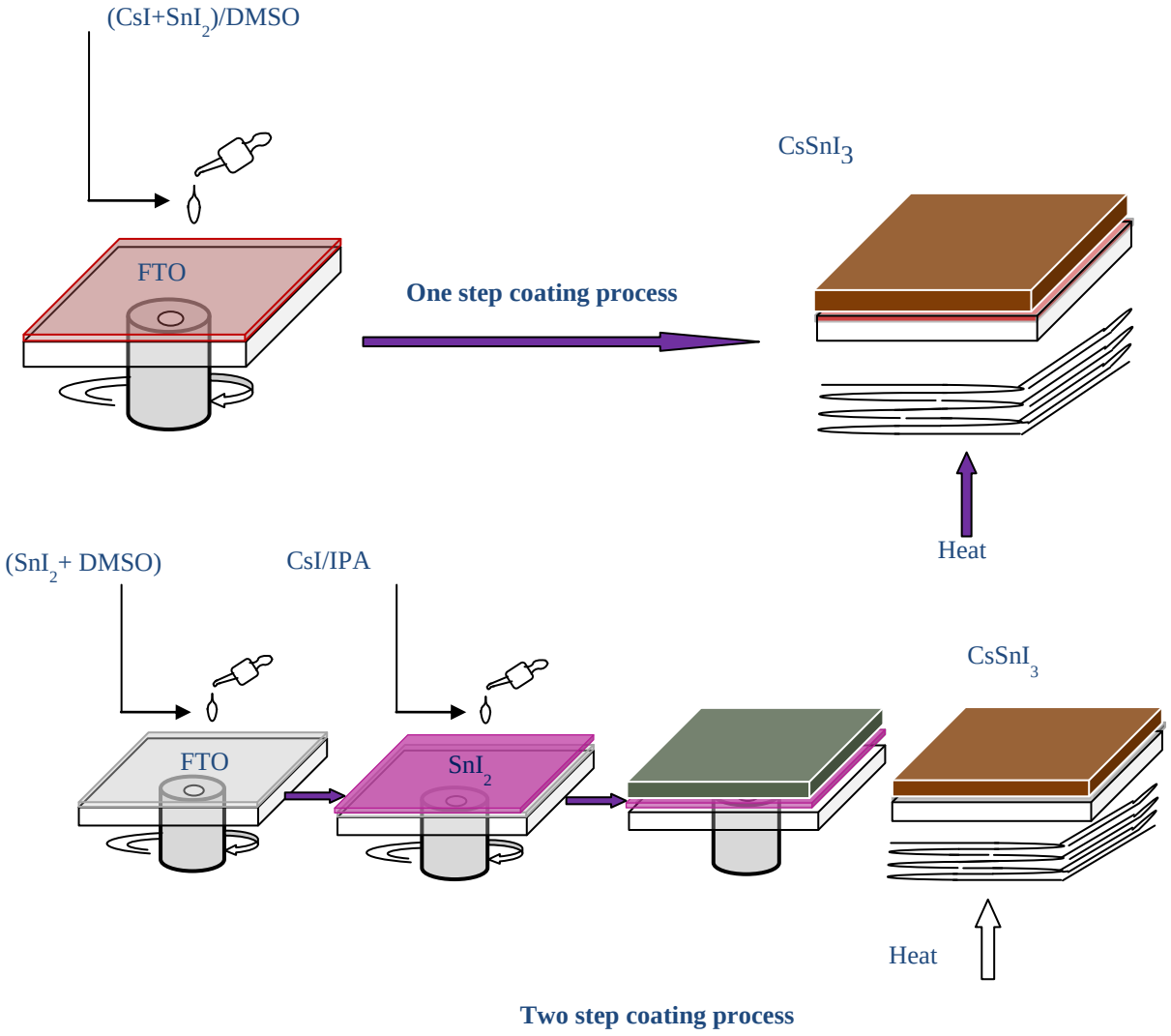

Figure 1. Schematic diagram of solution method for preparation of $CsSnI_3$ perovskite layer

3. RESULTS AND DISCUSSION

Figure 2 shows the optical absorption characteristics of the plain $CsSnI_3$ perovskite film fabricated with CsI and SnI_2 precursors. The data indicate that an enhanced optical absorption is obtained for nearly the whole absorbing region of visible spectrum, which benefits the photocurrent density enhancement of the $CsSnI_3$ based PSCs. The bandgap of the $CsSnI_3$ is estimated as ~1.5 eV, as shown by the Tauc plots of optical absorption spectra in Figure 2.

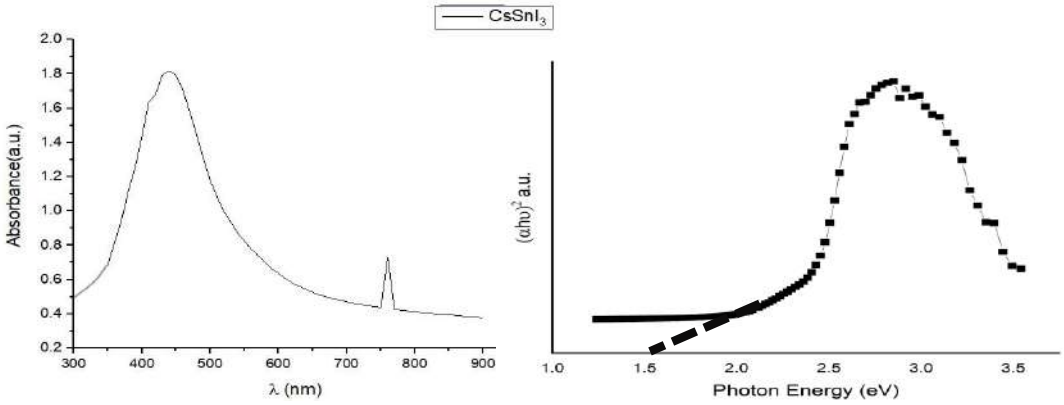

Figure 2. Absorbance Spectra and Tauc plot of $CsSnI_3$ perovskite film for the determination of bandgap (indirect method)

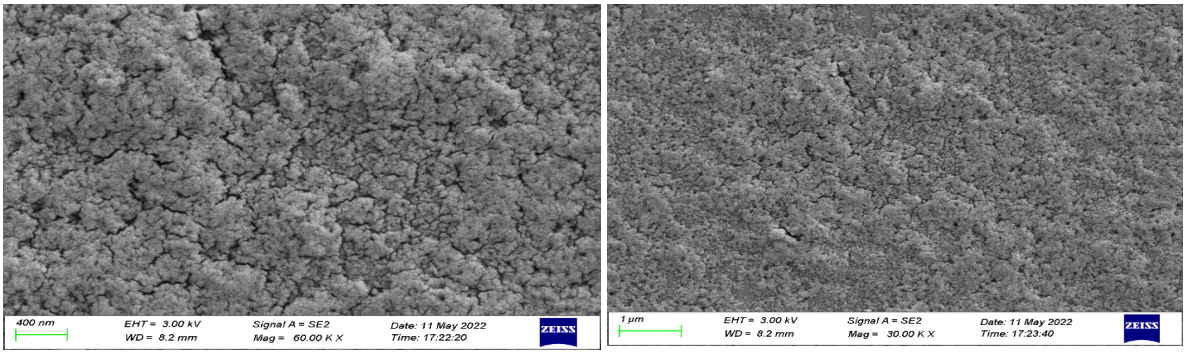

Figure 3. FESEM images of the $CsSnI_3$ perovskite layer

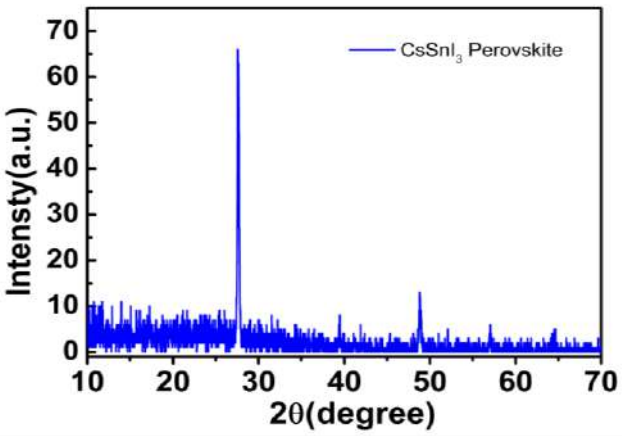

Figure 4. XRD patterns of the $CsSnI_3$ Perovskite thin layer

The surface morphologies of the perovskite films have been checked with FESEM characterization as shown in Figure 3. A good crystallinity recorded in the perovskite samples. Typical characteristic peaks of the B-γ $CsSnI_3$ structure can be found in the samples[10]. XRD result confirms the crystal structure of orthorhombic phase with dominating peak at 27.5^0 (2*Θ) corresponding (202) planes.

4. CONCLUSION

$CsSnI_3$ perovskite thin film was successfully fabricated using one step coating process. Surface morphology, crystallization and absorbance spectra were characterized by XRD, FESEM and Vis-NIR spectrophotometer, respectively. $CsSnI_3$ perovskite layer absorbance spectra showed good absorption in the visible region of solar spectrum. The fabricated $CsSnI_3$ perovskite active layer has bandgap ~1.5 eV with orthorhombic phase crystallinity, suitable for solar cell application.

ACKNOWLEDGEMENT

Central Instrumentation Facility, Indian Institute of Technology Bhilai, Chhattisgarh provided FESEM and XRD characterization facilities, which the authors gratefully acknowledge.

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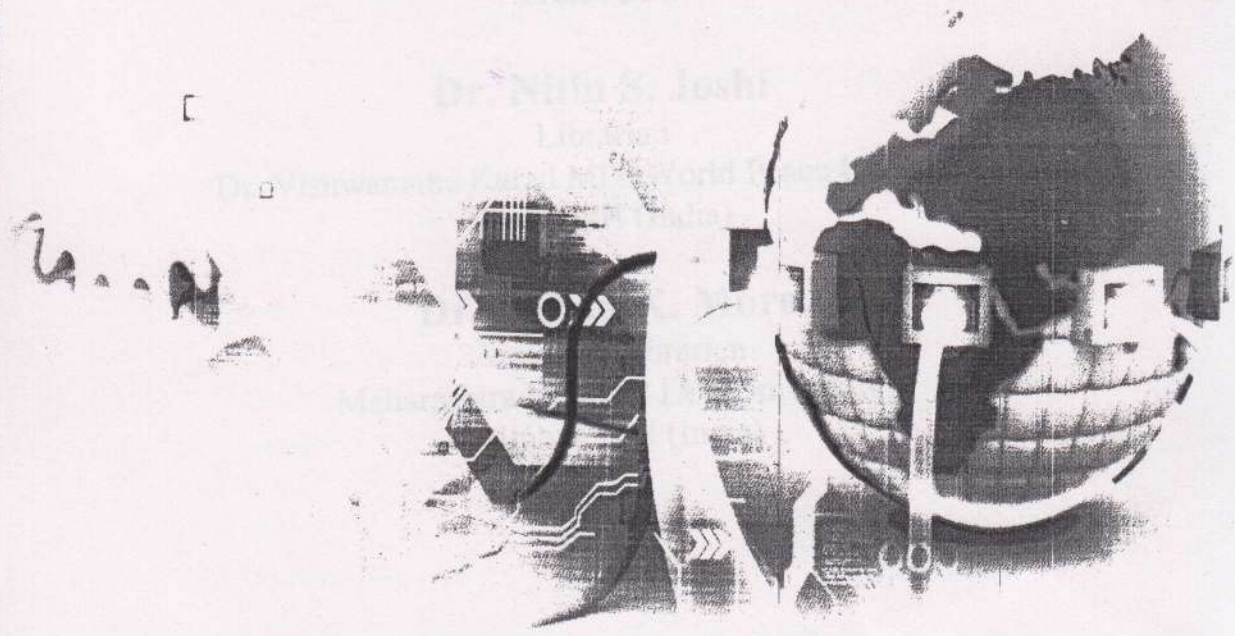

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DIGITAL TRANSFORMATIVE LIBRARY COLLECTIONS AND SERVICES: A SMART LIBRARY APPROACH

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SOCIAL DEVELOPMENT FEDERATION

Table of Contents

CHAPTER 12

Traditional to Modern: A Journey of Academic Libraries

Monika Tripathi Sharma
Santu Ram Kashyap

Abstract

Existence of Libraries in any academic institution is not a new thing but in ancient time also libraries were associated with academic institutions. This paper deals about the transition of libraries from traditional to modern. This transition occurred in almost everywhere i.e., in library resources, services and users' need also. Now the information seeking behaviour of users is also changed. This paper mainly focuses on academic libraries. Academic Libraries include school libraries, college libraries and university libraries and these libraries provide facilities to their students, staff, faculty and institutional members only.

Keywords: Modern Libraries, Traditional Libraries, Academic Libraries, E-resources, Modern Library Services.

Introduction

As we know that information is a very powerful weapon of today's society. In every sphere of life latest information is very essential. Libraries are now no more treated as store house of books or information. Now Libraries are known with new names as information centre, knowledge centre, knowledge hubs, digital library, electronic library, virtual library and so more. In recent times just storing information and keeping it safely is not the primary goal of libraries. Now libraries are focused to provide desired information to every user to promote its academic, research related or other

CHAPTER 14

CeRA- Consortium for e-Resources in Agriculture: An Introduction

Monika Tripathi Sharma
Santu RamKashyap

Abstract

Libraries are known as heart of any institution. To fulfil the information demands of user community librarian must update their resources. Resource sharing is a process by which libraries can share their resources and fulfil the demands of users in a cheaper cost. Library cooperation, collaboration, coordination are not the newer terms. Ever-growing information demands of users as well as hike in prices of library resources has given birth to the new concept consortia. In this paper we have discussed different consortia running in India and we have specially focused on CeRA (Consortium for e-Resources in Agriculture).

Keywords: Library Consortia, CeRA, Consortium for e-Resources, Agriculture libraries

Introduction

Journals are meant for nascent and current information. Journals are considered as primary source of information when they publish information about any new research. Any new research publishes firstly in the journal. Journals are main information resource of Library. With the help of journals libraries can update their users with new information. Users are also very eager to see the current issues of journals. Journals are very important source for researchers to know the latest trends and developments in their subjects. Utilization of every library depends upon its resources. Due to advent of Information technology the form of library resources has been changed. To provide better services and meet out the ever-

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Information Technology on the Job Satisfaction of LIS Professionals in Chhattisgarh

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ABSTRACT

In the present day, modern libraries have emerged in digitalization and are responsible for a variety of tools for accessing e-reading material from the library. The paper presents the impact of information technology (IT) on job satisfaction among library professionals in arts, commerce, science, engineering, medical, agriculture, law, education, management, and, other institutes. A total of 105 library professionals were selected as samples for the satisfaction of the Impact of Information Technology. As a result of the study, the majority of the respondents were working with information technology. Most engineering, medical, and agricultural LIS professionals are satisfied with the impact of IT. The study examines that there is no significant relationship between job satisfaction and job satisfaction of LIS professionals from various disciplines.

Keywords : Job satisfaction, digitization, information technology, library, LIS professionals, library automation.

1. INTRODUCTION

Nowadays, the academic library is an information center where information is generated in print and digital formats. On account of information and communication technology (ICT), the traditional library system and its processes have drastically changed. These deviations have influenced the user's outlook

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8. Endemic Biodiversity

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Abstract:

Biodiversity *is a collection of varieties of living organisms including animal, plant and microorganism as well in a perceptible area. The term* ***Endemism*** *is defined as the stringent distribution of a particular living species like plant and animal in a definite area or location. Most of the time endemic species are centre of attraction for biodiversity hotspot, national parks and sanctuaries. Endemic species are particularly represents endangered and rare species, now a day. Their existence and distribution in particular areas compel us to provide special care to them. India is one the significant landmark for biodiversity with 4 major hotspots i.e. Western Ghats, The Himalaya, Indo-Burma region and Sundaland. These hotspots are popularly known for Global Ecotourism. This hotspot attracts many ecologist, educationist, researchers of various fields and scientist etc. List of endemic species in South Asian regions is infinite. Some of the famous species that attract ecotourism are* ***Animals*** *- Lion-tailed macaque (Macaca silenus), Indian rhinoceros (Rhinoceros unicornis), Gaur (Bos gaurus), Sangai deer (Rucervus eldii eldii), Purple frog (Nasikabatrachus sahyadrensis),* ***Birds*** *-Narcondam hornbill (Rhyticeros narcondami), Malabar grey (Ocyceros griseus), Forest owlet (Athene blewitti),* ***Plants*** *- Red sandalwood (Pterocarpus santalinus), Buchanania barberi (found in Nadari-Kerla, India), Syzygium cumini (Syzygium densiflorum), Black turmeric (Curcuma caesia) etc. Hence, Endemic Biodiversity is consisting of a broad area of knowledge all over the world.*

Keywords: *Biodiversity, Endemism, Hotspot, National Parks, Sanctuaries, Ecotourism, South-Asia.*

8.1 Endemic Biodiversity:

8.1.1 Biodiversity:

Let's start with the term **"Biodiversity"**. We can observe presence of various species of plants, animals, microorganism in our surrounding environment. The probability of finding maximum number of species including plant, animals, microorganisms and other living organisms in a specified area is considered as **"Biodiversity"** of that area. Richness of biodiversity increases with increases in number of species.

- **BIO** means **LIFE**
- **DIVERSITY** means **VARIATION (No. and Types of Living Organisms)**

Chapter-7

Food and Therapeutic Importance of Plant Secondary Metabolites (PSMs)

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ABSTRACT

Plants produces secondary metabolites for their own benefits. PSMs are produced by plants for attaining defense against various diseases caused by microorganism and also for fighting against unfavorable environmental conditions. Scientifically they are categorized as biotic and abiotic stress. Human beings are also able to use PSMs as food and medicine after applying some modern techniques and scientific efforts. We can use them without altering their biological function in our body. PSMs has ability to alter various metabolic activities in plants and humans also if applied in specific concentration under favorable conditions i.e. temperature, pH, water etc.Literature reviewed reveals that identification of PSMs carrying neutraceutical properties is in transition phase. There is a long list of green leafy plants of edible varities which may includes coriander (*Coriandrum sativum*), mint (*Mentha*

Antimicrobial Secondary Metabolites from Medicinal Plants: A Boon of Nature for Mankind A Review

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1

Antimicrobial Secondary Metabolites from Medicinal Plants: A Boon of Nature for Mankind *A Review*

Dhananjay Pandey and A.K. Gupta

ABSTRACT

Medicinal Plants possesses diverse groups of secondary metabolites which are the key source of antimicrobials conferring ameliorative bio-efficacy for microbial diseases. In current prospects, owing to the profuse implication of antibiotic therapy to combat several microbial infections have made the antibiotic resistance a global issue. The situation has turned on the vision of scientific community to look inwards for the alternative mode of healing. Recently, the medicinal plants as a potent and vital source of therapeutics have gathered the interest of academia and scientific communities across the world. The immense bio-efficacy of medicinal plants as healing agents has proved to be a landmark for researchers to investigate the potential bioactive compound conferring antimicrobial activity. The need of hour is to harness good number of medicinal plants with the specific objectives to unlock their potential as antimicrobials by extraction, characterization and investigating the possible mode of action of bioactive secondary metabolites which will definitely lay a strong foundation of herbal therapy in years to come. Thus, in context with the present scenario the active research on the antimicrobial activity of the secondary metabolites from medicinal plants is very rewarding for the elucidation of new drug discovery and expands the horizon of novel and alternative source of antimicrobials for a better tomorrow.

Keywords: *Medicinal Plants, Bio-efficacy, Secondary Metabolites and Antimicrobial Activity.*

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INTRODUCTION

The therapeutic power of medicinal plants had been recognized since ages and botanic medicine is one of the oldest practiced professions by humanity (Kambizi and Afolayan, 2001). Medicinal plant can be the best source of obtaining a variety of newer drugs as secondary metabolites are more specific, biodegradable and supposed to have fewer side effects (Tomoko *et al*., 2002). They also offer unique platform for biological functionality and structural diversity that is indispensable for novel drug discovery (Verpoorte *et al*., 2002). Medicinal Plants are widely explored in the traditional system of medicine and their curative potentials are well-documented (Dubey *et al*., 2004). Microbiologists, natural product chemists and ethno botanists are in search of bioactive compounds from medicinal plants for curing several infectious diseases (Tanaka *et al*., 2006). Some important biological and pharmacological activities from various parts of plants species were reported as antimicrobial, antimalaria, antisickling, antihelminthic, anticonvultant, antihypertensive, antischistosomal, antitumour, antiviral, antiinflammatory, cardiotonic, contraceptive, antiplatelet, wound healing and prostaglandin inhibitory properties (Sharma and Kumar, 2009; Mahima *et al*., 2012; Prescott *et al*., 2002; Rahal *et al*., 2014). The documentation of the plant materials to treat and prevent infectious diseases has attracted the attention of scientist's worldwide (Falodun *et al*., 2006). Therefore, in light of present context an effort to further explore the medicinal or natural products towards improving health care delivery deserves attention.

According to the World Health Organization (WHO, 2001) a medicinal plant is any plant which contains substances useful for the therapeutic purposes in one or more of its organ and are the precursors for the synthesis of useful drugs. Medicinal plants possess a vast variety of organic compounds that have antimicrobial activity (Lai and Roy, 2004). These compounds are found in different part of the plants *viz*., stems, roots, leaves, bark, flowers or fruits and seeds such as allicins, isothiocyanates, plant pigments, hydrolytic enzymes, proteins, essential oils and phenolic compounds (Cutter, 2000; Jalalpure *et al*., 2004). The medicinal properties of plants are due to their antimicrobial, antioxidant and antipyretic effects of the secondary metaboloites present in them (Adesokan *et. al*., 2008). Medicinal plants are considered as clinically effective and safer alternatives to the synthetic antibiotics (Modi *et al*., 2012). Several reports have documented the effective activity of medicinal plants as antimicrobials, so plants are one of the bedrocks for the modern medicines (Evans *et al*., 2002). Therefore, systematic studies on the bioactive compounds of medicinal plants should be investigated and explored to understand their safety, properties and bio-efficacy.

Antimicrobial Secondary Metabolites

One of the special features of higher plants is their capacity to produce a large number of organic chemicals of high structural diversity referred as secondary metabolites (Naqri *et al*., 1991). These phytochemicals are synthesized by the plants during physiological process known to inhibit microbial growth (Chopra *et al*., 1992; Bruneton, 1995) and are the source of many potent and powerful drugs (Srivastava *et al*., 1996). They are used in traditional system of medicine, modern medicines, nutraceuticals, food supplements, folk medicines, pharmaceutical and chemical entities for synthetic drugs (Hammer *et al*., 1999). Nowadays, much attention has been paid to the biologically active compounds from plant species used in herbal medicines (Essawi and Srour, 2000). These metabolites are present in different parts of the plants such as root, stem, leaves, bark, flower and seeds (Ezeifeka *et al*., 2004). The bioactive constituents of plants are alkaloids, flavonoids, glycosides, tannins, phenols, steroids, saponins, resins, fatty acids, gums, anthraquinones and triterpenoids conferring antimicrobial activity (Edeoga *et al*., 2005; Santhi *et al*., 2006; Arokiyaraj *et al*., 2009; Shymala and Vasantha 2010; Kumar *et al*., 2010).

Van Vuuren *et al*. (2007) reported slight fluctuation in the levels of the two major constituents *viz*., 1,8-cineole and limonene from hydro distilled extracts of *Heteropyxis natalensis* collected from different regions of Johannesburg Botanical Garden. There was insignificant variation in the antimicrobial activity of seasonally collected plants. Okwu *et al*. (2007) reported quantitative phytochemical analysis of five varieties of citrus species *viz*., *C. aurantifolia*, *C. limonum*, *C. reticulata*, *Citrus sinensis*, *C. vitis* and showed the presence of alkaloids (0.22-1.60%), tannins (0.23-1.45%), saponin (0.30-0.98%), flavonoids (0.30-0.89%) and phenols (0.02-0.64%). The peels extract of *C. sinensis*, *C. reticulata* and *C. aurantifolia* showed respectively 83.55%, 68.14% and 17.10% inhibition of *Fusarium oxysporum* which causes damping-off disease in *Hibiscus esculentus.* The chemical profile showed the active constituents as geranoxycumarine, triclosan, benzetonine, limonin and nomilin in *C. vitis* and *C. sinensis*.

Aliyu *et al*. (2008) evaluated five ethno-medically important plants from northern Nigeria, such as, *Anchomanes difformis*, *Anisopus mannii*, *Pavetta crassipes*, *Stachytarpheta angustifolia* and *Vernonia blumeoides* for their phytochemical analysis. The detailed investigation revealed that *S. angustifolia* possessed higher concentrations of flavonoids (18.23%) and alkaloids (7.27%). *A. mannii* had high saponins (2.50%) and total phenols (1.25%) whereas, *A. difformis* contained least amounts of alkaloids, saponins and total phenolics. Koche *et al*. (2010) analyzed the phytochemicals of eight medicinal plants *viz*., *Cleome viscose*, *Croton tiglium*, *Galphimia glauca*, *Hyptis suaveolens*, *Malachra capitata*, *Ocimum sanctum*, *Physalis minima* and *Tephrosia*

villosa from Akola district and reported the presence of alkaloids, flavonoids, saponin, steroid, tannins, phlobatannin, cardiac glycosides and terpenoid in aqueous leaf extracts.

Hussain *et al*. (2011) quantitatively estimated phytochemicals (alkaloids, flavonoids saponins and total phenols), vitamins and protein content in four medicinal plants *viz*., *Carathamus lanatus*, *Equisetum ravens*, *Fagonia critica* and *Ranunculus arvensis* from Peshawar, Pakistan and revealed variable amounts of different phytochemicals, vitamins and protein contents in the plants. Saponin and flavonoids were dominant in these plants followed by phenols and alkaloids.

Nwokocha *et al*. (2011) reported phytochemicals of root, stem, leaf and seed of four *Jatropha* species *viz*., *J. curcas*, *J. gossypifolia*, *J. multifida* and *J. padagrica* from Niger Delta. The qualitative analysis revealed the presence of alkaloids, flavonoids, saponins and phenols in all the tissues in varied concentration. The concentration of tannins in the leaves was found to be highest in *J. curcas* (7.43%) followed by *J. padagrica* (6.79%), *J. multifida* (5.16%) and *J. gossypifolia* (5.14%). However, the concentration of saponins in leaf and seed of the species were as *J. curcas* (4.89%, 2.33%), *J. gossypifolia* (4.15%, 2.37%), *J. multifida* (3.15%, 2.44%) and *J. padagrica* (3.15%, 2.44%). The saponin concentration in the leaf and seed of *J. multifida* and *J. padagrica* was recorded to be same suggesting close affinity. The tannins were most abundant in plant parts followed by saponins, alkaloids, flavonoids and phenols. The results revealed the relatedness of these species. However, variations observed in their concentrations confer individuality of the species.

Kumar and Bhardwaj (2012) reported presence of flavonoids, tannins, phenols, saponins, phytosterols and carbohydrates in methanol extract of *Tribulus terrestris* collected from six different localities in north India. The quantitative determination revealed highest percentage of saponins with variations in the content in different regions. Prohp and Onoagbe (2012) analyzed the phytochemical properties of *Triplochiton scleroxylon* stem bark aqueous and ethanol extracts and revealed the presence of saponins, steroids, tannins, flavonoids, carbohydrate, and phlobatannins. The quantitative data revealed the highest yield of tannins (12.67%). Saponin (2.23%), flavonoid (0.69%) and phenols (0.06%) were next in order. Interestingly they did not record presence of alkaloids in the plant.

Gupta *et al*. (2013) reported the qualitative and quantitative phytochemical analysis of four plants belong to different families *viz*., *Acacia catechu*, *A. concina*, *Emblica officinalis* and *Hibiscus rosa sinensis*. The qualitative analysis revealed that alkaloids, flavonoids, saponins, tannins and terpenoids were present in all the plants. Phlobatannins was only present in *Acacia catechu*. However, the quantitative analysis of phytochemicals showed that all the four plants contains higher amount of alkaloids followed by tannins,

flavonoids, saponins and phenols. Sathya *et al*. (2013) reported presence of alkaloids, flavonoids, phenols, saponins and sterols in butanol, chloroform and water extracts of *Bauhinia tomentosa* flower with high flavonoid content (15.80%) exhibiting antibacterial activity against *Enterobacter aerogenes* and *Salmonella typhi.* Saxena *et al.* (2014) reported presence of alkaloids, flavonoids, steroids, terpenoids, phenols, saponins, tannins and cardiac glycosides in the root of *Uraria picta*, a Dashmul species.

Dutta (2015) studied six species of genus *Curcuma viz*., *C. amada, C. angustifolia*, *C. caesia, C. leucorrhiza, C. longa* and *C. zedoaria* for the presence of secondary metabolites. The qualitative phytochemical screening of ethanol extracts of each species detected the presence of flavonoids, phenols, tannins, alkaloids, terpenoids and saponins. The quantitative estimation of curcumin, an bioactive compound, contents varied within species of the same genus and was found to be highest in case of *C. longa* followed by *C. zedoaria, C. angustifolia*, *C. leucorrhiza, C. amada* and *C. caesia*.

Antimicrobial Activity of Medicinal Plants

The first plant compound possessing antimicrobial activity was reported in 1930s (Rall and Scleifer, 1991). The screening as tool in discovering new biologically active molecules has been most productive in search of novel antimicrobials (Kroschwitz and Howe-Grant, 1992; Tomoko *et al*., 2002). Many reports are available on the antiviral, antibacterial, antifungal, antihelmintic, antimolluscal and anti-inflammatory properties of medicinal plants (Samy and Ignacimuthu, 2000; Palombo and Semple, 2001; Kumaraswamy *et al*., 2002; Stepanovic *et al*., 2003; Bylka *et al*., 2004; Behera and Mishra, 2005; Govindarajan *et al*., 2006). Several researchers have documented the therapeutic efficacy of medicinal plants as antimicrobials in different parts of the world (Reddy *et al*., 2001; Erdogrul, 2002; Sharma and Kumar, 2009; Thenmozhi *et al*., 2013).

Rabe and Staden (1997) screened the antimicrobial activity of the twenty one traditionally used South African medicinal plants against Gram-positive bacteria. Twelve plants were effective against *B. subtilis*. The methanol extract of *Warburgia salutaris* was found to be bioactive against *E. coli* while none of the extracts was effective against *K. pneumoniae.* The highest antimicrobial activity was recorded in case of methanol extracts of *Artemisia afra*, *Bidens pilosa, Psidium guajava* and *Warburgia salutaris.* Ahmad and Beg (2001) tested alcoholic extracts of 45 traditionally used Indian medicinal plants against multi-drug resistant bacteria and *C. albicans* of clinical origin. Forty plants extract documented varied levels of antibacterial activity against one or more test bacteria whereas anticandidal activity was observed in twenty four plant extracts. The broad-spectrum antimicrobial activity was observed in 12 plants *viz*., *Camelia sinensis, Casuarina equistifolia*, *Emblica officinalis*, *Eucalyptus* sp., *Hemidesmus indicus*, *Holarrhena*

antidysentrica, *Lawsonia inermis*, *Punica granatum*, *Syzgium aromaticum*, *Terminalia belerica* and *T. chebula*. The TLC-bioautography revealed the presence of phenols, tannins and flavonoids as major bioactive constituents.

Rajakaruna *et al.* (2002) screened antimicrobial activity of methanol extracts of thirty-two plants collected from serpentine soils in Sri Lanka against three Gram-positive and two Gram-negative bacteria, a non-acid fast bacterium and *C. albicans*. Twenty nine species belonging to 12 family exhibited antimicrobial properties at lease against one organism. Locality variations in the antimicrobial activity were observed with few plant species suggesting climatic and ecological influence on the phyto-constituents produced by the plants. Janovska *et al.* (2003) analyzed antimicrobial activity of crude ethanol extracts of ten medicinal plants used in traditional Chinese medicine against *B. cereus, E. coli, S. aureus, P. aeruginosa* and *C. albicans*. The results revealed that five plants showed antimicrobial activity against one or more species of the test microorganisms.

Onyeagba *et al*. (2004) reported *in-vitro* antimicrobial activity of aqueous and ethanol extracts of *Allium sativum* L., *Zingiber officinale* Roscoe. and *Citrus aurantifolia* L. juice against *Bacillus* sp., *E. coli*, *Salmonella* sp. and *S. aureus*. The aqueous and ethanol extracts of *Allium sativum* L. and *Zingiber officinale* Roscoe. showed no activity against test organisms. However, the maximum zone of inhibition (19 mm) was recorded with a combination of extracts on *S. aureus* whereas, *Salmonella* sp. were found to be resistant to all the extracts except lime.

Aqueous and solvent extracts of the leaf of nine medicinal plants *viz*., *Dictyota* sp., *Colocasia esculenta*, *Gracilaria corticata*, *Hibiscus rosasinensis*, *Mirabilis jalapa*, *Nyctanthes arbortristis*, *Pulicaria wightiana*, *Rheo discolor* and *Sapindus emarginatus* were screened against six bacterial strains such as *B. subtilis*, *K. pneumoniae*, *Micrococcus flavus*, *Proteus morganii*, *Pseudomonas* sp. and *S. epidermidis*. Methanol extract showed more activity than aqueous extract. The results revealed that extract of *S. emarginatus* showed strong activity against the tested bacterial strains. However, *K. pneumoniae* and *Pseudomonas* sp. were the most resistant bacterial strains (Nair *et al*., 2005). *Mangifera indica* and *Psidium guajava* are generally used for herbal preparations in the treatment of toothache, dysentery, gastrointestinal disorders, diarrhea, sore throats and sore gums in Nigeria. Fifteen bacterial isolates comprising of Gram-positive and Gram-negative against the extract of *M. indica* and *P. guajava* exhibited antimicrobial activity at the concentration of 20 mg/ml (Akinpelu and Onakoya, 2006).

Abdolkarim *et al*. (2007) suggested that garlic and onion possess antibacterial activity. The antibacterial activity of aqueous extracts of six native *Allium* species was examined against six bacterial isolates comprising of both Gram-positive and Gram-negative. The maximum zone of inhibition

was exhibited by the extract of *A. atroviolaceum*. The bulb extracts of garlic exhibited stronger antibacterial activity and the flower extract of onion were more effective against *B. cereus* and *B. subtilis* while *K. pneamoniae* was resistant to both the extracts.

Doughari *et al*. (2007) screened antimicrobial activity of the aqueous and organic solvent extracts of root of *Carica papaya* L. against pathogenic bacteria. The results revealed that organic solvents were more effective with the methanol extracts showing the highest activity whereas, the aqueous extracts did not show any significant activity against the tested bacteria. Hot extraction gave better results as compared to cold extraction. The extracts showed broad spectrum antimicrobial potentiality with highest activity against *Salmonella typhi*. Increase in temperature enhanced the activity of the extracts, while alkaline pH decreased the activity. The MIC and MBC of the extracts ranged between 50-200 mg/ml. The phytochemical analysis revealed the presence of alkaloids, saponins, phenols, tannins and glycosides as the major bioactive compounds in the extracts conferring antimicrobial activity.

Vaghasiya and Chanda (2007) screened the antimicrobial activity of acetone and methanol extracts of fourteen medicinal plants from Gujarat region against five Gram-positive bacteria, *viz*., *B. cereus*, *B. subtilis*, *S. aureus*, *S. epidermidis*, *Micrococcus flavus* and seven Gram-negative bacteria, *viz*., *Citrobacter freundii*, *E. coli*, *K. pneumoniae*, *P. aeruginosa*, *Proteus mirabilis*, *P. vulgaris*, *Salmonella typhimurium* as well as three fungi *viz*., *C. albicans*, *C. tropicalis* and *Cryptococcus luteolus*. The percentage yield and antimicrobial activity was more in case of methanol than acetone extracts. The most susceptible bacterium was *K. pneumoniae* and the most resistant were *E. coli*, *P. aeruginosa*, *P. vulgaris* and *S. typhimurium*. The phytochemical analysis revealed the presence of tannins, steroids, cardiac glycosides and saponins. Among the different plants, *Aristolochia indica* (Family: Aristolochiaceae) showed the best antimicrobial activity.

Khan *et al* (2007) assessed the antibacterial, antifungal and cytotoxic ability of tuber of *Amorphophallus campanulatus* from Bangaldesh. The ethanol extract exhibited higher antibacterial activity as compared from antifungal activity. Four Gram-positive (*B. subtilis, B. megaterium, S. aureus, Streptococcus haemolyticus*) and six Gram-negative (*E. coli, P. aeruginosa, Salmonella typhi*, *Shigella dysenteriae, S. flexneri* and *S. sonnei*) bacteria were significantly inhibited by the extract. The MIC value ranged between 16-128 µg/ml against all the bacteria.

El-Mahmood and Doughari (2008) analyzed antimicrobial activity and phytochemicals in root and leaf of *Cassia alata* and revealed the presence of bioactive compounds conferring antimicrobial activity to them. The effects of water, methanol and chloroform extracts on pathogenic bacteria *viz*., *E.*

coli, Proteus mirabilis, *P. aeruginosa*, *S. aureus* and *Streptococcus pyogenes* and showed that the plant parts can be used to treat infections caused by these bacteria. The result revealed that *P. mirabilis*, *S. aureus* and *S. pyogenes* were more susceptible to these extracts than *E. coli* and *P. aeruginosa*.

Mahesh and Satish (2008) assessed the antimicrobial activity of methanol extracts of leaf of *Acacia nilotica, Sida cordifolia, Tinospora cordifolia, Withania somnifera* and *Ziziphus mauritiana* against *B. subtilis, E. coli*, *P. fluorescens, S. aureus* and *Aspergillus flavus*, *A. malvacearum, Dreschlera turcica* and *Fusarium verticillioides*. The results revealed that methanol leaf extract of *A. nilotica* and *S. cordifolia* showed maximum antibacterial activity against *B. subtilis* whereas, *Z. mauritiana* leaf extract showed significant activity against *A. malvacearum*. The root and leaf extracts of *S. cordifolia* showed better activity against all the bacteria tested. Bark and leaf extracts of *A. nilotica* showed antifungal activity against *A. flavus*. *Z. mauritiana* and *T. cordifolia* also recorded significant antifungal activity against *D. turcica*. However, the methanol extract of *S. cordifolia* exhibited antifungal activity against *F. verticillioides*.

Alam *et al*. (2009) evaluated the methanol, ethanol, ethyl acetate and chloroform leaf and stem extracts of two medicinal plants namely, *Achyranthes aspera* and *Cassia alata* for their antibacterial activities against *B. subtilis*, *E. coli*, *S. aureus*, *S. typhi* and *V. cholerae*. The organic solvent extracts of leaf and stem of *A. aspera* exhibited no significant antibacterial activity whereas, the methanol extracts of both leaf and stem of *C. alata* showed antibacterial activity, against *B. subtilis* & *S. typhi* and the corresponding MIC values of the leaf extracts were 1.25 and 1.5 mg/ml respectively. The ethanol extracts of stem and leaf were found equally effective to *S. aureus* (1.25 mg/ml). Ashafa and Afolayan (2009) assessed the antimicrobial efficacy of the root extracts of *Chrysocoma ciliata* L. against 10 bacteria and 4 fungi. The methanol and acetone root extracts exhibited broad-spectrum inhibition against Gram-positive and Gram-negative bacteria at MIC of < 1.0 mg/ml. The acetone, methanol and aqueous extracts exhibited complete growth inhibition of *Aspergillus flavus* and *A. niger* and at minimum inhibitory concentration of 0.5 mg/ml. All the extracts inhibited the growth of *C. albicans* at MIC of 5.0-10 mg/ml. The results revealed that root extracts from *C. ciliate* possess strong antimicrobial activity.

Jeyachandran *et al*. (2009) assessed the antibacterial activity of plumbagin (2-methyl-5-hydoxyl-1, 4-naphthoquinone) and methanol, chloroform and aqueous root extracts of *Plumbago zeylanica* L. against several pathogenic bacteria and their minimum inhibitory concentration was determined. The highest antibacterial activity was recorded for Plumbagin and chloroform root extract of *P. zeylanica* L. against *E. coli*, *S. aureus* and *S. typhi*. However, the inhibition was moderate against *B. subtilis*, *K.*

pneumoniae and *S. marcescens* and lowest against *P. aeruginosa* and *P. vulgaris*. The methanol extract showed moderate and the aqueous extract weak antibacterial activity. The activity was more with plumbagin as compared from the crude extract. The bioactive compound plumbagin and root extract of *P. zeylanica* exhibited broad-spectrum antibacterial activity.

Kumar *et al.* (2009) assessed the antimicrobial activity of the fruit extract of *Terminalia chebula* against *B. subtils*, *E. coli*, *P. aeruginosa*, *S. aureus*, *S. epidermidis* and *S. flexineria*. The results revealed that the fruit extract exhibited antimicrobial activity against Gram positive, *B. subtils*, *S. aureus* and *S. epidermidis* and Gram negative, *E. coli, P. auriginosa* and *S. flexineria*. Okigbo *et al*. (2009) screened African tuber *Curcuma longa*, *Dioscorea bulbifera* and *Zingiber officinale* ethanol and cold water extracts against three human pathogenic microorganisms' *viz*., *E. coli*, *S. aureus* and *C. albicans*. The ethanol extracts exhibited more inhibitory activity than aqueous extract. The minimum inhibitory concentration for ethanol ranged from 0.5-1.0 mg/ml on *E. coli*, *S. aureus* and *C. albicans*. However, the MIC of aqueous extract was 1.0 mg/ml on *E. coli* and ranged between 0.5-1.0 mg/ml on *S. aureus* and *C. albicans*. The result revealed that *S. aureus* was more susceptible to the extract while *C. albicans* was least inhibited. The phytochemical analysis revealed the presence of alkaloids, flavonoids, saponins, steroids, tannins, phenols and triterpenoids. The quantitative estimation revealed significant variations in the levels of phytochemicals in different plants under investigation.

Swarnkar and Katewa (2009) studied thirteen plants *viz*., *Ampellocissus latifolia*, *Asparagus racemosus, Costus speciosus*, *Crinum asiaticum, Curculigo orchiodies, Curcuma amada*, *Dioscorea bulbifera, Dioscorea pentaphylla, Gloriosa superba, Puearria tuberose, Sauromaticum venosum, Urgenia indica,* and *Withania somnifera* belonging to nine families collected from different localities from tribal area of Rajasthan for their antimicrobial activity against *E. coli*, *K. pnuemoniae*, *P. aeruginosa*, *S. aureus* and *C. albicans*. The methanol and aqueous extract of *A. racemosus* exhibited antimicrobial activity against all the microorganisms tested whereas, *A. latifolia* extracts showed no significant activity.

Kaladhar *et al*. (2010) made a comparative assessment of antimicrobial activity of tuber extract of *Dioscorea hamiltonii* and stem extract of *Azadirachta indica* against *B. subtilis*, *Enterococcus faecalis*, *E. coli*, *Lactobacillus delbrueckii*, *P. aeruginosa, P. vulgaris, Saccharomyces cerevisiae, Streptococcus pyogenes, Streptococcus thermophilus, Vibrio parahaemolyticus*, *A. niger* and *Penicillium chrysogenum.* The results revealed that the methanol and ethyl acetate extracts from *D. hamiltonii* and *A. indica* exhibited highest antimicrobial activity. The activity was found to be higher in case of Gram-positive than Gram-negative bacteria followed by fungi. Sumathi and Parvathi (2010) reported the antimicrobial activity of the extracts of *Andrographis paniculata* Nees, *Phyllanthus niruri* Linn., *Terminalia bellerica* Roxb., *Terminalia chebula*

Retz. and *Vitex negundo* Linn., against one Gram-positive and four Gram-negative bacteria. The minimum inhibitory concentration of *P. niruri* leaf extract against *Salmonella typhi* and *S. aureus* was 50 µg/ml whereas, the MIC of *T. bellerica* fruit extract against *E. coli* was 50 µg/ml and for *S. aureus* was 200 µg/ml. However, the leaf extracts of the *A. paniculata*, *T. chebula* and *V. negundo* did not exhibit any significant antimicrobial activity.

Periyasamy *et al*. (2010) assessed the antibacterial activity of five Indian medicinal plants *viz*., *Achyranthes aspera*, *Aristolochia bracteolate*, *Cassia senna*, *Rauvolfia tetraphylla* and *Wrightia tinctoria* leaf extracted in methanol, ethyl acetate, aqueous and chloroform against *B. subtilis*, *E. coli*, *K. pneumoniae*, *M. luteus*, *P. aeruginosa* and *S. aureus*. The results revealed that methanol extract showed highest antibacterial activity and moderate activity was recorded with aqueous, ethyl acetate and chloroform extracts. *A. aspera* exhibited maximum antibacterial activity as compared from other plants against all the tested bacteria. The methanol extracts were found to be more effective in inhibiting all the bacteria than other organic solvent extracts. The phytochemical screening revealed the presence of alkaloids, flavonoids, tannins, saponins, anthroquinones, glycosides and volatile oils.

Valarmathy *et al.* (2010) investigated the ethanol extracts of leaves of *Alternanthera sessilis*, *Anisochilus carnosus*, *Azardiratica indica*, *Cynodon dactylon*, *Moringa oleifera*, and *Musa paradisiacal* for their antimicrobial activity against *B. subtilis, E. coli, K. pneumoniae* and *Vibrio cholerae*. The ethanol extract of *Azardiratica indica* exhibited highest activity against *E. coli* than other extracts and penicillin.

Alagesaboopathi (2011) analyzed antimicrobial activity of the aqueous, acetone and petroleum ether extracts of root, stem and leaf of *Andrographis ovata, Aristolochia indica*, *Eclipta prostrata* and *Gloriosa superba* against four human pathogens, *viz., E. coli, K. pneumoniae, P. aeruginosa* and *P. vulgaris*. All the extracts were found to be effective against *E. coli*, *K. pneumoniae*, *P. aeruginosa* and *P. vulgaris*. The study revealed that the plant part possesses potential broad spectrum antimicrobial activity. The antimicrobial activity of acetone extracts was found to be higher than that of aqueous extracts. However, the root extract exhibited more inhibitory effect than the stem and leaf extracts. Grover *et al*. (2011) reported the antimicrobial activity of petroleum ether, methanol and aqueous leaves extracts of *Azadirachta indica* (Meliaceae), bulbs of *Allium cepa* (Liliaceae) and methanol extract of gel of *Aloe vera* (Liliaceae) against two Gram-positive bacteria *viz*., *B. subtilis* and *S. aureus* and four Gram-negative bacteria *viz*., *E. coli*, *P. aeruginosa*, *P. vulgaris*, *S. typhi* and two fungi *viz*., *A. niger* and *C. albicans*. The methanol extract of *A. indica* and *A. cepa* exhibited highest activity against *B. subtilis*.

Jayalakshmi *et al*. (2011) evaluated the antibacterial activity of some medicinal plants against human pathogenic bacteria *viz*., *B. cereus*, *B. subtilis*, *E. aerogenes*, *E. coli*, *K. pneumoniae*, *S. aureus* and *S. typhi* with respect to

streptomycin and gentamycin. The methanol extracts of *Anacardium occidentale* L., *Clerodendrum inerme* L., *Curcuma amada* Roxb., *Duranta repens* L., *Eucalyptus camaldulensis* Dehnh., *Euphorbia cotinifolia* L. and *Terminalia chebula* Retz showed maximum activity. The petroleum ether extract of *C. amada, P. betel* and *T. chebula* also showed better efficacy. The phytochemical analysis of different extracts showed the presence of flavonoids, terpinoids, tannins, steroids, alkaloids and glycosides.

Rahman *et al*. (2011) documented the *in-vitro* antimicrobial activity of hexane and methanol extracts of fresh aerial parts of ten wild medicinal plants collected from El-Hammam, Burg El Arab and Bahig regions located along the Western Mediterranean coast of Egypt *viz*., *Alhagi maurorum*, *Arthrocnemon glaucum*, *Atractylis carduus*, *Atriplex halimus*, *Blackiella aellen*, *Carduus getulus*, *Echinops spinosissimus*, *Mesembryanthemum crystallinum*, *Nicotiana glauca* and *Thymelaea hirsute* against fifteen Gram-positive and Gram-negative pathogenic bacteria. The results revealed that both methanol and hexane extracts showed strong antibacterial activity against at least two pathogenic microorganisms tested. However, hexane extracts showed lower activity against microorganisms as compared from methanol extracts under investigation.

Khan (2012) investigated the antibacterial efficacy of chloroform, ethanol and aqueous extracts of *Allium cepa*, *Allium sativum* and *Zingiber officinale* against *Enterococcus faecalis*, *E. coli*, *K. pneumoniae*, *Proteus mirabilis*, *P. aeruginosa*, *Salmonella* sp. and *S. aureus* and observed maximum antimicrobial activity in chloroform extract of *A. sativum* against *E. coli* and minimum antimicrobial activity in aqueous extract of *A. cepa* against *E. faecalis*. Priyavardhini *et al*. (2012) evaluated antibacterial activity, qualitative and quantitative phytochemical analysis of hexane, petroleum ether, chloroform, acetone and methanol extracts of *Corallocarpus epigaeus* tuber, stem and leaf against *E. coli*, *K. pneumoniae, P. aeruginosa*, *S. aureus* and *S. marcescens.* The tuber methanol extracts of *C. epigaeus* exhibited higher efficacy against all the tested pathogens. The phytochemical analysis revealed the presence of alkaloids, flavonoids, phenols, tannins, steroids, saponins, glycosides and terpenoids. Selvamohan *et al*. (2012) evaluated the *in-vitro* antimicrobial activity of methanol, ethanol and aqueous extracts of seven medicinal plants against *E. coli*, *Klebsiella* sp., *Pseudomonas* sp. and *Staphylococcus* sp. The methanol extract of *Phyllanthus niruri* showed the maximum activity against *Staphylococcus* sp. The ethanol and aqueous extracts showed minimum antimicrobial activity when compared to methanol extracts.

Singh and Jain (2012) extracted curcuminoids (curcumin, bisdemethoxycurcumin and demethoxycurcumin) from *Curcuma longa* for antimicrobial efficacy evaluation against *B. subtilis, Enterobacter aerogenes, E. coli*, *K. pneumoniae, P. aeruginosa, Proteus mirabilis, S. auresus*, *A. niger* and *C. albicans* with kanamycin and fluconazole as standard antibacterial and

antifungal agents respectively. The results revealed that out of three curcuminoids, curcumin showed highest antibacterial as well as antifungal potentiality. Yadav and Khan (2012) assessed the antimicrobial activity of eleven ethnomedicinal plant extracts against *B. subtilis, Enterococcus facalis, Ervinia* sp., *E. coli, K. pneumoniae, P. vulgaris*, *P. aeruginosa*, *S. aureus, S. epidermidis,* and *C. albicans*. The evaluated plants were used in folk medicine in the treatment of skin diseases, venereal diseases, respiratory and nervous disorders. The results revealed that ten plants exhibited antimicrobial activity against one or more of the tested microorganisms at three different concentrations of 1.25, 2.5 and 5 mg/disc. The medicinal plants *viz*., *Acalypha fruticosa, Cassia auriculata, Peltophorum pterocarpum, Punica granatum Syzygium lineare* and *Toddalia asiatica* were found to be most active. However, the maximum antifungal activity against *C. albicans* was exhibited by methanol extract of *P. pterocarpum* and *P. granatum*.

Chandra (2013) reported the antimicrobial activity of two medicinal plants *viz*., *Annona reticulata* and *Lagerstroemia indica* methanol and aqueous leaf extracts against human pathogens *viz., K. pneumoniae, S. auerus, S. typhi*, *P. aeruginosa* and *P. vulgaris.* The results revealed the presence of broad spectrum antibacterial activities. The maximum zone of inhibition was recorded in methanol extract as compared to aqueous extract for *S. typhi* (12 mm), *K. pneumoniae* (13 mm), *P. vulgaris* (20 mm), *P. aeruginosa* (12 mm) and *S. aureus* (12mm). The phytochemical screening showed the presence of varied phytochemicals such as flavonoids, saponins, tannins, terpenoids, deoxy sugars and phenolic compounds which may contribute for the antimicrobial activity of these medicinal plants. Jha *et al*. (2013) assessed the antimicrobial activity of ethanol and aqueous rhizome extracts of four *Curcuma* variety, *i.e. Curcuma longa, C. caesia*, *C. amada* and *C. aromatica* against two Gram-positive, *S. aureus* and *B. subtilis*, one Gram-negative, *P. aeruginosa* and two fungal species *C. albicans* and *A. flavus vis-a-vis* tetracycline and fluconazole. The ethanolic extract of *C. longa* and *C. aromatica* were found to exhibit both antibacterial and antifungal efficacy. The aqueous extract of all the plants showed no significant antimicrobial activity.

Kumar *et al*. (2013) reported twelve species of *Dioscorea* as the leading medicinal food sources among rural and tribal population of Odisha. Except *Dioscorea alata* all are wild types. *D. alata* is the cultivated species known for its food, medicinal and economic values. It has therapeutic values, antimicrobial properties, diversity and food potentiality for sustainable use by the tribal communities in amelioration of several infectious diseases. Malini *et al*. (2013) screened antibacterial activity in aqueous and ethanol extracts of *Aloe vera* and *Coleus aromaticus* against waste water borne pathogens *viz*., *Bacillus* sp., *E. coli, Klebsiella* sp., *Pseudomonas* sp., and *Staphylococcus* sp. The ethanol extract of *A. vera* exhibited better antimicrobial efficacy as compared to other plants and aqueous extracts.

Senthilkumar (2013) assessed *in-vitro* antibacterial activity of *Gloriosa superba* seeds and tubers extracted through various solvents against five Gram-positive bacteria *viz*., *B. cereus, B. subtilis*, *S. aureus*, *Streptococcus cremoris*, *Streptococcus fecalis* and five Gram-negative bacteria *viz*., *E. coli, K. pneumoniae*, *P. aeruginosa, P. vulgaris* and *S. typhi*. The methanol extracts exhibited higher antibacterial activity followed by chloroform extract. The methanol extract exhibited maximum antimicrobial activity against Gram-positive than Gram-negative organisms. The methanol extract showed maximum zone of inhibition in *B. cereus* followed by *E. coli*, *Streptococcus fecalis*, *K. pneumoniae*, *S. aureus*, *P. aeruginosa*, *S. cremoris, P. vulgaris, B. subtilis* and *S. typhi*. The preliminary phytochemical screening revealed the presence of alkaloids, glycosides, steriods, terpenoids and tannins.

Thenmozhi *et al*. (2013) reviewed antimicrobial efficacy of the methanol root extracts of *Emilia sonchifolia* (family: Asteraceae) against *B. cereus*, *B. subtilis*, *K. pneumoniae*, *P. aeureginosa*, *Salmonella typhi, Shigella dysenteriae*, *S. aureus* and *Streptococcus faecalis* and fungi such as *A. niger, Azospirillum lipoferum*, *C. albicans, Mucor racemosus* and *Tricoderma viride*. The methanol root extracts was reported to have significant antimicrobial activity. The minimum inhibitory concentration of the extracts ranged from 400-1000 µg/ml. Sahu *et al*. (2014) investigated the ethno medicinal plants in healthcare systems based on interviews from the tribal community belonging to Bhatra, Madiya, Muriya and Gond tribes in Geedam block of Dantewada. The tribals of this region mainly depend on forests for their livelihood and traditional medicine as a primary healthcare source. The study documents some new and less explored ethno medicinal uses of 104 plants used by tribes of this region in curing several dreadful diseases since long.

Islam *et al*. (2014) investigated antimicrobial activity of *Zingiber officinale* extracted in Soybean oil against 24 isolates of food borne pathogenic bacteria *viz*., *E. coli*, *Klebsiella* sp., *P. aeruginosa*, *Salmonella* sp., *S. aureus* and *V. cholerae*. The study revealed that ginger extract showed highest activity against *Salmonella* sp. and lowest activity against *E. coli* and *S. aureus*. Mehta *et al*. (2014) assessed the methanol root extract of *Phyllanthus fraternus* against eleven bacterial and three fungal strains. The result exhibited maximum antibacterial efficacy against *P. aeruginosa* followed by *S. typhi* B and minimum against *S. typhi* A. However, the maximum antifungal activity was recorded against *A. niger*. They attributed the antimicrobial activity to the presence of secondary metabolites.

Prakash *et al*. (2014) assessed the phytochemical analysis and antibacterial activity of petroleum ether, chloroform, ethyl acetate and methanol root extracts of *Decalepis hamiltonii* against Gram-positive pathogen *viz*., *B. subtilis, B. cereus, S. aureus* and Gram-negative bacteria, as *E. coli, K. pneumoniae, P. aeruginosa*, *S. typhi* using different concentrations of extracts. Among different solvent extracts, methanol extract was found to be more

active against most of the tested pathogenic bacteria as they showed the presence of higher phytochemical constituents such as, glycosides, steroids, flavonoids, phenols, terpenoids, saponins and tannins. Among all the organisms tested *K. pneumoniae* was found to be more resistant towards all the extracts. However, *E. coli, P. aeruginosa* and *S. typhi* showed moderate resistant and *S. aureus, B. cereus* and *B. subtilis* showed least resistant against all the extracts under investigation.

Gupta *et al*. (2015) evaluated antimicrobial potentiality of rhizome extract of *Curcuma longa* against clinical and standard strain of *S. aureus*. The clinical isolates were more sensitive than standard strains towards extracts showing its broad spectrum efficacy. The results were also confirmed by scanning electron microscopic observations which revealed that test pathogen treated with *C. longa* extract showed morphological deformity, with partial lack of the cytoplasmic membrane leading to cell disruption of the pathogens.

Sharma *et al*. (2015) analyzed antimicrobial activity of *Cassia alata* against eight MTCC and seven clinical isolates *viz*., *B. cereus, B. subtilis, E. coli, K. pneumoniae, P. aeruginosa*, *P. vulgaris*, *S. aureus* and *S. epidermidis*. Acetone extract of root showed highest antibacterial activity against *B. subtilis* (MTCC 441) and clinically isolated *P. vulgaris* while least activity was observed in case of acetone extracts of stem and leaf against *K. pneumoniae* (MTCC 3384) and clinically isolated *S. aureus*. The activity index was higher in Gram-positive bacteria in acetone root extracts for *B. subtilis* (MTCC 441) and clinically isolated *B. subtilis* with reference to streptomycin whereas, the activity index for chloroform extract of root with reference to tetracycline was found to be high in *B. subtilis* (MTCC 441) and clinically isolated *S. aureus*. The phytochemical profile of different parts of *C. alata* showed presence of alkaloid, flavonoid, phytosterol, tannin, saponin, glycoside, terpanoid, cardio glycoside, oils, gum and mucilage, quinine and resin.

Kowero *et al*. (2016) evaluated the antibacterial activity of five selected medicinal plants based on its traditional usage for curing bacterial infections in Tanzania *viz*., *Conyza floribunda*, *Embelia schimperi*, *Maerua decumbens*, *Ocimum gratissimum*, and *Plectranthus barbatus*. The plant extracts showed antibacterial activity with MIC range (1.56 mg/ml to > 25 mg/ml). Out of 22 extracts under study 8 extracts demonstrated antibacterial activity with MIC (1.56 mg/ml) against *E. coli*, *K. oxytoca*, *P. aeruginosa*, *P. mirabilis* and *S. typhi*. The *C. floribunda* extracts exhibited a narrow range antibacterial activity with MIC range (1.56 to 6.25 mg/ml) compared to the rest of plant species. The antibacterial activity of the evaluated plant species was in order of *C. floribunda* followed by *P. barbatus*, *M. decumbens*, *E. schimperi* and *O. gratissimum*.

CONCLUSION

Medicinal Plants contains several secondary metabolites which are the valuable sources of new and biologically active molecules possessing antimicrobial bio-efficacy. A sense of urgency accompanies in the search for new antimicrobials as the pace of species extinction continues. Laboratories along the globe have well documented the diverse groups of secondary metabolites conferring antimicrobial activity *in-vitro.* Several of these bioactive compounds were studied to determine their activity in whole organism systems, including toxicity studies and examination of their effects on beneficial normal micro biota as well. Researchers have correlating the botanical properties of the medicinal plants with their pharmacological activity. In future multi-dimension research aimed at correlating phytochemical and botanical properties to specific pharmacological potentiality is also expected. Thus, it would be rewarding to standardize methods of extraction and *in-vitro* testing so that the search for antimicrobials could be more systematic and the interpretation of results would be facilitated. Efficient collaborations with pharmacologists and medical doctors, plant pathologists and microbiologists are crucial to see the complete development of an interesting lead bioactive compound. Therefore, there is an urgent need of in depth investigation in the arena of medicinal plants research with the pin pointed objective of exploring their bio-efficacy and subsequently the screening, extraction, characterization and mode of action of the bioactive compounds which will definitely lay the strong foundation of phytoscience and herbal therapy in near future.

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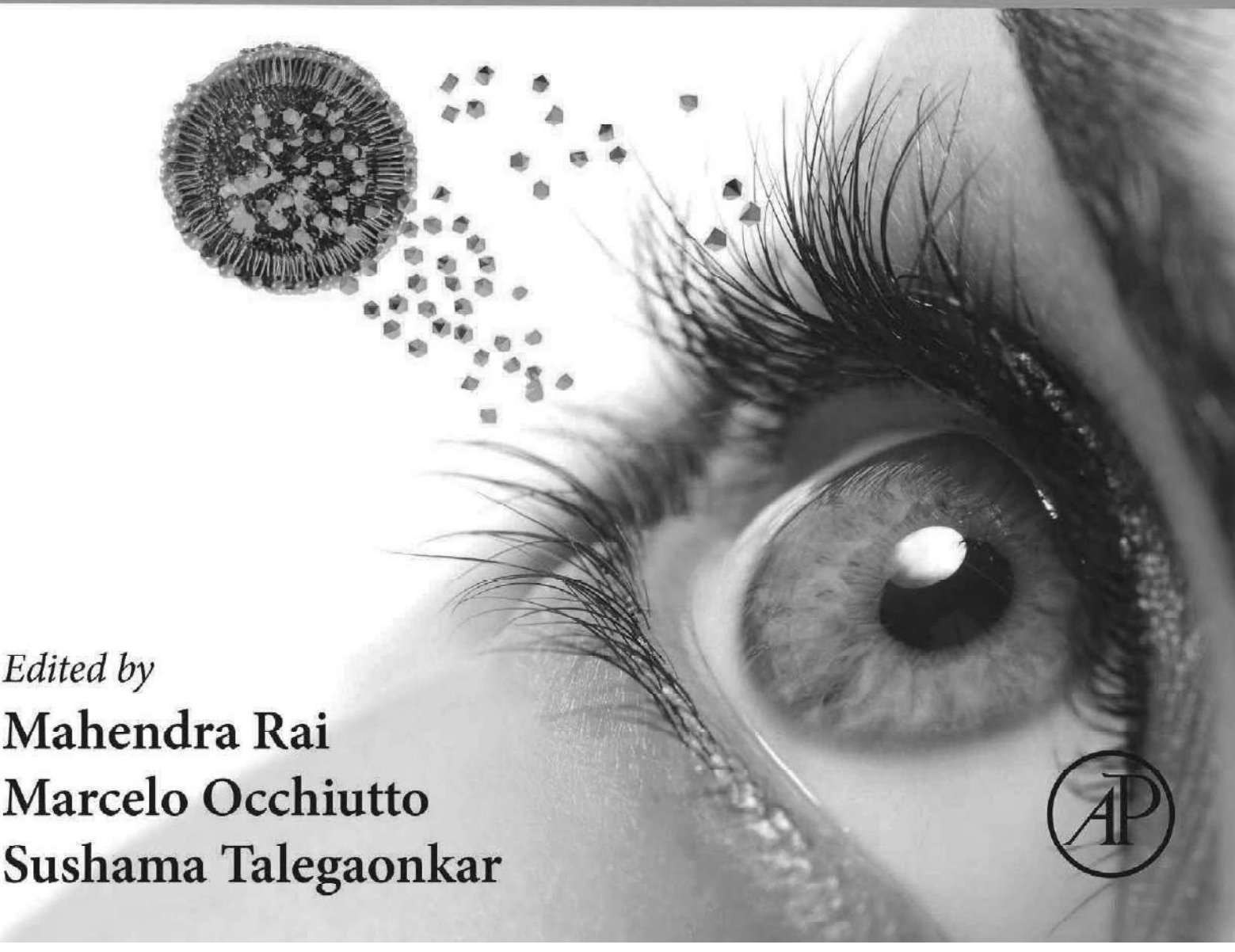

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Chapter 12

Advances in nanotherapies in the management of microbial keratitis

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1. Introduction

Corneal disorders are the third most prevalent cause of monocular blindness worldwide (Chaurasia et al., 2015), affecting underprivileged people disproportionately. Corneal opacities, which are mostly caused by infectious keratitis, are the fourth greatest cause of blindness globally and account for 10% of preventable visual impairment in the world's least developed nations. Any component of the eye may be infected by microorganisms, fungi, or parasites. The acquisition of the external ocular surface microbiome happens at birth. Some indigenous commensal bacteria in the conjunctiva and eyelids have the potential to become infections. In addition, ambient microorganisms may build a temporary microbiome on the placid ocular surface, which may become a persistent and stable consortium of live microorganisms, posing a threat to the ocular tissues. Studies on various populations describe the prevalence of bacterial, fungal, and parasitic pathogens in ulcerated corneas (Liesegang and Forster 1980; Katz et al., 1983; Upadhyay et al., 1991; Hagan et al., 1995; Gopinathan et al., 2009). Microbial keratitis is an ocular emergency that can result in vision loss with a poor prognosis for visual rehabilitation (Ung et al., 2019). Microbial keratitis is characterized by pain, blurred vision, redness, photophobia, an opacity of the cornea, and rupture or discharge in severe cases. In addition, the symptoms of several forms of microbial keratitis overlap, making it difficult to distinguish between them (Austin et al., 2017).

2. Classification of microbial keratitis

2.1 Bacterial keratitis

Bacteria are one of the easiest surviving disease-causing microorganisms and are associated with a variety of ocular diseases, including keratitis, corneal ulcer and abscess development, and conjunctival congestion, which can lead to corneal damage and blindness (Putri et al., 2015).

2.1.1 Epidemiology

The majority of the information about keratitis comes from solitary articles because it is not one of the five diseases that WHO has identified as a priority for preventing blindness. The second most frequent cause of legal blindness worldwide, after cataracts, is corneal opacifications, of which bacterial keratitis is one of the major causes. The geographic location and regional climate have an impact on the microbial keratitis pattern. There are significant differences between populations residing in developed and western countries according to the keratitis bacteriological profile (Cao et al., 2014).

2.1.2 Risk factors

Bacterial keratitis is an acute or chronic, transitory infection of the cornea with a variable predisposition for anatomical, topographical, and geographic corneal regions. It may be slowly progressing or rapidly deteriorating with suppuration affecting the corneal region. Multiple pathogens, including bacteria, are capable of infecting the cornea and cause keratitis that threatens vision. As the global number of contact lens wearers are on the rise, the incidence of corneal infection has

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Abstract

The field of nanotechnology has brought in a giant revolution and nanomedicine has emerged as a key player in offering cross-sectoral and cross-technological solutions for various treatment modalities. The domain of nanomedicine includes the nanocarriers and the nanomaterials themselves. The new generation of nanomaterials with their unique properties (acoustic, electrical, mechanical, optical) has unique interactions in the biological milieu. This has undoubtedly opened up new clinical perspectives for better management of various diseases and disorders. Over 50 formulations based on nanotechnology have reached the market and are approved as anesthetics, anti-cancer therapies, anti-fungal, and iron-replacement therapies among others. But, the development of nanomedicine that has the desired and reproducible functionalities, and can successfully transit from bench to bedside is a tedious, rigorous, and arduous pursuit. The Fourth Paradigm of scientific research including rational design, high throughput experimental techniques, process automatization, artificial intelligence technology, and machine learning has immense potential to be integrated with nanomedicine/nanomaterial research to achieve smart products having the desirable features. The chapter would cover the concepts, historical evolution, and application of these smart nanomaterials, implementation of AI in healthcare, biosensors/smart sensors in neurodegenerative diseases, telemedicine, and its fine-tuning to generate nano pharmaceuticals with requisite profiles to enable their successful clinical translation.

Keywords

Nanotechnology
Smart nanomaterials
Nanorobot
Artificial intelligence
Telemonitoring
Cloud computing
e-health

Chapter 4: Ocular nanomedicine: Fundamentals and recent advances

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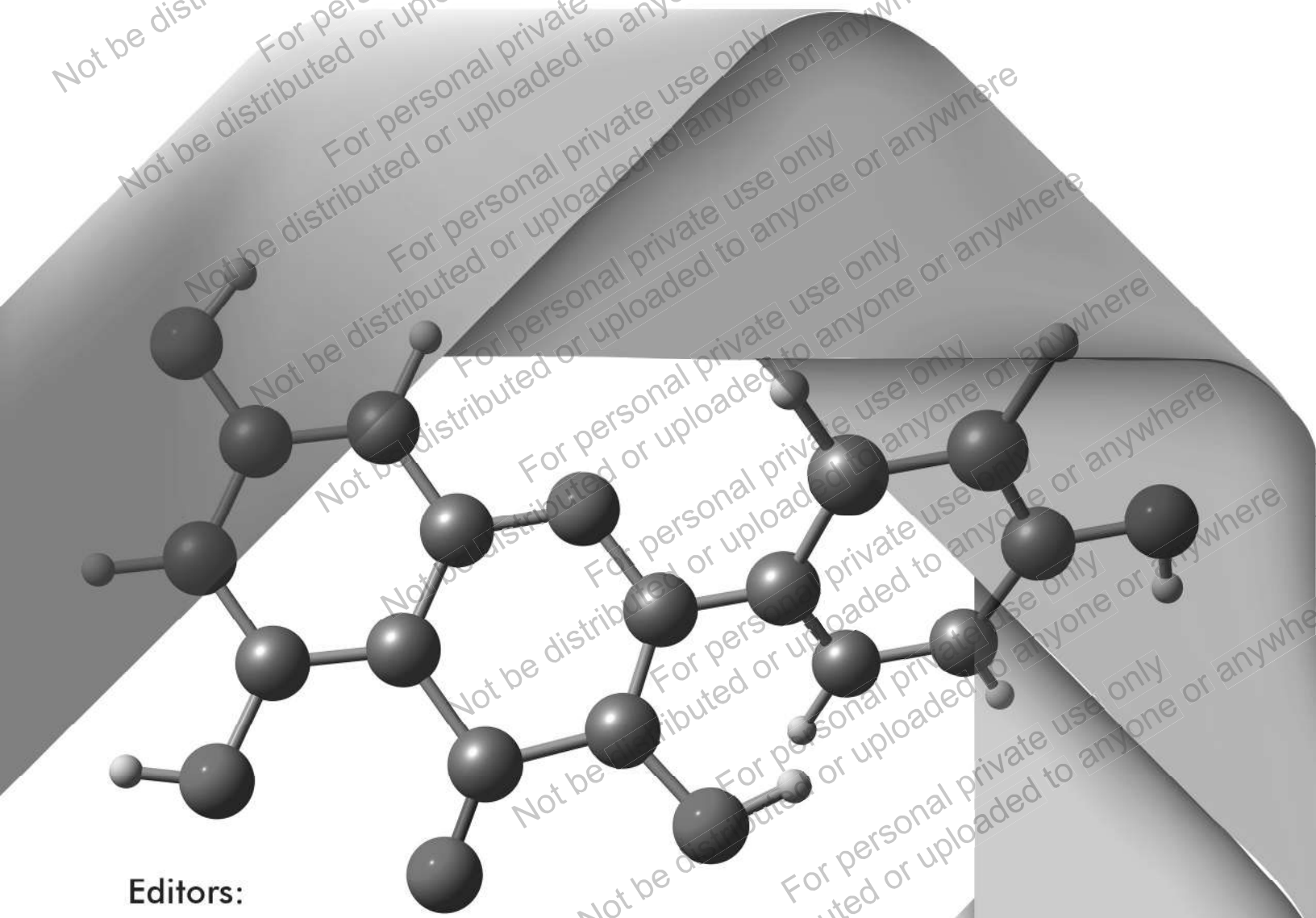
THE ROLE OF CHROMENES IN DRUG DISCOVERY AND DEVELOPMENT



Editors:
Ashutosh Kumar Dash
Deepak Kumar

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CHAPTER 5

Naturally Occurring Chromene Containing Molecules and their Isolation Protocols

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Abstract: Natural products have been used as major sources of therapeutic agents in drug discovery since the ancient eras. Natural products have been widely studied in the physical and biological sciences, including nutrition, health, bio-medical, and other interrelated sciences. Because of their unique chemical diversity and bioactivity, they have continued to offer templates for the development of novel forms of drugs. In the field of traditional medicine, natural products have been used for a very long time in the form of decoctions, medicinal extracts, infusions, or other therapeutic preparations. Chromene is one of the essential chemical constituents, derived from the conversion of multiple biosynthetic pathways present in the plant as well as animal kingdoms, which represents a remarkable group of structurally varied secondary metabolites. The scaffold is considered an important class of oxygenated heterocyclic compounds as two forms of 2H/4H-chromene (2H/4H-Ch) with versatile biological profiles. Chromenes are the basic backbone of various polyphenols, alkaloids, tocopherols, anthocyanins, *etc.* Crotin, Crotaramine, Dysoline, Malachromone, Oxalicumones A-C, Khellin, Baicalin, Diosmin, *etc.* are some examples of naturally isolated chromene fused compounds that are reported for the treatment of diverse health ailments. Their unique structure and varied pharmacological activities may provide new leads for the discovery of drugs with their action. In recent years, the need to develop effective and selective methods for the extraction and isolation of new natural products has been increasingly felt. This chapter presents the extraction, isolation, and characterization processes of the chromenes by the natural sources, illumination of the structures of purified chromenes, and their bioactivity.

Keywords: Chemical constituent, Chromene, Isolation, Natural product, Plant extract.

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[#] Authors contributed equally to this work.

Ashutosh Kumar Dash & Deepak Kumar (Eds.)

Chapter

Ocular Drug Delivery System: Barrier for Drug Permeation, Method to Overcome Barrier

Prakriti Diwan, Rajendra Jangde, Sulekha Khunte, Harish Bhardwaj and Preeti K. Suresh

Abstract

The physiological and anatomical barriers are major obstacles in the field of ocular drug delivery systems. The barriers involve nasolacrimal drainage, blinking, cornea, sclera, and blood-aqueous barriers whereas dynamic barriers involve conjunctival blood flow, lymphatic clearance and tear drainage. These barriers are showing natural protective functions, as well as limiting drug entry into the eye. Nanocarriers have been found to be effective at overcoming the problems and associated with conventional ophthalmic dosage forms. In this chapter emphasizes overcome to barriers and discusses advanced novel techniques used in the field of ocular drug delivery systems including nano dispersion systems, nanomicelles, lipidic nanocarriers, polymeric nanoparticles, liposomes, noisome, and dendrimer, have been investigated for improved permeation and effective targeted drug delivery to various ophthalmic site.

Keywords: ocular drug delivery, inflammation, conjunctiva, microphages, aqueous humor

1. Introduction

The eyes are one of the most important and complex sensory organs; they serve as a gateway for collecting and transmitting extraneous images to the brain as signals via the optic nerve. They maintain a relationship between the body and our surroundings through this action. Various disorders, such as inflammations or bacterial and viral infections, affect the eye's behavior. Such kind of disorders affecting the anterior eye tissues can be smoothly treated with high doses of drugs. However, diseases affecting the posterior tissue of the eye are tough to teach and treat. Age-related disorders including macular decay, glaucoma, diabetic macular edema, and proliferative vitreoretinopathies are some of familiar posterior eye diseases that can lead to vision loss if left untreated.

The complex structures of the eyes provide a high level of drug/treatment resistance. A thorough understanding of ocular anatomy, physiology, and barriers is essential for providing effective treatment for diseases affecting both anterior and

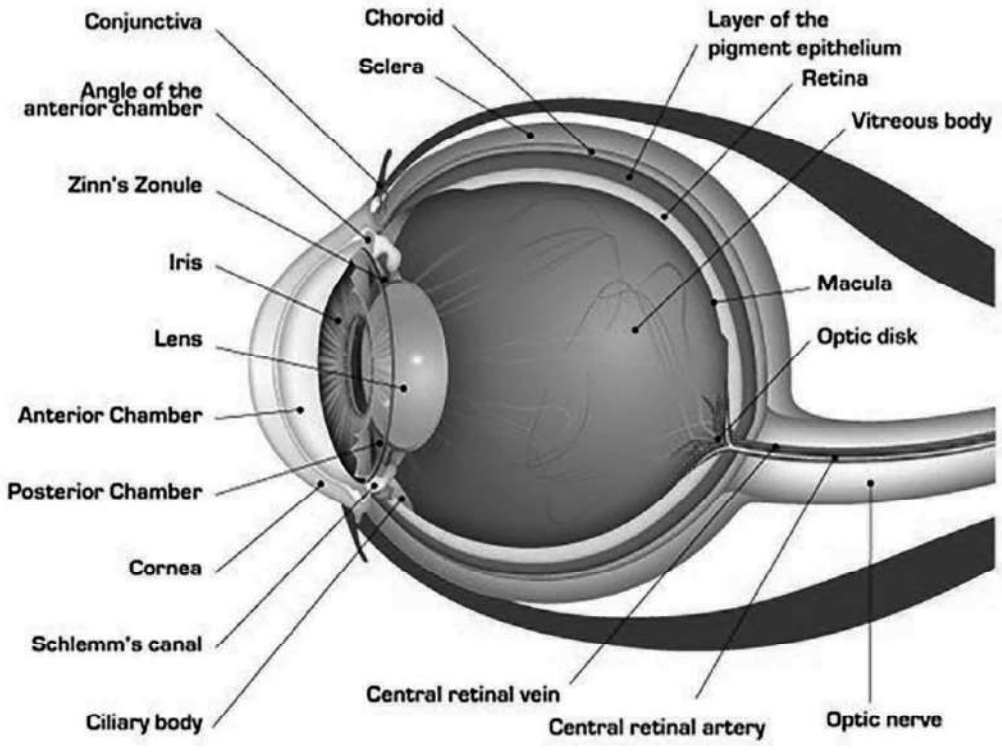
conveyance to eye. In this part, we give a point by point depiction of visual life systems and physiology as well as the blockade those stances difficulties to sedate conveyance.

2. Structure of the eye

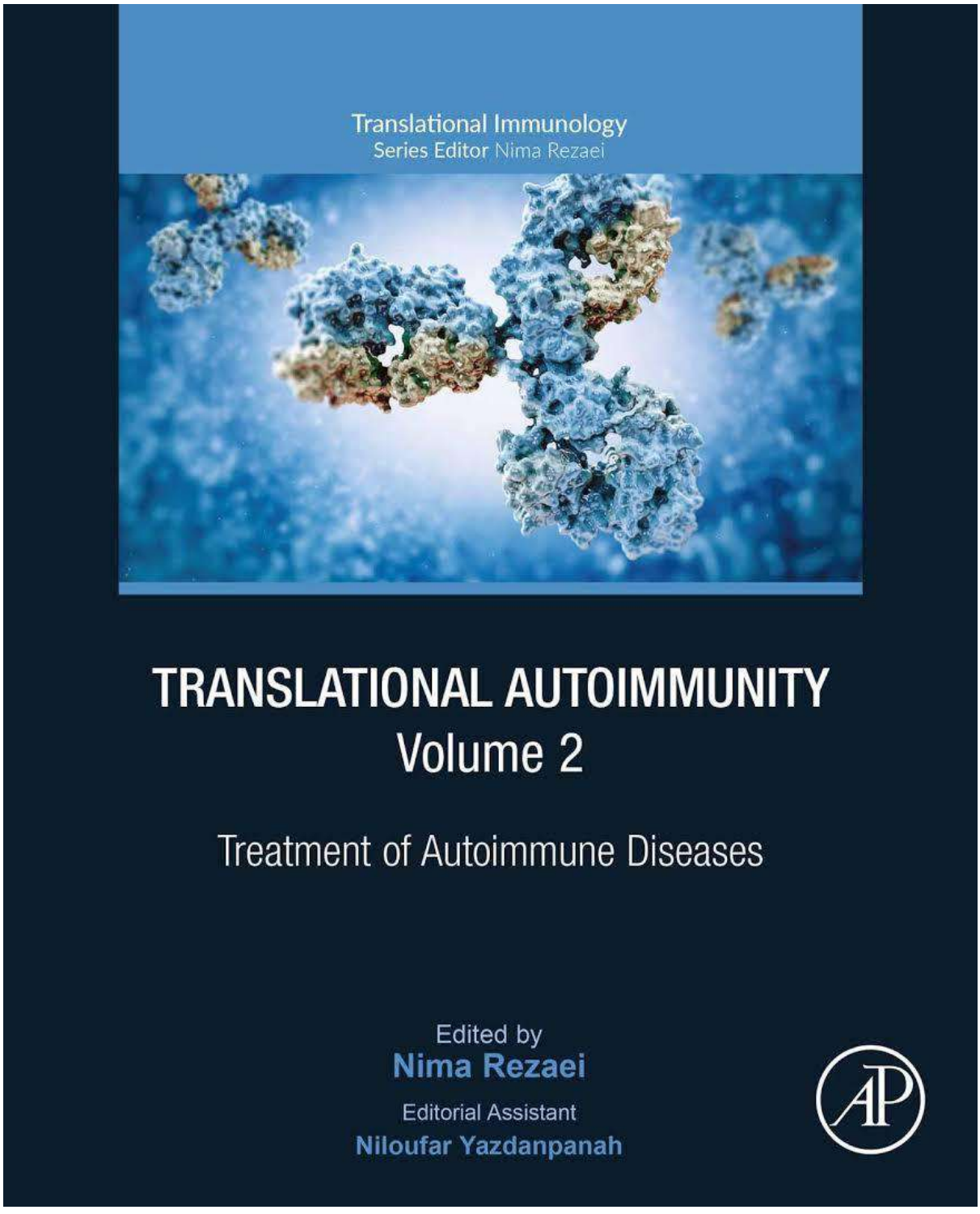
The eye can be partitioned into two divisions the front fragment and the back section in structure of eye (**Figure 1**). The front fragment stays alive of the cornea, conjunctiva, watery humor, iris, ciliary body, and translucent focal point. These elaborate roughly 33% of the front of the eye. The leftover part for example back section made out of the sclera, choroid, Bruch's layer, retinal shade epithelium (RPE), nonpartisan retina, and glassy humor. An exhaustive depiction of the life systems and physiology of the eye is introduced beneath.

2.1 Cornea

The cornea is delicate, straight, smooth, vascularized, generally deciduous, and the most meticulous tissue in the body. The curved and rounded design allows it to be inserted directly into the external environment. The cornea develops in the white part of the eye called the sclera and the translucent tissue called the conjunctiva. The limitation of the cornea from which it connects to the sclera is known as the annulus. Limbus is strangely angiogenic and is thought to be a reservoir of pluri potent juvenile microorganisms. The surface of the cornea, which is not covered by the external environment, is invaded by the tear film, and its inner surface is mainly in contact with liquid called liquid humor. The thickness of the cornea often increases from the center to the periphery. These are seen in the twist of the cornea, which is huge in the center and has the smallest ring.



1. Targeting autoimmune disorders through metal nanoformulation in overcoming the fences of conventional treatment approaches.



Translational Immunology Volume 2

TRANSLATIONAL AUTOIMMUNITY

Treatment of Autoimmune Diseases

Edited by
Nima Rezaei

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Translational Immunology series aimsto provide a comprehensive guide on the recent developments and discoveries to facilitate the employment of this information for clinical settings by approaching translational studies. It includes volumes that dive deep into the different fields of immunology in an attempt to translate immunology from bench to bedside and to present a comprehensive list of books that touch upon the full incorporation.

Translational Autoimmunity: Treatment of Autoimmune Diseases is the second volume of the Translational Immunology series. The book dives deep into the capability of immune system-directed therapies in autoimmunity. In addition, the efficacy and safety of the current biologic therapies and novel drug targets are discussed to provide a more comprehensive guide on the treatment strategies in autoimmune diseases. Therapeutic targeting of B and T regulatory cells, as well as immunomodulation effects of nanoparticles and organisms, is also the subject of discussion in this volume. Current understanding and future challenges of prognostic significance of the treatment in autoimmune diseases are also explored in the book.

Key Features

- Includes coverage of basic immunology, the clinical aspects of autoimmunity, and translational immunology studies in autoimmunity
- Presents key concepts supported by a systematic appraisal of the most recent evidence
- Assists students at all the academic levels while also applicable to scientists who work with autoimmunity
- Designed for learning, teaching, review and testing, practice, and research, and therefore might be useful for students, teachers and instructors, physicians, and researchers

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CHAPTER

16

Targeting autoimmune disorders through metal nanoformulation in overcoming the fences of conventional treatment approaches

Krishna Yadav[a], *Madhulika Pradhan*[b], *Deependra Singh*[a], *and Manju Rawat Singh*[a,*]

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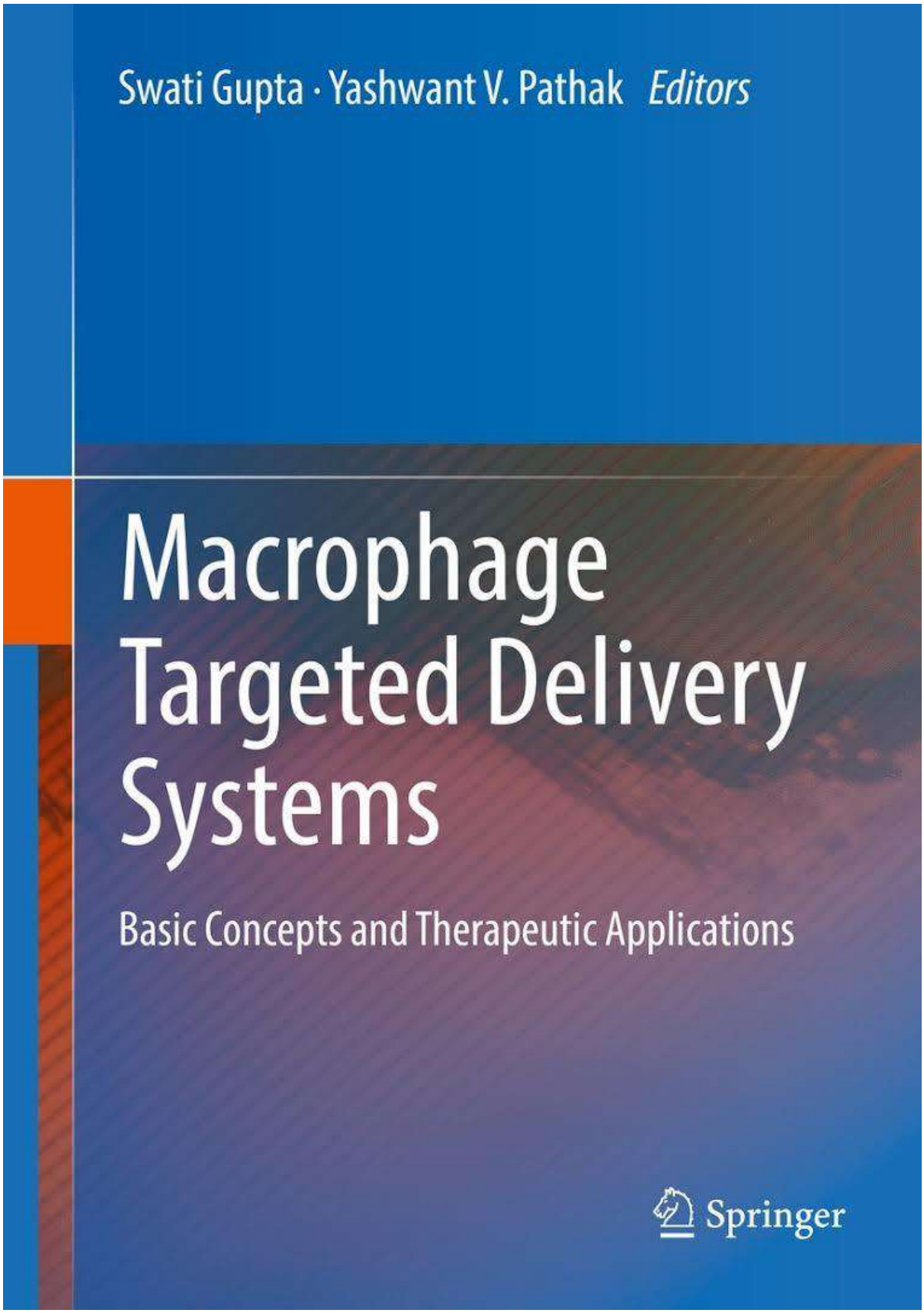
Abstract

Nanomedicine is a rapidly developing area of medicine with promising applications in molecular nanotechnology for safe, effective, and precise drug delivery. To date, many inorganic and polymeric nanoparticles (NPs) with and without surface modifications have been produced for selective drug delivery. An autoimmune disorder is a self-destructive immune cell condition that affects various body tissues and organs. Poor penetration and nonspecific delivery of therapeutic constituents to the targeted cells, which contributes to insufficient therapeutic effectiveness, is one of the main obstacles in targeting therapy for autoimmune diseases. Metallic nanoparticles provide a number of scopes in biomedical applications including diagnosis, treatment, and immunotherapy. Metal nanoparticles (MeNPs) (gold, silver, etc.) may suppress the immune system, causing a strong reaction to threatening cells. They are useful for drug targeting because of their nanosize, nontoxic properties, charge, and ease of high surface functionalization—all of which make them good carriers for drug transportation. This chapter intends to examine numerous strategic methods by integrating material science and immunobioengineering expertise for the safe and efficient delivery of metal-based nanoparticles for the treatment of various autoimmune disorders. Furthermore, the toxicity and safety issues of these metallic NPs are systematically presented.

Keywords

Metallic-nanoparticle, Autoimmune disorders, Nanomedicines, Targeting, Autoimmunity

2. Macrophage associated disorders: pathophysiology, treatment challenges and possible solutions.



Overview

The proposed book is envisioned for the nascent and entry-level researchers who are interested to work in the field of drug delivery and its applications specifically for macrophage targeting. Macrophages have gained substantial attention as therapeutic targets for drug delivery considering their major role in health and regulation of diseases. Macrophage-targeted therapeutics have now added significant value to the lives and quality of life of patients, without undue adverse effects in multiple disease settings. We anticipate examining and integrating the role of macrophages in the instigation and advancement of various diseases. The major focus of the book is on recent advancements in various targeting strategies using delivery systems or nanocarriers followed by application of these nanocarriers for the treatment of macrophage associated disorders.

Macrophage Targeted Delivery Systems is primarily targeted to Pharmaceutical Industry & Academia, Medical & Pharmaceutical Professionals, Undergraduate & Post graduate students and Research Scholars, Ph.D, post docs working in the field of medical and pharmaceutical sciences.

Product Details | About the Author | Table of Contents

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Macrophage-Associated Disorders: Pathophysiology, Treatment Challenges, and Possible Solutions

Krishna Yadav, Madhulika Pradhan, Deependra Singh, and Manju Rawat Singh

Abstract

Immune disorders are a self-attacking state of our defense mechanism influencing diverse body tissues and organs. One of the most significant obstacles in treatment for immune system ailments is the imprecise targeting of therapeutic molecules to the ideal cells due to a lack of insights into disease pathophysiology prompting deficient therapeutic viability. The activated macrophages are chieftain in immune reaction safeguarding the body from unauthorized invaders. They are ubiquitous in almost all autoimmune conditions finding a link between acquired and innate immunities. In recent days, understanding macrophage structural configuration and functioning has opened a new portal between the molecular aspects and their therapeutic targeting in the path of treatment. These have conceivably revolutionized the treatment pattern for autoimmune disorders from targeting perspectives. Even though macrophages are impending targets for immune disorders, the detailing related to their targeting approaches is still lacking. This chapter is an endeavor to summarize various key aspects of macrophage-associated disorders, pathophysiology, treatment challenges, and possible solutions for safe and compelling targeting of therapeutics in various immune disorders.

Keywords

Macrophage targeting · Nanoparticles · Surface modification · Autoimmune disorder

1 Introduction

Macrophages (MPs) are specialized mononuclear phagocytes that are differentiated from monocytes and that own more intracellular organelles within a large cell. They perform diverse functions ranging from sensing pathogens, phagocytosis, digesting cell debris, and initiation of inflammation by the release of cytokine molecules that subsequently activate other cells (Williams et al. 2018). Monocytes reside in the circulating blood, whereas MPs are present in the tissues. They have a comparatively long life span, and they produce diverse surface receptors and a variety of secretory products contributing to various inflammatory and anti-inflammatory responses. They acclimatize easily to any changes in their environment and support to maintain local and systemic homeostasis (Guilliams et al. 2014; Wynn and Vannella 2016).

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M. Pradhan
Rungta College of Pharmaceutical Sciences and Research, Bhilai, Chhattisgarh, India

S. Gupta, Y. V. Pathak (eds.), *Macrophage Targeted Delivery Systems*,

3. Nanobiomaterials as novel modules in the delivery of artemisinin and its derivatives for effective management of malaria.

Natural Products in Vector-Borne Disease Management

Edited by
Nagendra Singh Chauhan
Durgesh Nandini Chauhan

Natural Products in Vector-Borne Disease Management

Edited by Nagendra Singh Chauhan and Durgesh Nandini Chauhan

Natural Products in Vector-Borne Disease Management explores the potential application of natural products in vector control and disease management. The chapters discuss the global impact of specific vector-borne diseases, gaps in management, and natural products in specific stages of development – discovery, optimization, validation, and preclinical/clinical development. Toxic effects and mechanisms of action are also discussed. This book also explores how therapeutic plant derivatives can be used to combat the vectors of infection and how natural products can be used to manage and treat vector-borne diseases like malaria, leishmaniasis, dengue, and trypanosomiasis.

With the inclusion of case studies on field and clinical applications and the contributions from experts in the field, *Natural Products in Vector-Borne Disease Management* is an essential resource to researchers, academics, and clinicians in parasitology, virology, microbiology, biotechnology, pharmacology, and pharmacognosy working in the field of vector-borne diseases.

Key Features

- Offers an alternative, natural approach to the prevention of vector-borne diseases
- Discusses the current and future perspectives of vector-borne diseases and natural product management
- Covers the properties of plants extracts and their phytoactives in vector-borne disease management
- Explores the advantages and disadvantages of natural products versus western medicine for treatment of vector-borne diseases

About the Editors

Dr. Nagendra Singh Chauhan obtained his MPharm and PhD from the Department of Pharmaceutical Sciences at Dr. Harisingh Gour University in Sagar, India. He has about 15 years of research experience and has professional expertise in natural product isolation. He is presently working as a senior scientific officer grade-II and government analyst at Drugs Testing Laboratory Avam Anusandhan Kendra, Raipur, Chhattisgarh, India. He has written more than 65 articles and 24 book chapters and has edited 4 books with publishers like Academic Press, CRC, and Wiley. He is a member of various professional and academic bodies like the Society of Pharmacognosy, International Natural Product Sciences Taskforce (INPST), Società Italo-Latinoamericana di Etnomedicina (SILAE), Institutional Human Ethics Committee, and Association of Pharmaceutical Teachers of India (APTI).

Durgesh Nandini Chauhan is presently working as an assistant professor at the Columbia Institute of Pharmacy, Raipur, Chhattisgarh, India. Mrs. Durgesh Nandini Chauhan has 15 years of academic (teaching) experience in pharmaceutical sciences at various institutes in India. She has taught subjects such as pharmaceutics, pharmacognosy, traditional concepts of medicinal plants, and drug delivery phytochemistry. She is a member of the Association of Pharmaceutical Teachers of India (APTI) and Società Italo-Latinoamericana di Etnomedicina (SILAE). She has written more than 10 publications in national and international journals and 15 book chapters and has edited 9 books. She is also active as a reviewer for several international scientific journals and an active participant in national and international conferences such as the International Convention of Society of Pharmacognosy.

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c0015 Chapter 18

Nanobiomaterials as novel modules in the delivery of artemisinin and its derivatives for effective management of malaria

Krishna Yadav[a,b], Deependra Singh[b], Manju Rawat Singh[b], Nagendra Singh Chauhan[c], Sunita Minz[d], and Madhulika Pradhan[e]

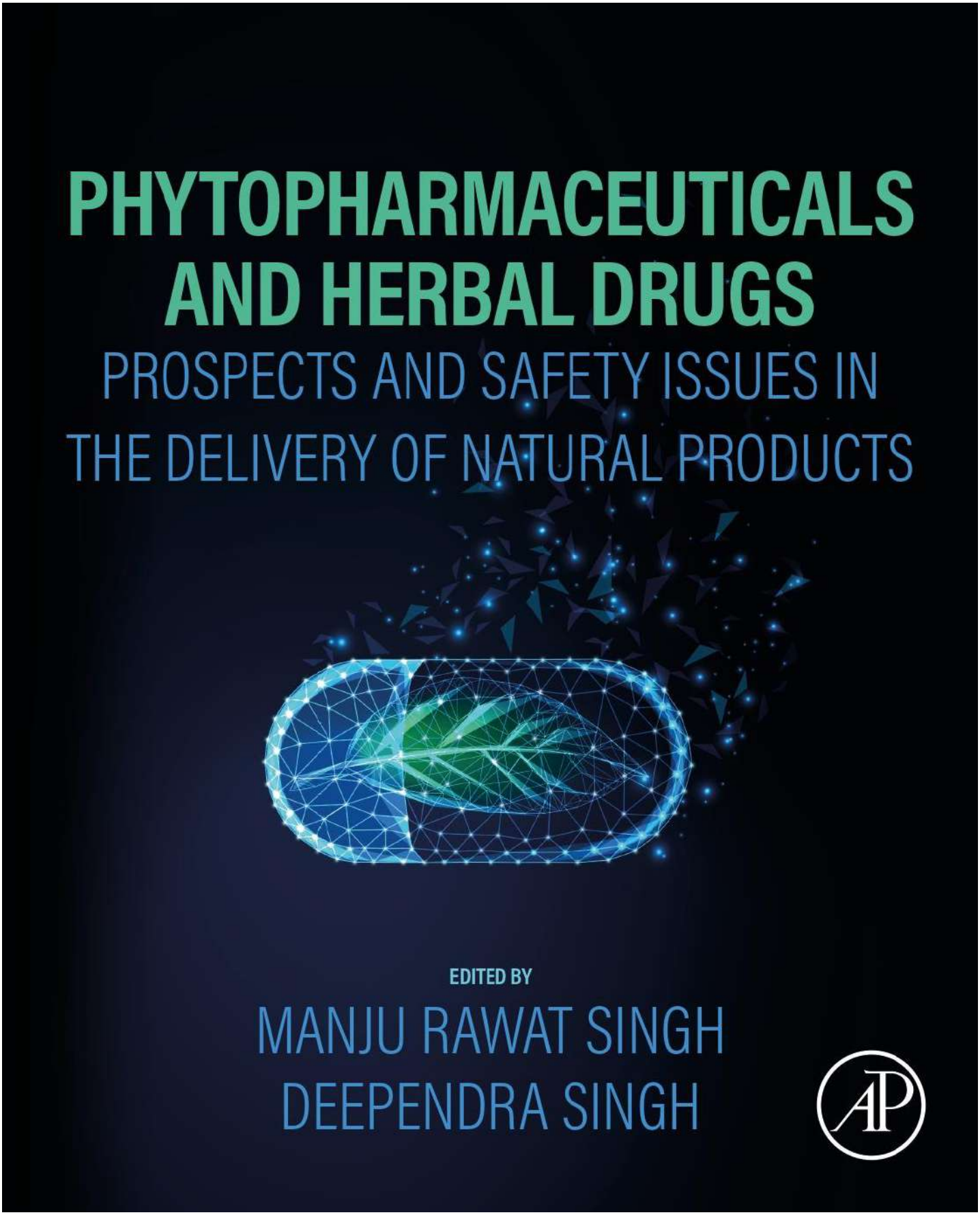
[a]Raipur Institute of Pharmaceutical Education and Research, Sarona, Raipur, Chhattisgarh, India, [b]University Institute of Pharmacy, Pt. Ravishankar Shukla University, Raipur, Chhattisgarh, India, [c]Drugs Testing Laboratory Avum Anusandhan Kendra (State Government Lab of AYUSH), Government Ayurvedic College, Raipur, Chhattisgarh, India, [d]Department of Pharmacy, Indira Gandhi National Tribal University, Amarkantak, Madhya Pradesh, India, [e]Gracious College of Pharmacy, Abhanpur, Chhattisgarh, India

s0020 Introduction

p0020 The renowned herbal plant Artemisia annual is being utilized to get artemisinin (ARTM) which has the most potent medicinal assets. The medication has a sesquiterpene lactone structure with a focal peroxide bridge that distinguishes it from the different medications available. A number of its derivatives are semi-synthetic, for example, artemether, artesunate, arteether artenimol, and artelinic acid (Efferth, 2017; Fontinha et al., 2020; Mishra et al., 2021). ARTM and its analogs have different recuperative services. They are utilized to treat joint agony, liver issues, seizures, loss of hunger, and menstrual problems. They likewise have remedial effects against malignant growth and possess anti-inflammatory properties. It is similarly used to treat sleep deprivation and stomach-related issues and to assist with irritating skin issues and wounds. They are equally significant as antibacterial agents. They advance the development of healthy cells as well as prevent, annihilate, and control viral infections (Aderibigbe, 2017; Jung et al., 2004; Krishna et al., 2008). They are powerful against malaria and other protozoan infections. The utilization of ARTM in the treatment of malaria is exceptionally well yet not in trend due to its cost contrasted with other antimalarials (Anti-M) drugs and has low solvency and bioavailability, short half-life, toxic behavior, and possession of drug resistance (Aderibigbe, 2017; Talapko et al., 2019). Because of the pharmacological limitations mentioned

Natural Products in Vector-Borne Disease Management. https://doi.org/10.1016/B978-0-323-91942-5.00003-3

4. Worldwide health scenario from the perspective of herbal medicine research



PHYTOPHARMACEUTICALS AND HERBAL DRUGS

PROSPECTS AND SAFETY ISSUES IN THE DELIVERY OF NATURAL PRODUCTS

EDITED BY MANJU RAWAT SINGH AND DEEPENDRA SINGH

Phytopharmaceuticals and Herbal Drugs: Prospects and Safety Issues in the Delivery of Natural Products explores the delivery aspects of plant-based drugs, providing insight into the formulation constraints associated with plant-based drugs to the development of novel delivery systems based on polymers or lipids, combining natural products with technological advancements in drug delivery. Some of the best-selling drugs for the treatment of diseases like cancer, ulcer, and malaria are either natural products or their derivatives. *Phytopharmaceuticals and Herbal Drugs* will be useful to researchers working in plant-derived medicines and development of their delivery systems.

Herbal drugs are well known for their ancestral therapeutic potentials such as hypoglycemic, antimalarial, antidiabetic, antioxidant, antimicrobial, anticarcinogenic, anticholinergic, antiinflammatory, etc. However, there are certain limitations which can be overcome by the development of novel delivery systems. Drug delivery systems for plant actives and extracts is an extensive field and requires an encyclopedia to describe all the technologies. Considering these aspects, this book highlights the current scenarios related to the expansion of novel herbal formulations utilizing the novel technologies with their mechanism, methodology, and applications.

This volume compiles descriptions of important approaches used in the delivery of plant-based drugs. It will be an important source of information for pharmaceutical scientists, pharmacognosists, drug delivery scientists, and pharmacologists working in academia as well as in the industry dealing with plant-based drugs. The first objective is to provide the reader with a sound knowledge of the utility of plant-based drugs, the challenges faced practically, and to enrich potential activity by modifying and selecting appropriate delivery systems. The second aim is to develop an appreciation for the importance of safety, regulatory aspects, and clinical aspects dealing with plant-based drugs, and thirdly, introduction of the concept of healing through plant-based drugs for the benefit of every individual in the community along with development of new targeted drug delivery systems and their various applications.

Key Features

- Includes perspectives from academic and industry research
- Provides information on the safety, regulatory aspects, and clinical aspects of dealing with plant-based drugs
- Introduces developments of new targeted drug delivery systems and their various applications
- Provides detailed facts and information for all scientists dealing with medicinal plants and their utility
- Summarizes various delivery systems for plant actives and extracts, novel techniques for extraction, and the limitations, and importance, of herbal extracts and their safety considerations and standardization

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CHAPTER

2

Worldwide health scenario from the perspective of herbal medicine research

Anita Bhoi[1], *Shradha Devi Dwivedi*[2], *Deependra Singh*[2], *Manju Rawat Singh*[2] *and S. Keshavkant*[1]

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1. Introduction

Traditional medicine is defined as knowledge, skills, and practices based on theories, beliefs, and experiences from various cultures that are used for health maintenance and improvement, diagnosis, prevention, or treatment of physical or mental illness [1]. The knowledge of traditional medicine has developed over generations within various societies before the era of modern medicine. So, for the treatment of chronic and acute diseases, these traditionally used plants can be explored effectively in order to find new chemical entities. Traditional medicines are also termed as indigenous or folk medicines [2]. These are naturally occurring, plant-derived drugs that have been utilized to treat ailments in local or regional healing traditions with little or no industrial processing. World Health Organization (WHO) revealed a survey report that world's 80% of population relies on traditional medicines for their primary healthcare requirements. Alternative medicine is getting more popular in developed countries, and it is growing progressively because of its efficacy, safety, and lack of adverse effects [3].

Phytopharmaceuticals and Herbal Drugs
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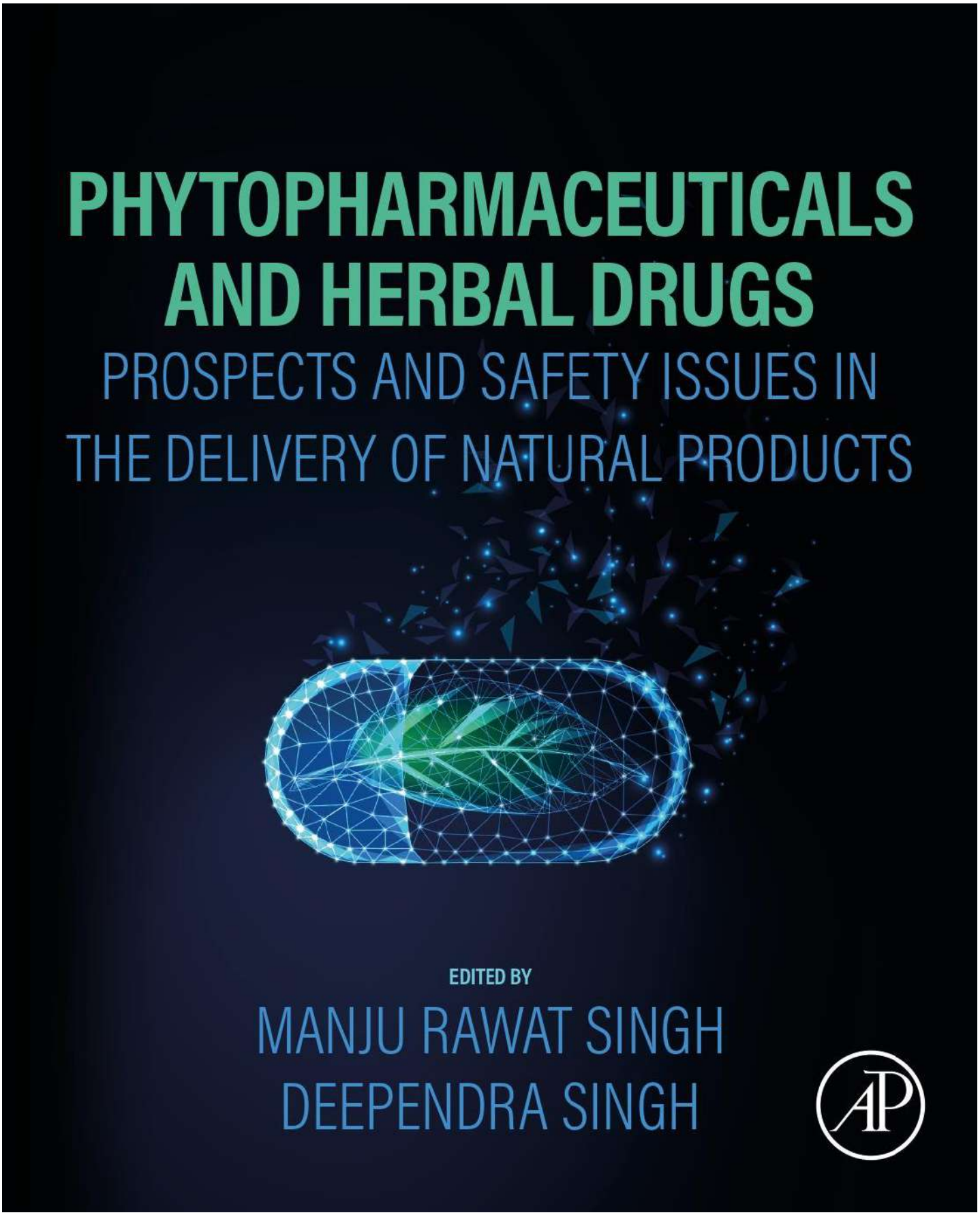
5. Lipid-based particulate systems for delivery of plant actives and extracts: Extraction, prospective carriers, and safety issues.



PHYTOPHARMACEUTICALS AND HERBAL DRUGS

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CHAPTER

4

Lipid-based particulate systems for delivery of plant actives and extracts: Extraction, prospective carriers, and safety issues

Manju Rawat Singh[1], *Kusum Pradhan*[1], *Madhulika Pradhan*[2], *Krishna Yadav*[1,3], *Nagendra Singh Chauhan*[4], *Shradha Devi Dwivedi*[1] and *Deependra Singh*[1]

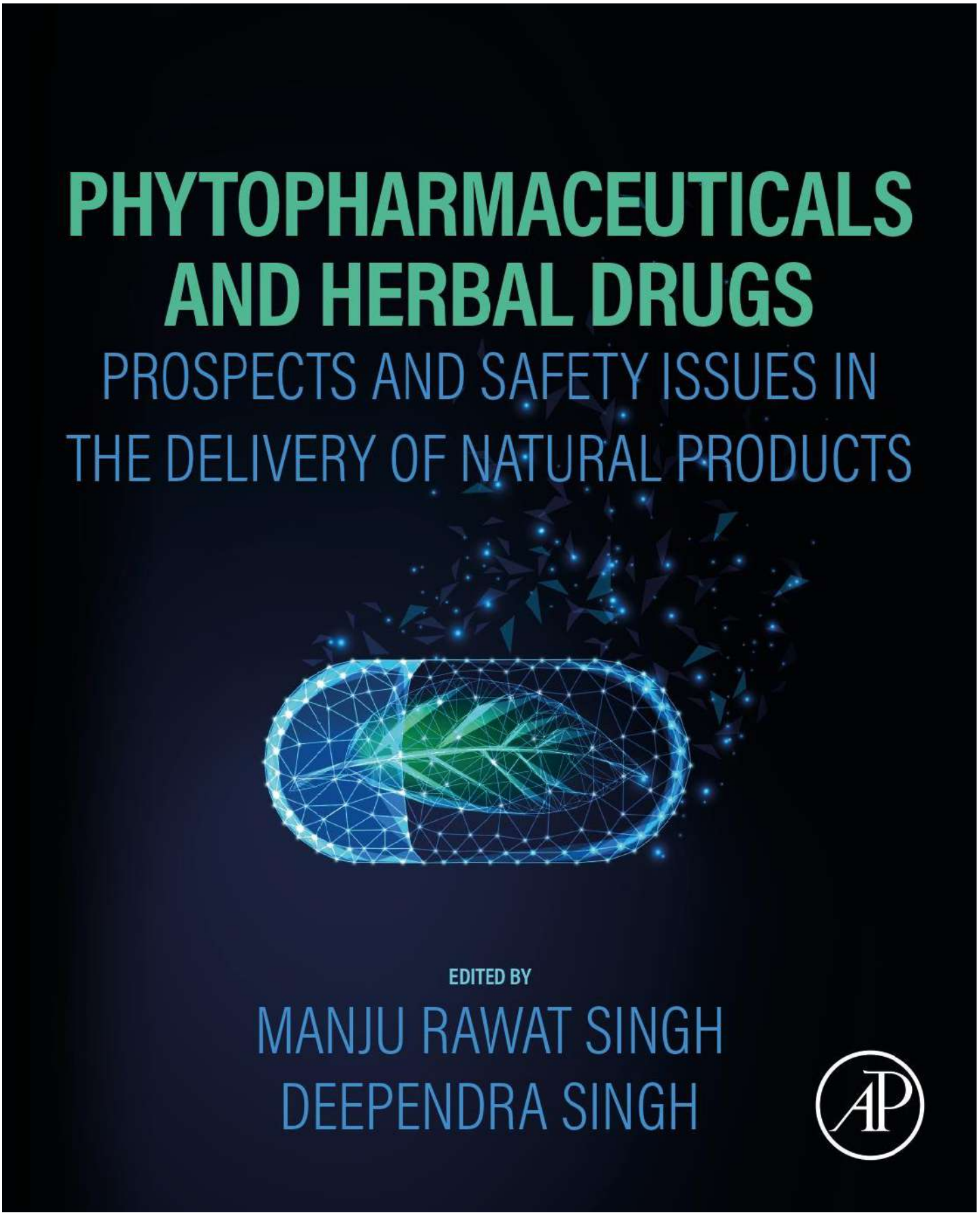
[1]University Institute of Pharmacy, Pt. Ravishankar Shukla University, Raipur, Chhattisgarh, India; [2]Rungta College of Pharmaceutical Sciences and Research, Bhilai, Chhattisgarh, India; [3]Raipur Institute of Pharmaceutical Education and Research, Raipur, Chhattisgarh, India; [4]Drugs Testing Laboratory, Avam Anusandhan Kendra (State Government Lab of AYUSH), Raipur, Chhattisgarh, India

1. Introduction

Modern biotechnology and pharmacotherapy recently developed more interest in the production of new therapeutic agents with a novel formulation originating from botanical sources [1]. Herbal medicines from natural sources share a major portion of traditional medicine and come in naturopathy. WHO also estimates that 65%–80% of the world's population depend on traditional medicine as primary health care medication system and 85% of these medicines involve the use of herbal preparations [2]. It is also estimated that about 25% of the drugs prescribed worldwide are derived from plants and application of these modern medicines directly correlate with their traditional use as herbal medicines [3].

Herbal drugs are gaining enhanced popularity in the modern world in curing various diseases due to less toxic and better therapeutic effects [4]. It has been increasingly common in recent years for herbals to be employed as the basis for new medicine development (Fig. 4.1).

6. Novel drug delivery approaches for improving therapeutic applications of berberine and berberine-rich herbal preparations.



PHYTOPHARMACEUTICALS AND HERBAL DRUGS

PROSPECTS AND SAFETY ISSUES IN THE DELIVERY OF NATURAL PRODUCTS

EDITED BY MANJU RAWAT SINGH AND DEEPENDRA SINGH

Phytopharmaceuticals and Herbal Drugs: Prospects and Safety Issues in the Delivery of Natural Products explores the delivery aspects of plant-based drugs, providing insight into the formulation constraints associated with plant-based drugs to the development of novel delivery systems based on polymers or lipids, combining natural products with technological advancements in drug delivery. Some of the best-selling drugs for the treatment of diseases like cancer, ulcer, and malaria are either natural products or their derivatives. *Phytopharmaceuticals and Herbal Drugs* will be useful to researchers working in plant-derived medicines and development of their delivery systems.

Herbal drugs are well known for their ancestral therapeutic potentials such as hypoglycemic, antimalarial, antidiabetic, antioxidant, antimicrobial, anticarcinogenic, anticholinergic, antinflammatory, etc. However, there are certain limitations which can be overcome by the development of novel delivery systems. Drug delivery systems for plant actives and extracts is an extensive field and requires an encyclopedia to describe all the technologies. Considering these aspects, this book highlights the current scenarios related to the expansion of novel herbal formulations utilizing the novel technologies with their mechanism, methodology, and applications.

This volume compiles descriptions of important approaches used in the delivery of plant-based drugs. It will be an important source of information for pharmaceutical scientists, pharmacognosists, drug delivery scientists, and pharmacologists working in academia as well as in the industry dealing with plant-based drugs. The first objective is to provide the reader with a sound knowledge of the utility of plant-based drugs, the challenges faced practically, and to enrich potential activity by modifying and selecting appropriate delivery systems. The second aim is to develop an appreciation for the importance of safety, regulatory aspects, and clinical aspects dealing with plant-based drugs, and thirdly, introduction of the concept of healing through plant-based drugs for the benefit of every individual in the community along with development of new targeted drug delivery systems and their various applications.

Key Features

- Includes perspectives from academic and industry research
- Provides information on the safety, regulatory aspects, and clinical aspects of dealing with plant-based drugs
- Introduces developments of new targeted drug delivery systems and their various applications
- Provides detailed facts and information for all scientists dealing with medicinal plants and their utility
- Summarizes various delivery systems for plant actives and extracts, novel techniques for extraction, and the limitations, and importance, of herbal extracts and their safety considerations and standardization

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CHAPTER

16

Novel drug delivery approaches for improving therapeutic applications of berberine and berberine-rich herbal preparations

Deependra Singh[1,2], *Krishna Yadav*[1,4], *Manju Rawat Singh*[1], *Narayan D. Chaurasiya*[3] *and Babu L. Tekwani*[3]

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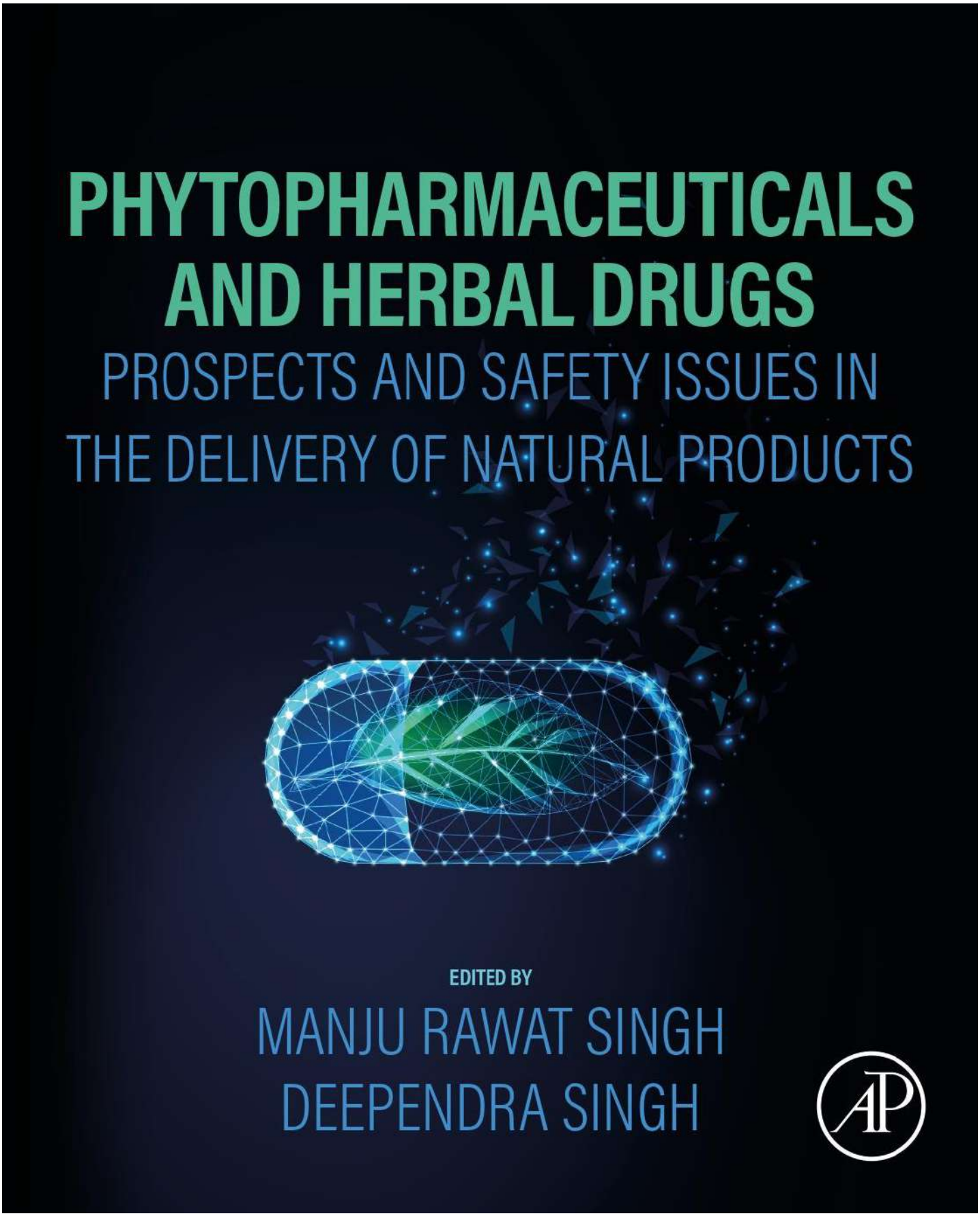
1. Introduction

Herbs and herbal drugs have drawn immense interest among people due to their clinically proven effects in curing a wide variety of communicable as well as noncommunicable diseases [1]. Herbal drugs are popular due to their safety profiles under clinical settings [2,3]. However, the complex nature of herbal preparations poses significant challenges and limitations regarding bioavailability, pharmacokinetics, and pharmacodynamics of principal active constituents [4,5] (Table 16.1). Conventional formulations have not been effective in avoiding these limitations. Furthermore, due to a lack of scientific rationale and processing challenges, such as standardization, extraction, and identification of specific medicinal components in complicated poly-herbal preparations, herbal medicines were not taken into account for development as new formulations [30]. However, the development of complex herbal medicine preparations as approved treatments requires scientific validation, development of standardized preparations, quality control, and systematic evaluations of the safety of herbal drugs. These requirements have paved the pathway for the development of novel drug

8. Commercial aspect and market potential of phytoactive products



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CHAPTER

20

Commercial aspects and market potential of novel delivery systems for bioactives and biological agents

Krishna Yadav[1], *Manju Rawat Singh*[1], *Vineet Kumar Rai*[2], *Nidhi Srivastava*[2] *and Narayan Prasad Yadav*[2]

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[2]CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow, India

20.1 Introduction

Drug delivery system with novel approaches is the boon to the success of pharmaceutical delivery of therapeutic active indisputably have strong commercial worth on the pharmaceutical market. Because of the immense benefit of novel drug delivery system (NDDS) including controlled delivery of medication, targeted delivery of active, reduction in dosing frequency, avoid repeated administration and hence increase patient's compliances, it became foremost choice for every delivery problems (Anselmo and Mitragotri, 2014; Pradhan et al., 2013). It also avails means of a patent extension of the delivery system that further enhances the value of new active agents. Several investigations have been done which revealed the clinical and commercial success stories (Martins et al., 2014). Currently, numerous commercial products are available in the market for different delivery approaches such as oral route, transdermal, ophthalmic, and depot injection worth a billion-dollar. However, the translation of these technologies from bench scales to commercial was never easy. Additionally, translation of these technologies is long-term process (Fig. 20.1), as proven by the some Food and Drug Administration (FDA) permitted products and early research that are in pipeline (Junghanns and Müller, 2008; Weissig and Guzman-Villanueva, 2015). There are multitudinous hurdles at each stride that can spell prompt failure, thus obstructing the clinical or commercial transformation of the various promising delivery system (Rai et al., 2014). Intense scholarly research has contributed diverse early-stage technologies for drug delivery. Most of the successful commercial drug delivery system is usually

PHYTOPHARMACEUTICALS AND HERBAL DRUGS

Prospects and Safety Issues in the Delivery of Natural Products

Edited by

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About the Authors

Swati Pandey gained her post graduate studies from the Chhattisgarh Swami Vivekananda Technical University (CSVTU), Bhilai, Chhattisgarh and undergraduate from Guru Ghasidas Central University, Bilaspur bagging Gold medals in both B. Pharm and M. Pharm (Qualified GPAT 2011). Presently, she is an Assistant Professor at the Columbia Institute of Pharmacy. She has 10 years of research and academic experience. Her research area of interest includes Pharmaceutical analysis; Impurity profiling; Chromatographic and Spectroscopic techniques. She has 15 publications to her credit in various journals of international and national repute and received awards at National and International conferences. She is a life member of Society of Ethanopharmacology, IPA & APTI

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Ravindra Kumar Pandey presently, working as Professor in Columbia Institute of Pharmacy, Raipur (C.G.) has 17 years of Teaching and Industrial experience. He has completed M. Pharm from Rajiv Gandhi Proudyogiki Vishwavidyalaya (R.G.P.V.), Bhopal (M.P.) and Ph.D from Pt. Ravishankar Shukla University, Raipur (C.G.). His area of interest is Pharmacognosy and Phytochemistry. He has several research projects and research papers published in national and international Journals to his credit. He is author of several books and book chapters. He is frequently invited as a resource person in various national and international conferences in India and abroad.

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CHAPTER 6

Inflammatory Mediators and Cytokines involved in Rheumatoid Arthritis

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Abstract: Rheumatoid arthritis (RA) is a chronic inflammatory disease that mostly affects the joints. Inflammation is an immune response of the human body, but an overabundance of such responses is thought to be a key element in the evolution of many other issues, including RA, cancer, and neurological illnesses. The growth and inhibition of RA necessitate the identification of a precise mechanism and target in the body. Interleukins (IL), tumour necrosis factors (TNF-), interferons (INF), and arachidonic acid derivatives are the most important cytokines and inflammatory mediators in rheumatoid arthritis. IL-6 inhibitors, JAK inhibitors, anti-TNF, and currently available disease-modifying anti-rheumatic medications (DMARDs) have all been demonstrated to be effective in the treatment of RA. We have also summarised the inflammatory mediators such as arachidonic acid metabolites and their role in inflammation. This chapter also observed cytokines and other transcription factors that play a role in the disease's onset and progression. The current study includes a wide range of issues, including RA molecular pharmacology, such as cytokines pharmacology, transcription factors, and other active biomolecules. However, the study shows that a number of biomolecules and mediators play a key role in the pathogenesis of RA, and a thorough understanding of the underlying pathways can aid in the creation of new targeted pharmacological therapies that are both safer and more effective in RA.

Keywords: Inflammation, Rheumatoid Arthritis, Cytokines, Prostaglandins, Inflammatory mediators, Interleukins, Interferons.

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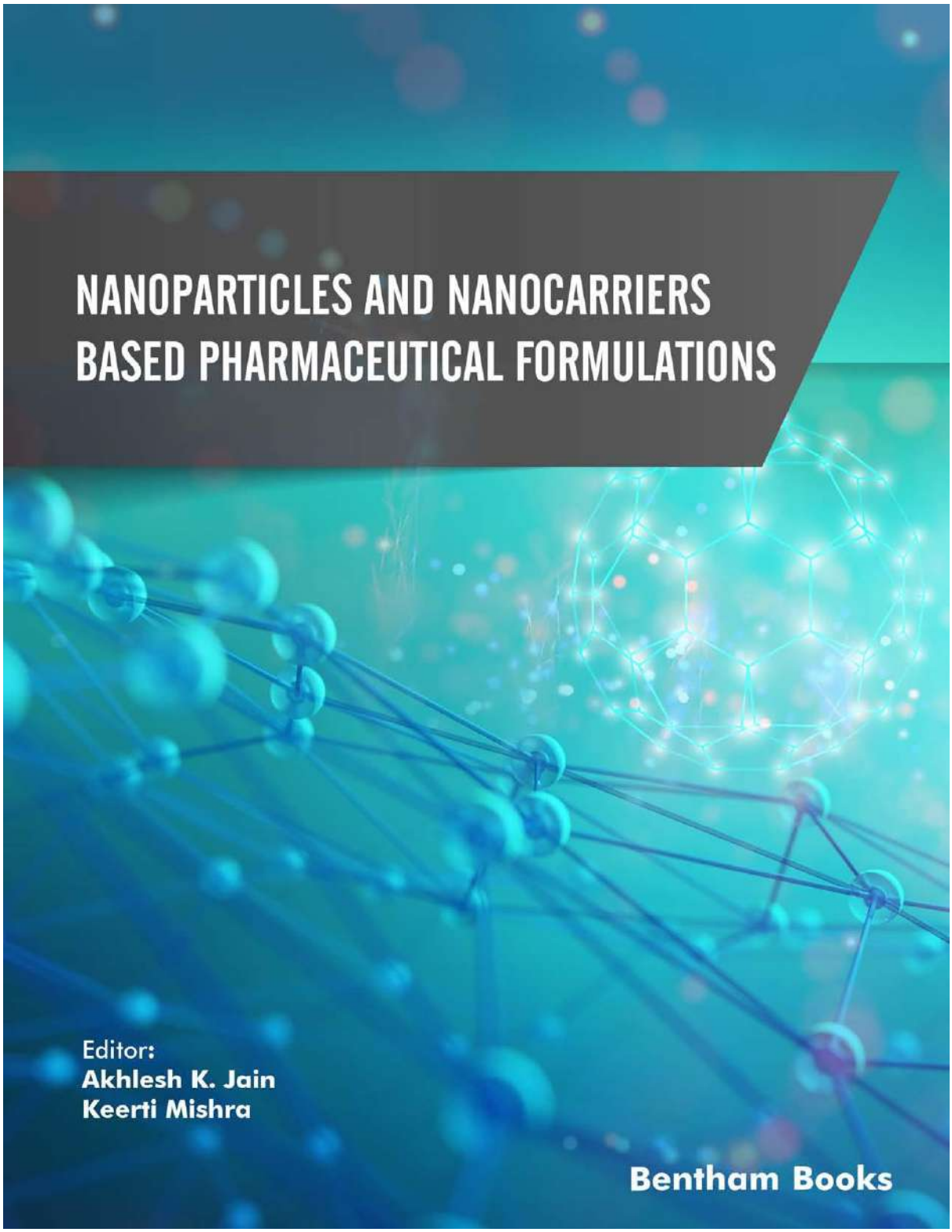
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CHAPTER 2

Polymeric Nanoparticles as Drug Delivery System: Basic Concepts and Applications

Sakshi Tiwari[1], Bina Gidwani[2], Priya Namdeo[1], Atul Tripathi[4], Ravindra Kumar Pandey[2], Shiv Shankar Shukla[2], Veenu Joshi[3], Vishal Jain[1], Vikas Kumar Jain[5] and **Amber Vyas[1,*]**

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Abstract: Delivering drugs through various delivery systems into the body for successful treatment of diseases is most entrancing deeds for the pharmaceutical analyst. Conventional drug delivery systems have various hindrances like loss of medication and poor bioavailability of drugs. Polymer-based nanocarriers such as polymeric nanoparticles upgrade bioavailability of drug, delivery of drug to specific site and improve solubility of drugs. They are widely explored as controlled, precise, sustained and continuous release systems for drug delivery and are easily incorporated and appropriate for practically all parts of nanomedicines and bring new trust in field of drug conveyance by redesigning drug viability and diminishing drug toxicity. This chapter mainly focuses on polymers and techniques engaged with advancement of polymer-based nanoparticles and their applications in therapeutic intervention.

Keywords: Bioavailability, Controlled release, Diagnosis, Dispersion, Drug delivery system, Drug efficacy, Drug toxicity, Diffusion, Polymeric nanoparticles, Macromolecules, Natural polymers, Nanoprecipitation, Interfacial polymerization, Synthetic polymers, Targeted drug delivery, Potent drug delivery, Polymerization, Sustained release, Treatment, Solvent evaporation.

INTRODUCTION

The intricacy of specific diseases and the related toxicity of certain therapies progressively request novel courses for drug conveyance [1]. In the mid of the twentieth century, Paul Ehrlich conjectured the concept of "Magic bullet" that has

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CHAPTER 4

Nanocarriers For Drug Targeting

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Abstract: Drug targeting specific cells/tissues of the body without their becoming a part of the systemic circulation is a prominent area of research in drug delivery, with the main emphasis on improvement in formulation and development. Drug-targeting can improve the viability, lower/minimize the adverse/side effects, and can become cost-effective. Certain limitations like short circulating half-life, bioavailability issues, rapid metabolism and degradation, poor tissue distribution and penetration in the blood-brain barrier, intestinal absorption barriers, *etc*., are associated with the delivery of various therapeutic agents. Nanocarriers have arisen in the field of drug targeting with valuable delivery of drugs to site-specific/desired areas which is a significant therapeutic advantage since it keeps drugs from being conveyed to some unacceptable spots. Nanocarriers prevent the obstacles in clinical utilization of the therapeutic agents as they decrease the serious and critical side/adverse effects by targeted drug delivery and provide slow and sustained drug release. Nanocarriers bring new trust to drug targeting by upgrading the efficacy, defeating resistance, and minimizing toxicity. This chapter mainly focuses on the role and benefits of nanocarriers in drug-targeting and nanocarriers as prominent systems for targeting and delivering drugs to achieve maximum effects with improved therapeutic response.

Keywords: Bioavailability, Blood-brain barrier, Drug delivery, Drug efficacy, Drug resistance, Drug targeting, Half-life, Intestinal barrier, Metabolic degradation, Nanocarriers, Site of action, Site-specific targets, Sustained release, Targeted drug delivery, Tissue distribution.

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CHAPTER 10

Lipoidal Carrier as Drug Delivery System

Bina Gidwani[1], Priya Namdeo[2], Sakshi Tiwari[2], Atul Tripathi[4], Ravindra Kumar Pandey[1], Shiv Shankar Shukla[1], Veenu Joshi[3], Vishal Jain[2], Suresh Thareja[5] and **Amber Vyas[2,*]**

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Abstract: The delivery system plays a vital role in managing the pharmacokinetics and pharmacodynamics of a drug. The size of the carrier system contributes to its pharmacological action. Lipid-based carriers refer to the formulations containing a dissolved or suspended drug in lipidic excipients. Lipoidal systems as carriers are achieving heights due to their significant lipid nature and the size of particles in the delivery system. The micro/nano-sized lipid-based carriers possess versatility in improving the physic-chemical properties of drugs. Also, they are biocompatible and can be administered through all possible routes. Lipid-based drug delivery carrier systems of new and existing formulations can be commercialized to achieve the desired range of product specifications. Solubility of the drug in various lipids is a key factor in the development of the delivery system. Lipids as functional excipients are compatible with solid, liquid, and semi-solid dosage forms. Besides improving/enhancing the solubility and bioavailability, lipids provide multiple broad-based applications in the pharmaceutical delivery system.

Keywords: Bioavailability, BCS Class, Cancer, Carriers, Delivery system, Lipids, Micro/nano, Pharmacokinetics, Pharmacodynamics, Solubility, Liposomes, Solid Lipid Nanoparticles, Nanostructured lipid carrier, Lipid-drug conjugate, Liposphere, Topical, Oral, Parenteral, Pulmonary, Protein/peptide.

INTRODUCTION

Lipoidal carrier is a versatile delivery platform, which has achieved a lot of attention in the current era. Lipoidal carriers are systems with significant

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CHAPTER 2

Traditional Herbal Medicines: A Prospective Panacea for SARS-CoV-2

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Abstract: The pandemic has trembled the world with the massive outbreak, leaving the scientific fraternity in shambles. The SARS-CoV-2 strain took a heavy toll and led to the death of millions of people. In late 2020, various mutated strains of the virus surged the disease across the world. For the same, diverse methods were used around the globe in search of precise medication against the pandemic. Despite vaccination for viral disease prevention, the virus has spread without restraint, making the need for strong antiviral drugs- a need of the hour. Several techniques were used for the fabrication of a strong antiviral drug in different modes of remedies. Many countries utilized their conventional therapeutic knowledge against the virus, which comprises the use of indigenous phytochemicals with varied biological activities. The present review includes the virology, epidemiology, and different therapeutic procedures practiced globally to combat the viral disease and highlights different indigenous potent plants with biological activities, such as antiviral, antipyretic, immunomodulatory and antimicrobial. These plants are efficacious and can be explored further as prospective remedies for many other maladies affecting the world.

Keywords: B.1.617, COVID-19, Coronavirus, Herbal Medicines, Indigenous Curatives, Lopinavir, Remdesivir, SARS-CoV-2, 2-deoxy-D-glucose, Traditional Medicines.

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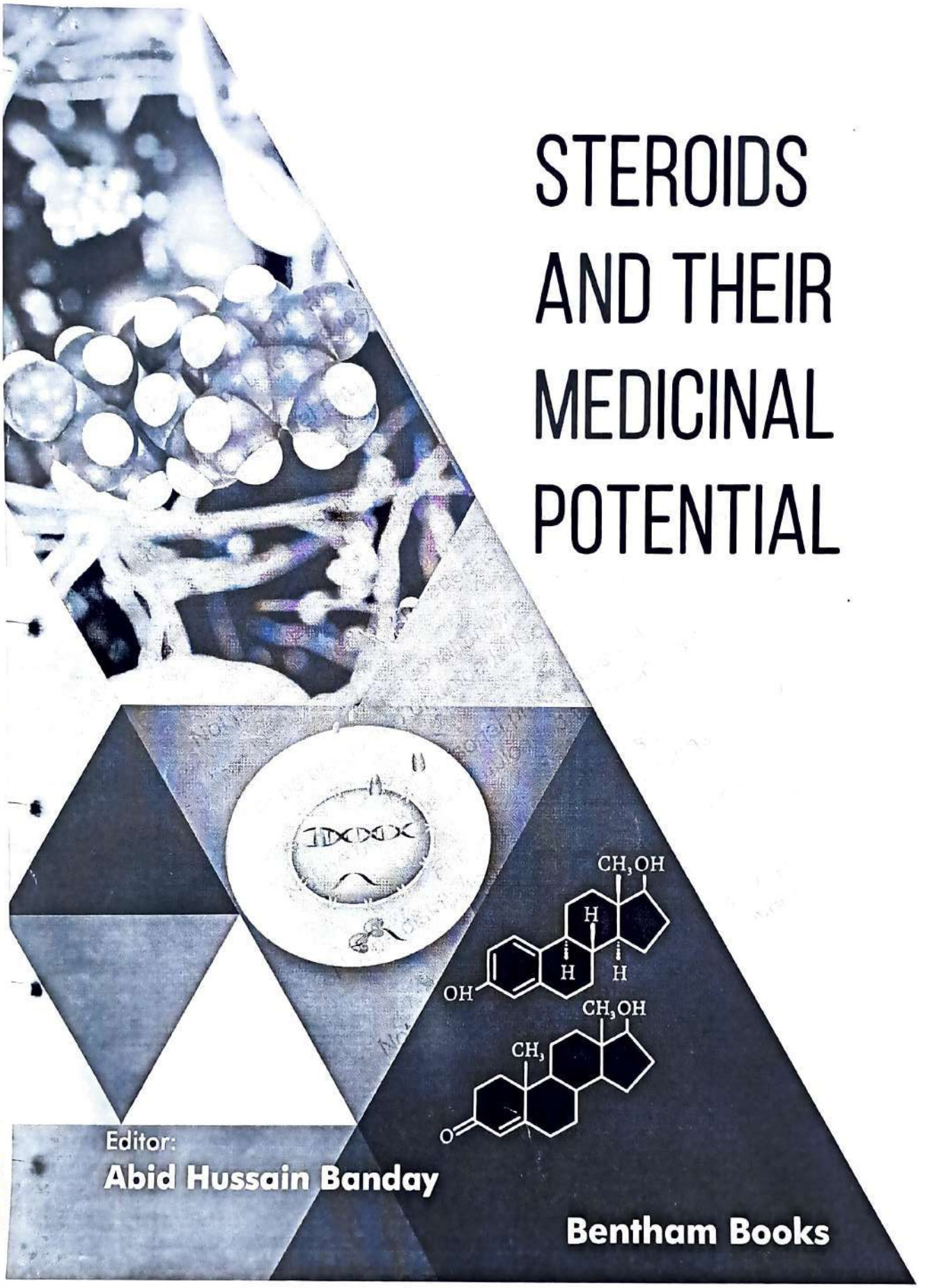

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CHAPTER 7

Plant Cardenolides: Multifunctional Medicinal Agents

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Abstract: Cardenolides are a class of compounds steroidal in nature, belonging to the cardiac glycoside group of secondary metabolites. They consist of a sugar part and a non-sugar part consisting of a steroidal cyclopentanoperhydrophenanthrene ring with lactone substitution at the β-17 position. Cardenolides are found in angiosperm plant families like Plantiginaceae, Asclepiadaceae, Apocynaceae, Brassicaceae, Cruciferae, Liliaceae, Moraceae, Ranunculaceae, and Scrophulariaceae. These include some important glycosides, such as digitoxin, digoxin, Ouabain, Calotropin, *etc.* with profound pharmacological potential. Moreover, cardenolides have toxic effects for which these have been used in poison arrows and for self-harm purposes. Traditionally, these were used to treat congestive heart failure. However, recently they have emerged as promising agents to exhibit anticancer, antiviral, anti-inflammatory, neuroprotective, and various other therapeutic roles. Cardenolides like Digoxin and Digitoxin have been used in the treatment of heart failure and atrial fibrillation. Toxicarioside A, and Calotropin have been reported to suppress tumor growth and are used as anticancer agents, Strophalloside and Oubain are reported to be involved in apoptosis. Oleandrin is an antiproliferative agent and can inhibit IL-8 which is responsible for cystic fibrosis.

Keywords: Anticancer, Cardiac Glycosides, Cardenolides, Digitoxin, Neuroprotective.

INTRODUCTION

Plants are chemical factories which synthesize magical compounds with profound medicinal properties. These phytocompounds are considered to be much safer than synthetic compounds for the treatment of various ailments. Alkaloids,

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PHYTOPHARMACEUTICALS AND HERBAL DRUGS

PROSPECTS AND SAFETY ISSUES IN THE DELIVERY OF NATURAL PRODUCTS

EDITED BY

MANJU RAWAT SINGH

DEEPENDRA SINGH

PHYTOPHARMACEUTICALS AND HERBAL DRUGS

Prospects and Safety Issues in the Delivery of Natural Products

Edited by

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PHYTOPHARMACEUTICALS AND HERBAL DRUGS

PROSPECTS AND SAFETY ISSUES IN THE DELIVERY OF NATURAL PRODUCTS

EDITED BY MANJU RAWAT SINGH AND DEEPENDRA SINGH

Phytopharmaceuticals and Herbal Drugs: Prospects and Safety Issues in the Delivery of Natural Products explores the delivery aspects of plant-based drugs, providing insight into the formulation constraints associated with plant-based drugs to the development of novel delivery systems based on polymers or lipids, combining natural products with technological advancements in drug delivery. Some of the best-selling drugs for the treatment of diseases like cancer, ulcer, and malaria are either natural products or their derivatives. *Phytopharmaceuticals and Herbal Drugs* will be useful to researchers working in plant-derived medicines and development of their delivery systems.

Herbal drugs are well known for their ancestral therapeutic potentials such as hypoglycemic, antimalarial, antidiabetic, antioxidant, antimicrobial, anticarcinogenic, anticholinergic, antiinflammatory, etc. However, there are certain limitations which can be overcome by the development of novel delivery systems. Drug delivery systems for plant actives and extracts is an extensive field and requires an encyclopedia to describe all the technologies. Considering these aspects, this book highlights the current scenarios related to the expansion of novel herbal formulations utilizing the novel technologies with their mechanism, methodology, and applications.

This volume compiles descriptions of important approaches used in the delivery of plant-based drugs. It will be an important source of information for pharmaceutical scientists, pharmacognosists, drug delivery scientists, and pharmacologists working in academia as well as in the industry dealing with plant-based drugs. The first objective is to provide the reader with a sound knowledge of the utility of plant-based drugs, the challenges faced practically, and to enrich potential activity by modifying and selecting appropriate delivery systems. The second aim is to develop an appreciation for the importance of safety, regulatory aspects, and clinical aspects dealing with plant-based drugs, and thirdly, introduction of the concept of healing through plant-based drugs for the benefit of every individual in the community along with development of new targeted drug delivery systems and their various applications.

Key Features

- Includes perspectives from academic and industry research
- Provides information on the safety, regulatory aspects, and clinical aspects of dealing with plant-based drugs
- Introduces developments of new targeted drug delivery systems and their various applications
- Provides detailed facts and information for all scientists dealing with medicinal plants and their utility
- Summarizes various delivery systems for plant actives and extracts, novel techniques for extraction, and the limitations, and importance, of herbal extracts and their safety considerations and standardization

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CHAPTER

10

Herbal drug interaction and effects on phytopharmaceuticals

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1. Introduction

Herbal medicines are widely preferred throughout the world because of their effectiveness, easy availability, economic consideration, and safety attributes. According to WHO, herbal medicines are defined as finished, labeled therapeutic products containing a single or blend of active ingredients acquired from plant parts whether in an unrefined state or as plant preparations. These herbal medicines are utilized in pretty much all aspects of world since the existence of humankind for the treatment of diseases with their own practice in each culture. As these medications are obtained from natural sources and this inclination has prompted the growth in usage of these herbal medicines [1,2]. The absence of information on the collaboration potential along with an underreporting of herbal use represents a test for medical services suppliers and a wellbeing worry for patients [3]. According to WHO estimates, the market for herbal products would be worth $5 trillion annually by 2050 [4]. The increment in number of drug interactions with the quantities of clinical items devoured simultaneously has shown danger in parts of the viability, security, and nature of herbal items are the subjects of ongoing discussions. Simultaneous administration of herbs might disrupt the impact of medications [5]. A decent comprehension of the herb-drug interaction is additionally fundamental for surveying and limiting clinical dangers. In spite of this high

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CHAPTER 4

DNA Fingerprinting for Identification and Standardization of Herbal Drugs

Rakhi Khabiya[1,2], Akanksha Dwivedi[2], Gajendra Pratap Choudhary[1], Gajanan Narayanrao Darwhejar[2], Swati Pandey[3], Vishal Jain[4], Amber Vyas[4], Ravindra Kumar Pandey[3] and **Shiv Shankar Shukla[3,*]**

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Abstract: Herbal medicines are emerging as the bliss of the modern era for the treatment and welfare of the population owing to their safety, and minimum or lack of side effects. Keeping this perspective in mind, the quality of herbal medicines is equally important as allopathic medicines. To thwart the adulteration of herbal medicines with substandard or similar low-grade herbs is the prime objective of standardization for the maintenance of the quality of herbal medicines. Assessment of quality and purity of crude drugs using several parameters such as morphological, microscopical, physical, chemical & biological evaluation can be performed through standardization technique. A number of conventional standardization methods are available, but owing to their lackings in one or more aspects, modern standardization techniques are being opted for by many researchers nowadays. Amid all the novel standardization techniques, DNA fingerprinting method is the most important in the quality control of herbal medicines on account of its accuracy and consistency. DNA fingerprinting defines barcode-like DNA fragment patterns generated by multilocus probes after the electrophoretic parting of genomic DNA fragments. Hence, this chapter primarily emphasizes on DNA fingerprinting method as a tool for the standardization of herbal medicines.

Keywords: Fingerprinting, Herbal drug, Identification, Isolation, Standardization.

INTRODUCTION

Herbal drugs basically include natural plant-derived products that may be either herbs, minerals, vitamins, immunomodulators, antibacterial, or any other medicinal agent. They can be administered orally as solid or liquid or applied

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D.K. Tripathi
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1 Introduction to Magnetic Quantum Dots

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CONTENTS

1.1 INTRODUCTION

One of the most significant fields of science is nanotechnology, which operates at the cellular and molecular level and contributes to significant advancements in engineering, biology, and medicine [1]. In nanotechnology different types of nano-scale materials are available, which possess specific optical, electrical, catalytic, and

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10 Magnetic Quantum Dots for In-Vivo Imaging

Venu Yakati[a], *Swathi Vangala*[b], *VJ Reddy*[c], *Bina Gidwani*[d], *Amber Vyas*[e], *Vishal Jain*[e], *Veenu Joshi*[g], *Kapil Agrawal*[f], *and Gopikrishna Moku*[c]

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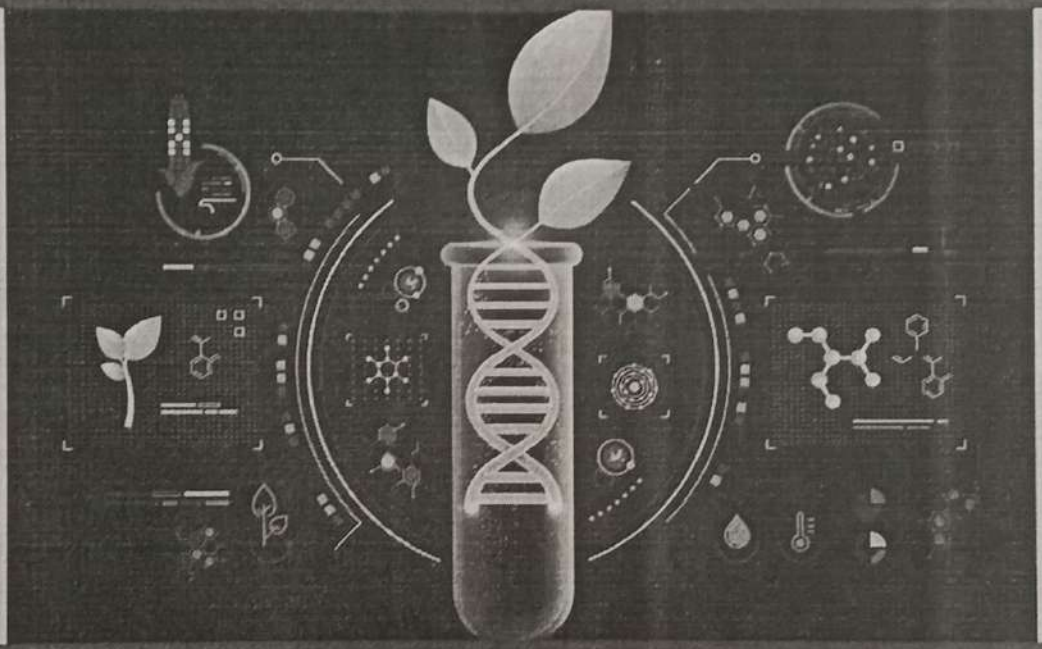

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CHAPTER

18

Use of plant-defense hormones against pathogen diseases

Priya Sutaoney[1,8], *Dhananjay Pandey*[2], *Veenu Joshi*[1], *Amber Vyas*[3], *Neelu Joshi*[4], *Kamal Shah*[5], *Durgesh Nandini Chauhan*[6] and *Nagendra Singh Chauhan*[7]

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List of abbreviations

4-CL 4-coumarate CoA ligase
ABA Abscisic acid
ACC 1-aminocyclopropane-1-carboxylic acid
APX ascorbic acid peroxidise
BPH brown plant hopper
BR brassinosteroids
C4H cinnamate-4-hydroxylase
CAT catalases
CHI chitinase
CHS chalcone synthase
CK cytokinin
Cmm *Clavibacter michiganensis* subsp. *michiganensis*
D-E-L-L-A aspartic acid–glutamic acid–leucine–leucine–alanine
EBR 24-epibrassinolide
ET ethylene
FHB fusarium head blight

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CHAPTER

11

Signaling crosstalk between cytokinins and abscisic acid in plant defense, growth, and development

Veenu Joshi[1], *Akanksha Sahu*[1], *Neelu Joshi*[2], *Amber Vyas*[3], *Kamal Shah*[4], *Durgesh Nandini Chauhan*[5] and *Nagendra Singh Chauhan*[6]

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1. Introduction

As the plants are immobile in nature, they are more vulnerable to various biotic including bacterial and fungal pathogens, herbivores, and insects as well as abiotic entities of their surrounding environment like drought, salinity, low or high temperatures, and heavy metals. The plants have the ability to adapt themselves to the changing environment through the highly complex and intricate working of the phytohormones (Husen, 2021a,b; Siddiqi and Husen, 2017, 2019, 2021). Phytohormones are the hormones produced by plants similar to animals which play indispensable roles in various physiological processes regulating their growth and development. These are low molecular weight biomolecules synthesized in low concentration including cytokinins, auxins, gibberellins, abscisic acid, ethylene, salicylic acid, jasmonates, and brassinosteroids. Out of these, auxins, gibberellins, abscisic acid, and cytokinins, ethylene constitutes the major category of hormones playing key roles in various growth and development-related processes. Auxins have an intense effect on plant growth and development; it has the ability to stimulate differential growth in response to gravity

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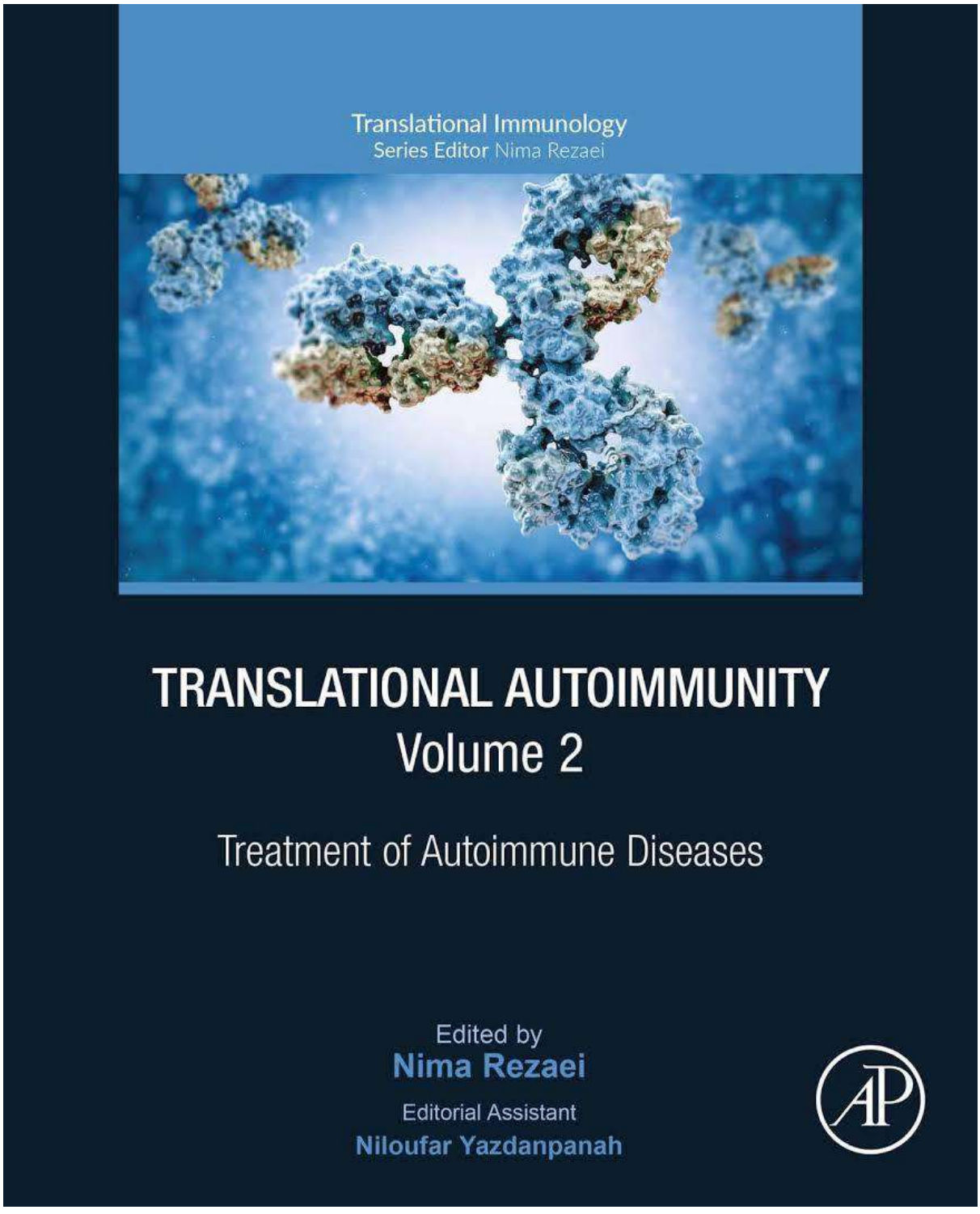

Translational Immunology Volume 2

TRANSLATIONAL AUTOIMMUNITY

Treatment of Autoimmune Diseases

Edited by
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Translational Immunology series aimsto provide a comprehensive guide on the recent developments and discoveries to facilitate the employment of this information for clinical settings by approaching translational studies. It includes volumes that dive deep into the different fields of immunology in an attempt to translate immunology from bench to bedside and to present a comprehensive list of books that touch upon the full incorporation.

Translational Autoimmunity: Treatment of Autoimmune Diseases is the second volume of the Translational Immunology series. The book dives deep into the capability of immune system-directed therapies in autoimmunity. In addition, the efficacy and safety of the current biologic therapies and novel drug targets are discussed to provide a more comprehensive guide on the treatment strategies in autoimmune diseases. Therapeutic targeting of B and T regulatory cells, as well as immunomodulation effects of nanoparticles and organisms, is also the subject of discussion in this volume. Current understanding and future challenges of prognostic significance of the treatment in autoimmune diseases are also explored in the book.

Key Features

- Includes coverage of basic immunology, the clinical aspects of autoimmunity, and translational immunology studies in autoimmunity
- Presents key concepts supported by a systematic appraisal of the most recent evidence
- Assists students at all the academic levels while also applicable to scientists who work with autoimmunity
- Designed for learning, teaching, review and testing, practice, and research, and therefore might be useful for students, teachers and instructors, physicians, and researchers

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CHAPTER

16

Targeting autoimmune disorders through metal nanoformulation in overcoming the fences of conventional treatment approaches

Krishna Yadav[a], *Madhulika Pradhan*[b], *Deependra Singh*[a], *and Manju Rawat Singh*[a,*]

[a]University Institute of Pharmacy, Pt. Ravishankar Shukla University, Raipur, Chhattisgarh, India [b]Rungta College of Pharmaceutical Sciences and Research, Bhilai, Chhattisgarh, India

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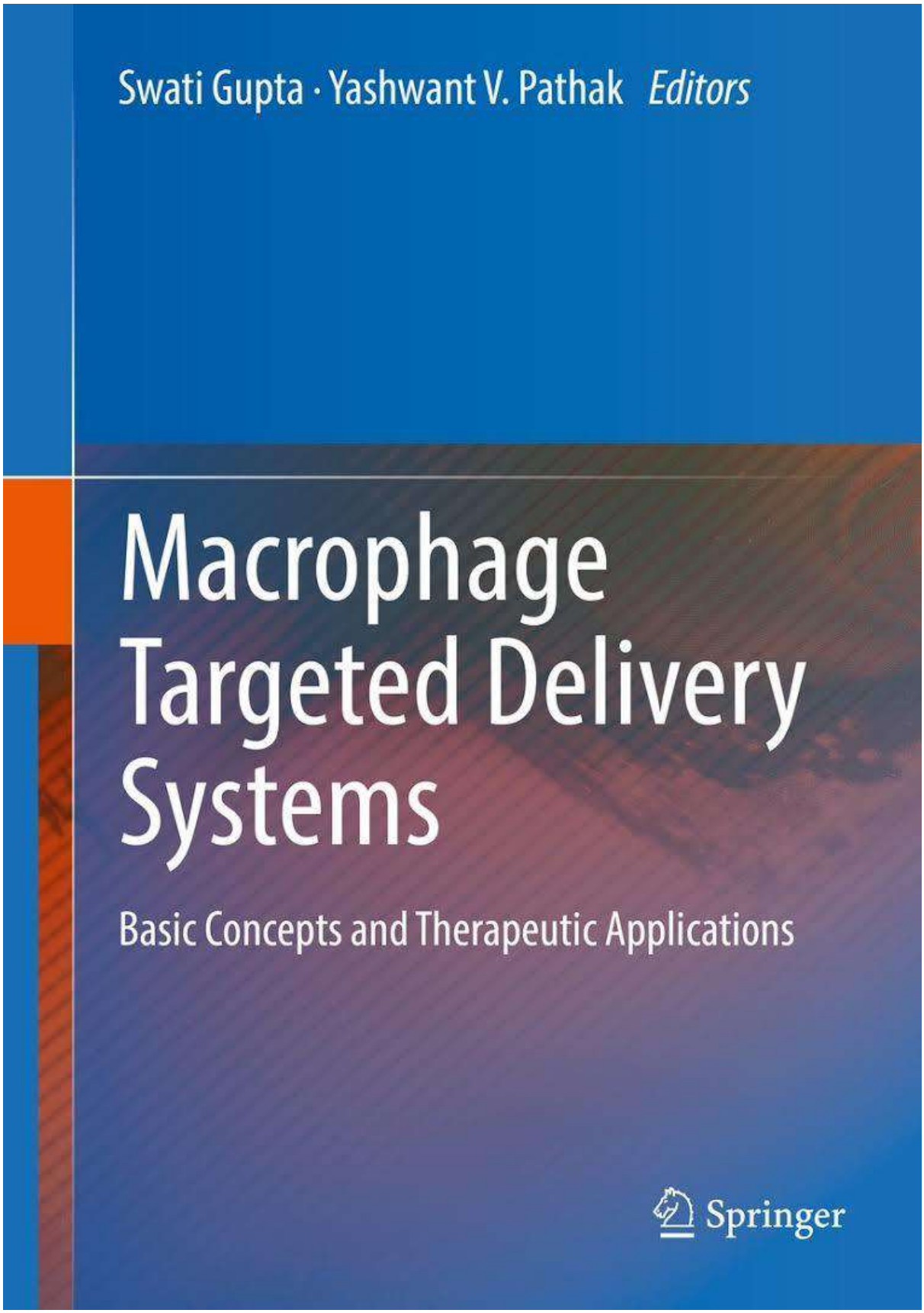
Abstract

Nanomedicine is a rapidly developing area of medicine with promising applications in molecular nanotechnology for safe, effective, and precise drug delivery. To date, many inorganic and polymeric nanoparticles (NPs) with and without surface modifications have been produced for selective drug delivery. An autoimmune disorder is a self-destructive immune cell condition that affects various body tissues and organs. Poor penetration and nonspecific delivery of therapeutic constituents to the targeted cells, which contributes to insufficient therapeutic effectiveness, is one of the main obstacles in targeting therapy for autoimmune diseases. Metallic nanoparticles provide a number of scopes in biomedical applications including diagnosis, treatment, and immunotherapy. Metal nanoparticles (MeNPs) (gold, silver, etc.) may suppress the immune system, causing a strong reaction to threatening cells. They are useful for drug targeting because of their nanosize, nontoxic properties, charge, and ease of high surface functionalization—all of which make them good carriers for drug transportation. This chapter intends to examine numerous strategic methods by integrating material science and immunobioengineering expertise for the safe and efficient delivery of metal-based nanoparticles for the treatment of various autoimmune disorders. Furthermore, the toxicity and safety issues of these metallic NPs are systematically presented.

Keywords

Metallic-nanoparticle, Autoimmune disorders, Nanomedicines, Targeting, Autoimmunity

2. Macrophage associated disorders: pathophysiology, treatment challenges and possible solutions.



Overview

The proposed book is envisioned for the nascent and entry-level researchers who are interested to work in the field of drug delivery and its applications specifically for macrophage targeting. Macrophages have gained substantial attention as therapeutic targets for drug delivery considering their major role in health and regulation of diseases. Macrophage-targeted therapeutics have now added significant value to the lives and quality of life of patients, without undue adverse effects in multiple disease settings. We anticipate examining and integrating the role of macrophages in the instigation and advancement of various diseases. The major focus of the book is on recent advancements in various targeting strategies using delivery systems or nanocarriers followed by application of these nanocarriers for the treatment of macrophage associated disorders.

Macrophage Targeted Delivery Systems is primarily targeted to Pharmaceutical Industry & Academia, Medical & Pharmaceutical Professionals, Undergraduate & Post graduate students and Research Scholars, Ph.D, post docs working in the field of medical and pharmaceutical sciences.

Product Details | About the Author | Table of Contents

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Macrophage-Associated Disorders: Pathophysiology, Treatment Challenges, and Possible Solutions

Krishna Yadav, Madhulika Pradhan, Deependra Singh, and Manju Rawat Singh

Abstract

Immune disorders are a self-attacking state of our defense mechanism influencing diverse body tissues and organs. One of the most significant obstacles in treatment for immune system ailments is the imprecise targeting of therapeutic molecules to the ideal cells due to a lack of insights into disease pathophysiology prompting deficient therapeutic viability. The activated macrophages are chieftain in immune reaction safeguarding the body from unauthorized invaders. They are ubiquitous in almost all autoimmune conditions finding a link between acquired and innate immunities. In recent days, understanding macrophage structural configuration and functioning has opened a new portal between the molecular aspects and their therapeutic targeting in the path of treatment. These have conceivably revolutionized the treatment pattern for autoimmune disorders from targeting perspectives. Even though macrophages are impending targets for immune disorders, the detailing related to their targeting approaches is still lacking. This chapter is an endeavor to summarize various key aspects of macrophage-associated disorders, pathophysiology, treatment challenges, and possible solutions for safe and compelling targeting of therapeutics in various immune disorders.

Keywords

Macrophage targeting · Nanoparticles · Surface modification · Autoimmune disorder

1 Introduction

Macrophages (MPs) are specialized mononuclear phagocytes that are differentiated from monocytes and that own more intracellular organelles within a large cell. They perform diverse functions ranging from sensing pathogens, phagocytosis, digesting cell debris, and initiation of inflammation by the release of cytokine molecules that subsequently activate other cells (Williams et al. 2018). Monocytes reside in the circulating blood, whereas MPs are present in the tissues. They have a comparatively long life span, and they produce diverse surface receptors and a variety of secretory products contributing to various inflammatory and anti-inflammatory responses. They acclimatize easily to any changes in their environment and support to maintain local and systemic homeostasis (Guilliams et al. 2014; Wynn and Vannella 2016).

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S. Gupta, Y. V. Pathak (eds.), *Macrophage Targeted Delivery Systems*,

3. Nanobiomaterials as novel modules in the delivery of artemisinin and its derivatives for effective management of malaria.

Natural Products in Vector-Borne Disease Management

Edited by
Nagendra Singh Chauhan
Durgesh Nandini Chauhan

Natural Products in Vector-Borne Disease Management

Edited by Nagendra Singh Chauhan and Durgesh Nandini Chauhan

Natural Products in Vector-Borne Disease Management explores the potential application of natural products in vector control and disease management. The chapters discuss the global impact of specific vector-borne diseases, gaps in management, and natural products in specific stages of development – discovery, optimization, validation, and preclinical/clinical development. Toxic effects and mechanisms of action are also discussed. This book also explores how therapeutic plant derivatives can be used to combat the vectors of infection and how natural products can be used to manage and treat vector-borne diseases like malaria, leishmaniasis, dengue, and trypanosomiasis.

With the inclusion of case studies on field and clinical applications and the contributions from experts in the field, *Natural Products in Vector-Borne Disease Management* is an essential resource to researchers, academics, and clinicians in parasitology, virology, microbiology, biotechnology, pharmacology, and pharmacognosy working in the field of vector-borne diseases.

Key Features

- Offers an alternative, natural approach to the prevention of vector-borne diseases
- Discusses the current and future perspectives of vector-borne diseases and natural product management
- Covers the properties of plants extracts and their phytoactives in vector-borne disease management
- Explores the advantages and disadvantages of natural products versus western medicine for treatment of vector-borne diseases

About the Editors

Dr. Nagendra Singh Chauhan obtained his MPharm and PhD from the Department of Pharmaceutical Sciences at Dr. Harisingh Gour University in Sagar, India. He has about 15 years of research experience and has professional expertise in natural product isolation. He is presently working as a senior scientific officer grade-II and government analyst at Drugs Testing Laboratory Avam Anusandhan Kendra, Raipur, Chhattisgarh, India. He has written more than 65 articles and 24 book chapters and has edited 4 books with publishers like Academic Press, CRC, and Wiley. He is a member of various professional and academic bodies like the Society of Pharmacognosy, International Natural Product Sciences Taskforce (INPST), Società Italo-Latinoamericana di Etnomedicina (SILAE), Institutional Human Ethics Committee, and Association of Pharmaceutical Teachers of India (APTI).

Durgesh Nandini Chauhan is presently working as an assistant professor at the Columbia Institute of Pharmacy, Raipur, Chhattisgarh, India. Mrs. Durgesh Nandini Chauhan has 15 years of academic (teaching) experience in pharmaceutical sciences at various institutes in India. She has taught subjects such as pharmaceutics, pharmacognosy, traditional concepts of medicinal plants, and drug delivery phytochemistry. She is a member of the Association of Pharmaceutical Teachers of India (APTI) and Società Italo-Latinoamericana di Etnomedicina (SILAE). She has written more than 10 publications in national and international journals and 15 book chapters and has edited 9 books. She is also active as a reviewer for several international scientific journals and an active participant in national and international conferences such as the International Convention of Society of Pharmacognosy.

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c0015 Chapter 18

Nanobiomaterials as novel modules in the delivery of artemisinin and its derivatives for effective management of malaria

Krishna Yadav[a,b], Deependra Singh[b], Manju Rawat Singh[b], Nagendra Singh Chauhan[c], Sunita Minz[d], and Madhulika Pradhan[e]

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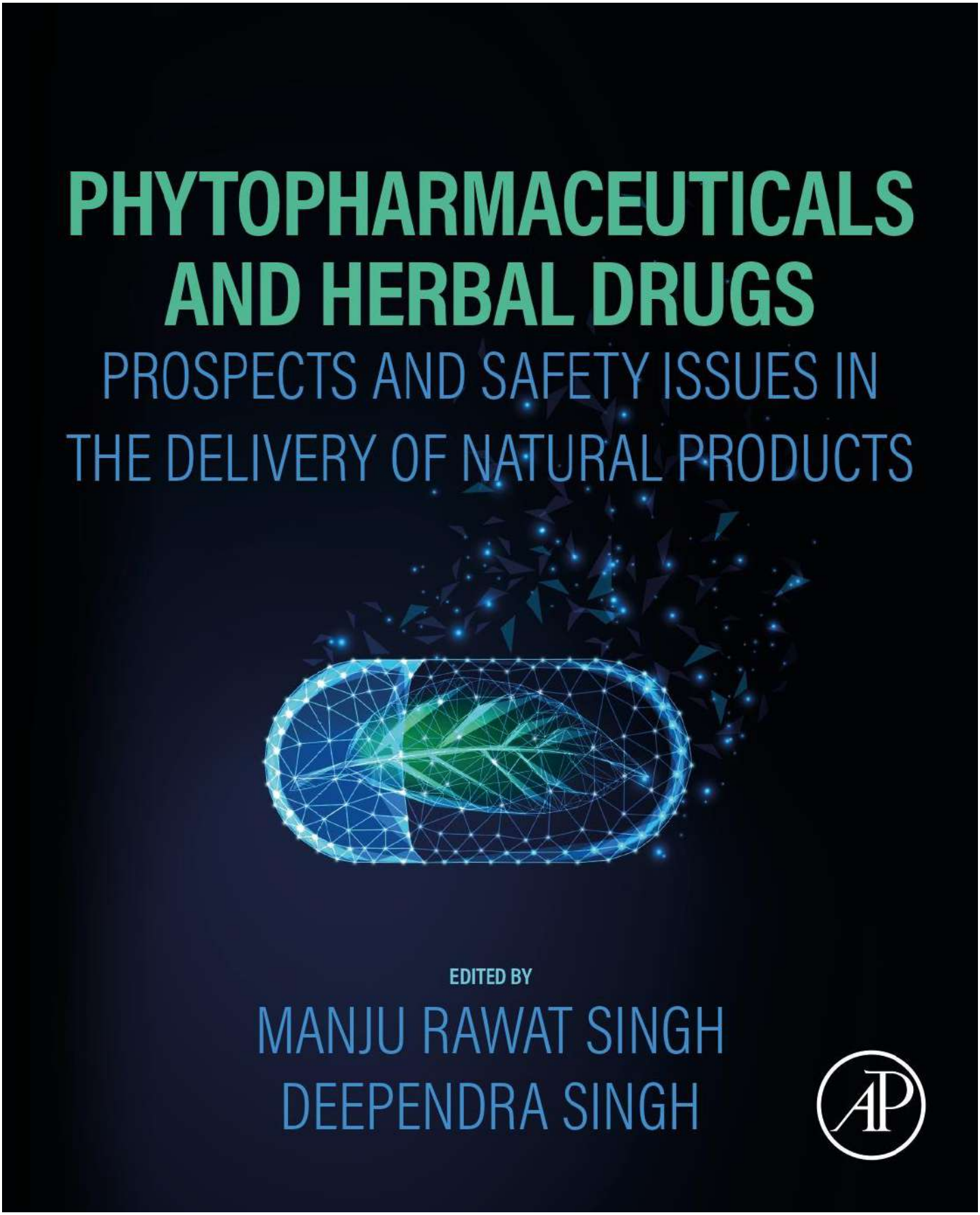
s0020 Introduction

p0020 The renowned herbal plant Artemisia annual is being utilized to get artemisinin (ARTM) which has the most potent medicinal assets. The medication has a sesquiterpene lactone structure with a focal peroxide bridge that distinguishes it from the different medications available. A number of its derivatives are semi-synthetic, for example, artemether, artesunate, arteether artenimol, and artelinic acid (Efferth, 2017; Fontinha et al., 2020; Mishra et al., 2021). ARTM and its analogs have different recuperative services. They are utilized to treat joint agony, liver issues, seizures, loss of hunger, and menstrual problems. They likewise have remedial effects against malignant growth and possess anti-inflammatory properties. It is similarly used to treat sleep deprivation and stomach-related issues and to assist with irritating skin issues and wounds. They are equally significant as antibacterial agents. They advance the development of healthy cells as well as prevent, annihilate, and control viral infections (Aderibigbe, 2017; Jung et al., 2004; Krishna et al., 2008). They are powerful against malaria and other protozoan infections. The utilization of ARTM in the treatment of malaria is exceptionally well yet not in trend due to its cost contrasted with other antimalarials (Anti-M) drugs and has low solvency and bioavailability, short half-life, toxic behavior, and possession of drug resistance (Aderibigbe, 2017; Talapko et al., 2019). Because of the pharmacological limitations mentioned

Natural Products in Vector-Borne Disease Management. https://doi.org/10.1016/B978-0-323-91942-5.00003-3

4. Worldwide health scenario from the perspective of herbal medicine research



PHYTOPHARMACEUTICALS AND HERBAL DRUGS

PROSPECTS AND SAFETY ISSUES IN THE DELIVERY OF NATURAL PRODUCTS

EDITED BY MANJU RAWAT SINGH AND DEEPENDRA SINGH

Phytopharmaceuticals and Herbal Drugs: Prospects and Safety Issues in the Delivery of Natural Products explores the delivery aspects of plant-based drugs, providing insight into the formulation constraints associated with plant-based drugs to the development of novel delivery systems based on polymers or lipids, combining natural products with technological advancements in drug delivery. Some of the best-selling drugs for the treatment of diseases like cancer, ulcer, and malaria are either natural products or their derivatives. *Phytopharmaceuticals and Herbal Drugs* will be useful to researchers working in plant-derived medicines and development of their delivery systems.

Herbal drugs are well known for their ancestral therapeutic potentials such as hypoglycemic, antimalarial, antidiabetic, antioxidant, antimicrobial, anticarcinogenic, anticholinergic, antiinflammatory, etc. However, there are certain limitations which can be overcome by the development of novel delivery systems. Drug delivery systems for plant actives and extracts is an extensive field and requires an encyclopedia to describe all the technologies. Considering these aspects, this book highlights the current scenarios related to the expansion of novel herbal formulations utilizing the novel technologies with their mechanism, methodology, and applications.

This volume compiles descriptions of important approaches used in the delivery of plant-based drugs. It will be an important source of information for pharmaceutical scientists, pharmacognosists, drug delivery scientists, and pharmacologists working in academia as well as in the industry dealing with plant-based drugs. The first objective is to provide the reader with a sound knowledge of the utility of plant-based drugs, the challenges faced practically, and to enrich potential activity by modifying and selecting appropriate delivery systems. The second aim is to develop an appreciation for the importance of safety, regulatory aspects, and clinical aspects dealing with plant-based drugs, and thirdly, introduction of the concept of healing through plant-based drugs for the benefit of every individual in the community along with development of new targeted drug delivery systems and their various applications.

Key Features

- Includes perspectives from academic and industry research
- Provides information on the safety, regulatory aspects, and clinical aspects of dealing with plant-based drugs
- Introduces developments of new targeted drug delivery systems and their various applications
- Provides detailed facts and information for all scientists dealing with medicinal plants and their utility
- Summarizes various delivery systems for plant actives and extracts, novel techniques for extraction, and the limitations, and importance, of herbal extracts and their safety considerations and standardization

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CHAPTER

2

Worldwide health scenario from the perspective of herbal medicine research

Anita Bhoi[1], *Shradha Devi Dwivedi*[2], *Deependra Singh*[2], *Manju Rawat Singh*[2] *and S. Keshavkant*[1]

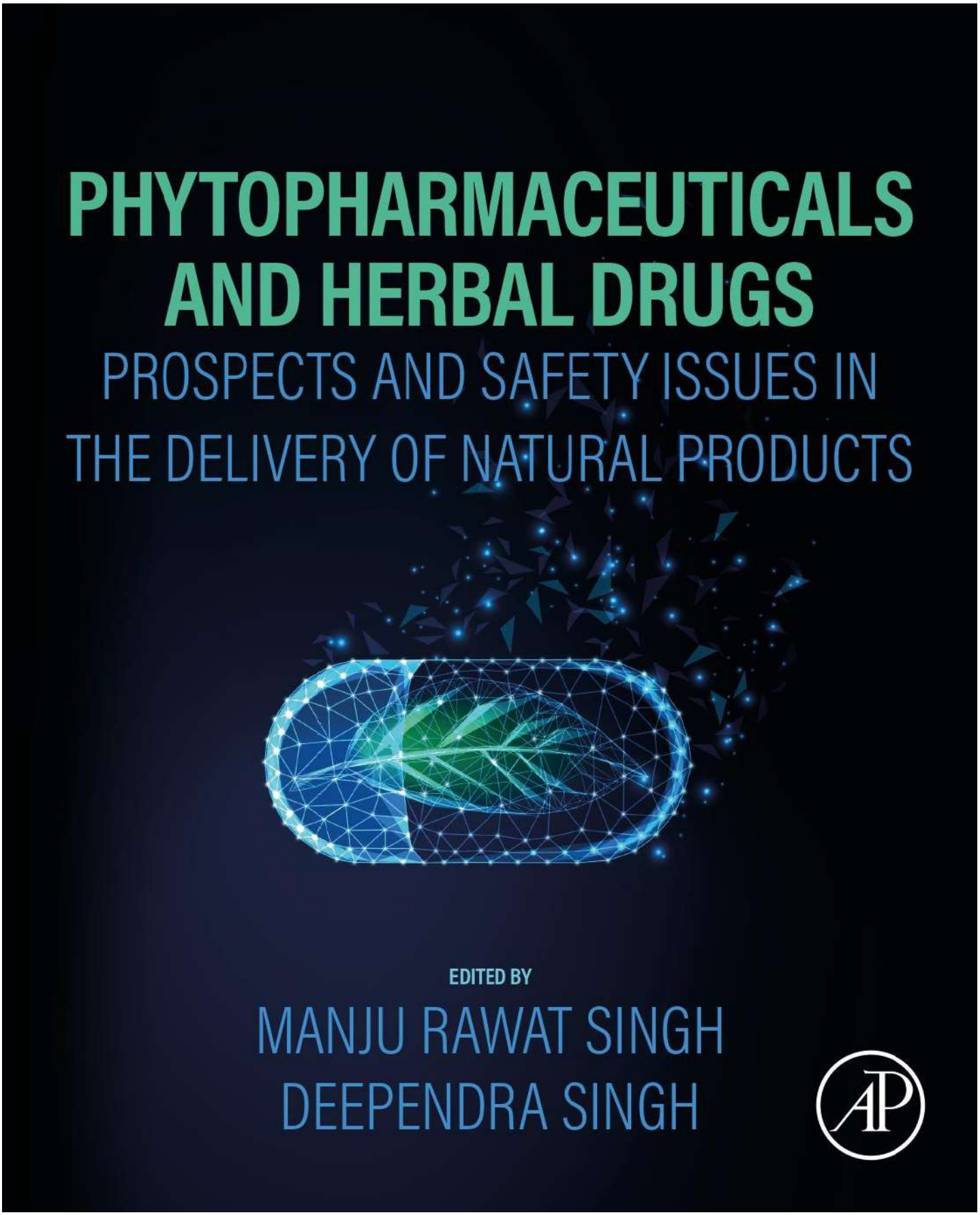
[1]School of Studies in Biotechnology, Pt. Ravishankar Shukla University, Raipur, Chhattisgarh, India; [2]University Institute of Pharmacy, Pt. Ravishankar Shukla University, Raipur, Chhattisgarh, India

1. Introduction

Traditional medicine is defined as knowledge, skills, and practices based on theories, beliefs, and experiences from various cultures that are used for health maintenance and improvement, diagnosis, prevention, or treatment of physical or mental illness [1]. The knowledge of traditional medicine has developed over generations within various societies before the era of modern medicine. So, for the treatment of chronic and acute diseases, these traditionally used plants can be explored effectively in order to find new chemical entities. Traditional medicines are also termed as indigenous or folk medicines [2]. These are naturally occurring, plant-derived drugs that have been utilized to treat ailments in local or regional healing traditions with little or no industrial processing. World Health Organization (WHO) revealed a survey report that world's 80% of population relies on traditional medicines for their primary healthcare requirements. Alternative medicine is getting more popular in developed countries, and it is growing progressively because of its efficacy, safety, and lack of adverse effects [3].

Phytopharmaceuticals and Herbal Drugs
https://doi.org/10.1016/B978-0-323-99125-4.00014-7

5. Lipid-based particulate systems for delivery of plant actives and extracts: Extraction, prospective carriers, and safety issues.



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CHAPTER

4

Lipid-based particulate systems for delivery of plant actives and extracts: Extraction, prospective carriers, and safety issues

Manju Rawat Singh[1], *Kusum Pradhan*[1], *Madhulika Pradhan*[2], *Krishna Yadav*[1,3], *Nagendra Singh Chauhan*[4], *Shradha Devi Dwivedi*[1] and *Deependra Singh*[1]

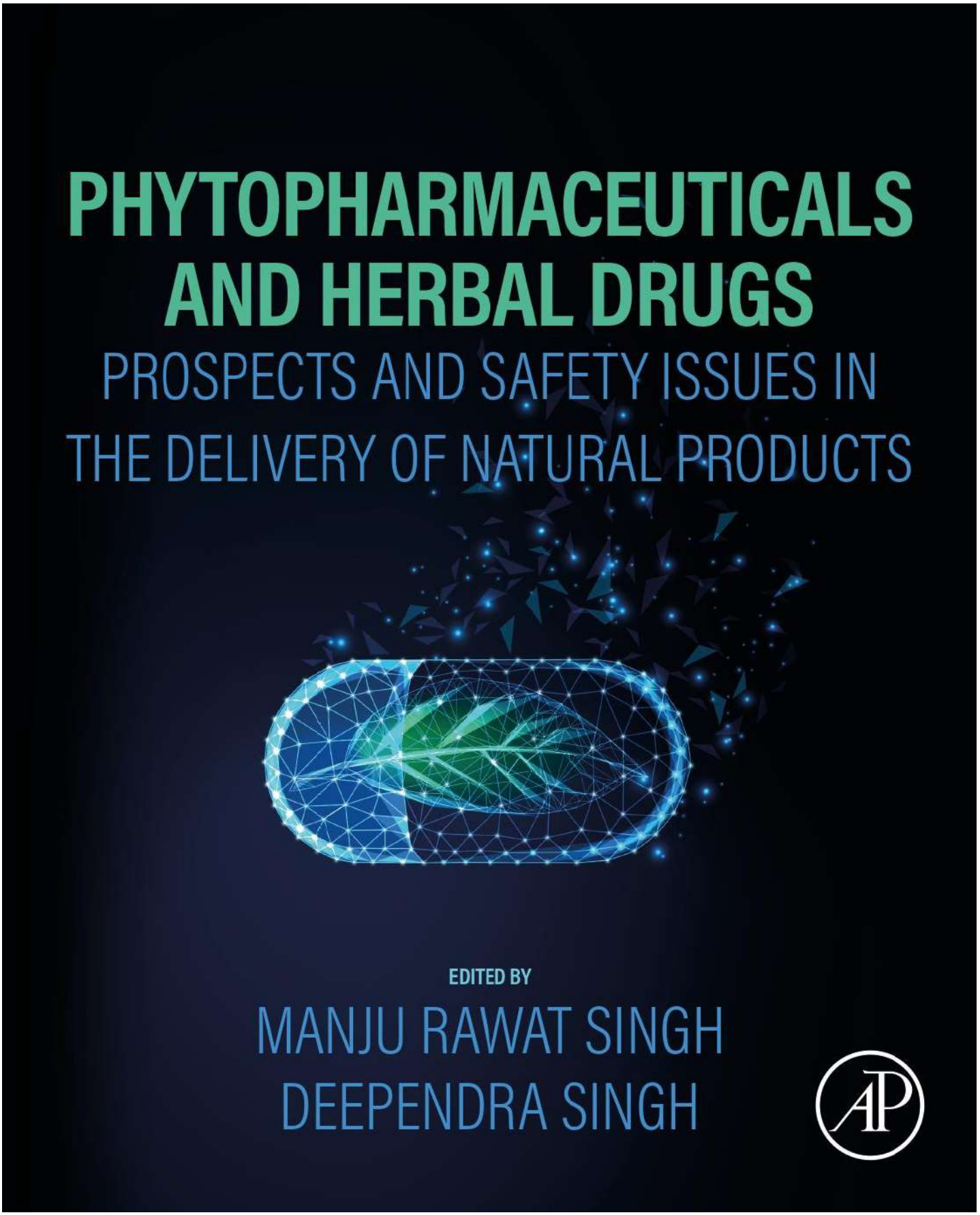
[1]University Institute of Pharmacy, Pt. Ravishankar Shukla University, Raipur, Chhattisgarh, India; [2]Rungta College of Pharmaceutical Sciences and Research, Bhilai, Chhattisgarh, India; [3]Raipur Institute of Pharmaceutical Education and Research, Raipur, Chhattisgarh, India; [4]Drugs Testing Laboratory, Avam Anusandhan Kendra (State Government Lab of AYUSH), Raipur, Chhattisgarh, India

1. Introduction

Modern biotechnology and pharmacotherapy recently developed more interest in the production of new therapeutic agents with a novel formulation originating from botanical sources [1]. Herbal medicines from natural sources share a major portion of traditional medicine and come in naturopathy. WHO also estimates that 65%–80% of the world's population depend on traditional medicine as primary health care medication system and 85% of these medicines involve the use of herbal preparations [2]. It is also estimated that about 25% of the drugs prescribed worldwide are derived from plants and application of these modern medicines directly correlate with their traditional use as herbal medicines [3].

Herbal drugs are gaining enhanced popularity in the modern world in curing various diseases due to less toxic and better therapeutic effects [4]. It has been increasingly common in recent years for herbals to be employed as the basis for new medicine development (Fig. 4.1).

6. Novel drug delivery approaches for improving therapeutic applications of berberine and berberine-rich herbal preparations.



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CHAPTER

16

Novel drug delivery approaches for improving therapeutic applications of berberine and berberine-rich herbal preparations

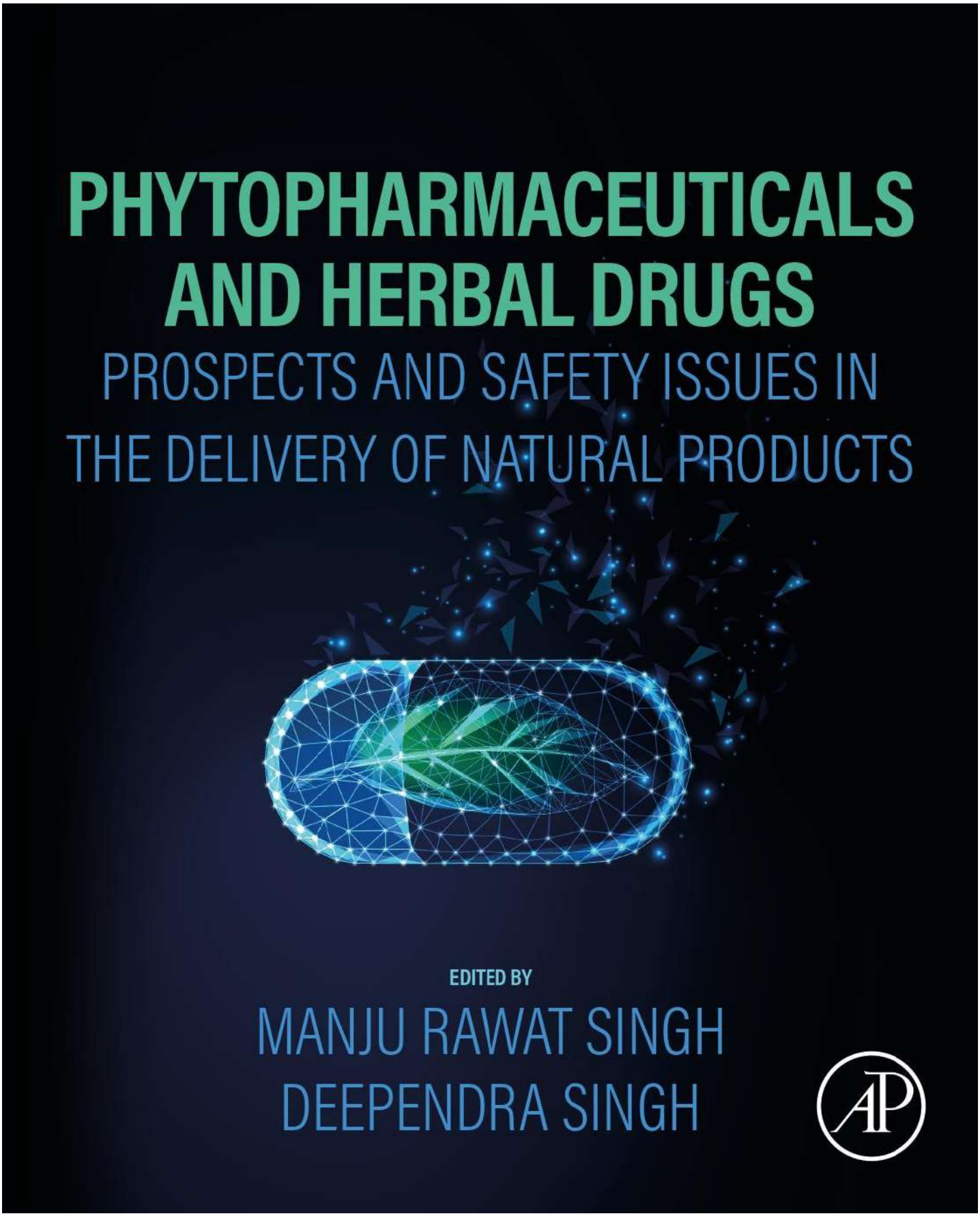
Deependra Singh[1,2], *Krishna Yadav*[1,4], *Manju Rawat Singh*[1], *Narayan D. Chaurasiya*[3] *and Babu L. Tekwani*[3]

[1]University Institute of Pharmacy, Pt. Ravishankar Shukla University, Raipur, Chhattisgarh, India; [2]NCNPR, School of Pharmacy, University of Mississippi, Olemiss, Oxford, MS, United States; [3]Department of Infectious Diseases, Division of Drug Discovery, Southern Research, Birmingham, AL, United States; [4]Raipur Institute of Pharmaceutical Education and Research, Raipur, Chhattisgarh, India

1. Introduction

Herbs and herbal drugs have drawn immense interest among people due to their clinically proven effects in curing a wide variety of communicable as well as noncommunicable diseases [1]. Herbal drugs are popular due to their safety profiles under clinical settings [2,3]. However, the complex nature of herbal preparations poses significant challenges and limitations regarding bioavailability, pharmacokinetics, and pharmacodynamics of principal active constituents [4,5] (Table 16.1). Conventional formulations have not been effective in avoiding these limitations. Furthermore, due to a lack of scientific rationale and processing challenges, such as standardization, extraction, and identification of specific medicinal components in complicated poly-herbal preparations, herbal medicines were not taken into account for development as new formulations [30]. However, the development of complex herbal medicine preparations as approved treatments requires scientific validation, development of standardized preparations, quality control, and systematic evaluations of the safety of herbal drugs. These requirements have paved the pathway for the development of novel drug

8. Commercial aspect and market potential of phytoactive products



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CHAPTER

20

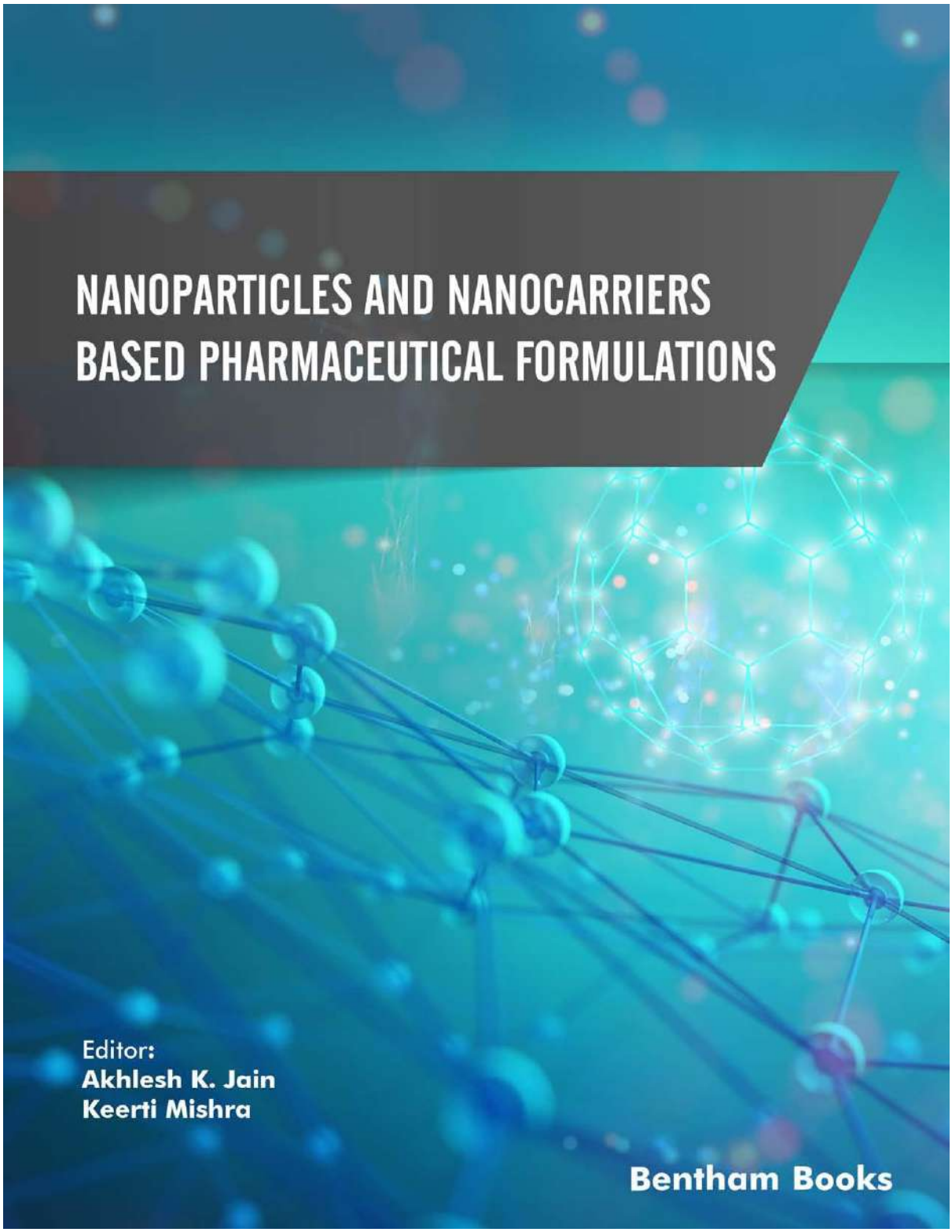
Commercial aspects and market potential of novel delivery systems for bioactives and biological agents

Krishna Yadav[1], *Manju Rawat Singh*[1], *Vineet Kumar Rai*[2], *Nidhi Srivastava*[2] *and Narayan Prasad Yadav*[2]

[1]University Institute of Pharmacy, Pt. Ravishankar Shukla University, Raipur, India
[2]CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow, India

20.1 Introduction

Drug delivery system with novel approaches is the boon to the success of pharmaceutical delivery of therapeutic active indisputably have strong commercial worth on the pharmaceutical market. Because of the immense benefit of novel drug delivery system (NDDS) including controlled delivery of medication, targeted delivery of active, reduction in dosing frequency, avoid repeated administration and hence increase patient's compliances, it became foremost choice for every delivery problems (Anselmo and Mitragotri, 2014; Pradhan et al., 2013). It also avails means of a patent extension of the delivery system that further enhances the value of new active agents. Several investigations have been done which revealed the clinical and commercial success stories (Martins et al., 2014). Currently, numerous commercial products are available in the market for different delivery approaches such as oral route, transdermal, ophthalmic, and depot injection worth a billion-dollar. However, the translation of these technologies from bench scales to commercial was never easy. Additionally, translation of these technologies is long-term process (Fig. 20.1), as proven by the some Food and Drug Administration (FDA) permitted products and early research that are in pipeline (Junghanns and Müller, 2008; Weissig and Guzman-Villanueva, 2015). There are multitudinous hurdles at each stride that can spell prompt failure, thus obstructing the clinical or commercial transformation of the various promising delivery system (Rai et al., 2014). Intense scholarly research has contributed diverse early-stage technologies for drug delivery. Most of the successful commercial drug delivery system is usually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CHAPTER 4

Nanocarriers For Drug Targeting

Bina Gidwani[1], Varsha Sahu[2], Priya Namdeo[2], Sakshi Tiwari[2], Atul Tripathi[4], Ravindra Kumar Pandey[1], Shiv Shankar Shukla[1], Veenu Joshi[3], Vishal Jain[2], Suresh Thareja[5] and **Amber Vyas[2,*]**

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Abstract: Drug targeting specific cells/tissues of the body without their becoming a part of the systemic circulation is a prominent area of research in drug delivery, with the main emphasis on improvement in formulation and development. Drug-targeting can improve the viability, lower/minimize the adverse/side effects, and can become cost-effective. Certain limitations like short circulating half-life, bioavailability issues, rapid metabolism and degradation, poor tissue distribution and penetration in the blood-brain barrier, intestinal absorption barriers, *etc*., are associated with the delivery of various therapeutic agents. Nanocarriers have arisen in the field of drug targeting with valuable delivery of drugs to site-specific/desired areas which is a significant therapeutic advantage since it keeps drugs from being conveyed to some unacceptable spots. Nanocarriers prevent the obstacles in clinical utilization of the therapeutic agents as they decrease the serious and critical side/adverse effects by targeted drug delivery and provide slow and sustained drug release. Nanocarriers bring new trust to drug targeting by upgrading the efficacy, defeating resistance, and minimizing toxicity. This chapter mainly focuses on the role and benefits of nanocarriers in drug-targeting and nanocarriers as prominent systems for targeting and delivering drugs to achieve maximum effects with improved therapeutic response.

Keywords: Bioavailability, Blood-brain barrier, Drug delivery, Drug efficacy, Drug resistance, Drug targeting, Half-life, Intestinal barrier, Metabolic degradation, Nanocarriers, Site of action, Site-specific targets, Sustained release, Targeted drug delivery, Tissue distribution.

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Akhlesh K. Jain & Keerti Mishra (Eds.)

CHAPTER 2

Polymeric Nanoparticles as Drug Delivery System: Basic Concepts and Applications

Sakshi Tiwari[1], Bina Gidwani[2], Priya Namdeo[1], Atul Tripathi[4], Ravindra Kumar Pandey[2], Shiv Shankar Shukla[2], Veenu Joshi[3], Vishal Jain[1], Vikas Kumar Jain[5] and **Amber Vyas[1,*]**

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Abstract: Delivering drugs through various delivery systems into the body for successful treatment of diseases is most entrancing deeds for the pharmaceutical analyst. Conventional drug delivery systems have various hindrances like loss of medication and poor bioavailability of drugs. Polymer-based nanocarriers such as polymeric nanoparticles upgrade bioavailability of drug, delivery of drug to specific site and improve solubility of drugs. They are widely explored as controlled, precise, sustained and continuous release systems for drug delivery and are easily incorporated and appropriate for practically all parts of nanomedicines and bring new trust in field of drug conveyance by redesigning drug viability and diminishing drug toxicity. This chapter mainly focuses on polymers and techniques engaged with advancement of polymer-based nanoparticles and their applications in therapeutic intervention.

Keywords: Bioavailability, Controlled release, Diagnosis, Dispersion, Drug delivery system, Drug efficacy, Drug toxicity, Diffusion, Polymeric nanoparticles, Macromolecules, Natural polymers, Nanoprecipitation, Interfacial polymerization, Synthetic polymers, Targeted drug delivery, Potent drug delivery, Polymerization, Sustained release, Treatment, Solvent evaporation.

INTRODUCTION

The intricacy of specific diseases and the related toxicity of certain therapies progressively request novel courses for drug conveyance [1]. In the mid of the twentieth century, Paul Ehrlich conjectured the concept of "Magic bullet" that has

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CHAPTER 10

Lipoidal Carrier as Drug Delivery System

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Abstract: The delivery system plays a vital role in managing the pharmacokinetics and pharmacodynamics of a drug. The size of the carrier system contributes to its pharmacological action. Lipid-based carriers refer to the formulations containing a dissolved or suspended drug in lipidic excipients. Lipoidal systems as carriers are achieving heights due to their significant lipid nature and the size of particles in the delivery system. The micro/nano-sized lipid-based carriers possess versatility in improving the physic-chemical properties of drugs. Also, they are biocompatible and can be administered through all possible routes. Lipid-based drug delivery carrier systems of new and existing formulations can be commercialized to achieve the desired range of product specifications. Solubility of the drug in various lipids is a key factor in the development of the delivery system. Lipids as functional excipients are compatible with solid, liquid, and semi-solid dosage forms. Besides improving/enhancing the solubility and bioavailability, lipids provide multiple broad-based applications in the pharmaceutical delivery system.

Keywords: Bioavailability, BCS Class, Cancer, Carriers, Delivery system, Lipids, Micro/nano, Pharmacokinetics, Pharmacodynamics, Solubility, Liposomes, Solid Lipid Nanoparticles, Nanostructured lipid carrier, Lipid-drug conjugate, Liposphere, Topical, Oral, Parenteral, Pulmonary, Protein/peptide.

INTRODUCTION

Lipoidal carrier is a versatile delivery platform, which has achieved a lot of attention in the current era. Lipoidal carriers are systems with significant

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Akhlesh K. Jain & Keerti Mishra (Eds.)

Advancements in Controlled Drug Delivery Systems

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Yulin University, China

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Chapter 10
Recent Advancement to Improve Intestinal Absorption of Macromolecular Drugs

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ABSTRACT

Therapy of many ailments such as malignancy hepatitis, AIDS, cardiovascular diseases are carried out by using biological macromolecular drugs such as fusion protein drugs and antibodies. The majority of macromolecular drugs are either proteins or peptides, which are made into solution or suspension and are administered through intravenous or subcutaneous route that are invasive and painful. A significant level of attention has been given to oral macromolecular drug delivery over the last 30 years. The major obstruction faced by macromolecular drugs administered through oral route is the physical and biochemical properties of the epithelial layer of the gastrointestinal tract, which acts as a boundary. The chapter focuses on the physiological hindrance faced by protein and peptide during their conveyance through the GIT. Moreover, discussion about techniques that are used for dodging the boundaries and for enhancing the penetration of drug through GIT have been done. These methodologies can be of great value for absorption of drugs like bio macromolecules through the intestines.

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10 Magnetic Quantum Dots for In-Vivo Imaging

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CHAPTER 4

DNA Fingerprinting for Identification and Standardization of Herbal Drugs

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Abstract: Herbal medicines are emerging as the bliss of the modern era for the treatment and welfare of the population owing to their safety, and minimum or lack of side effects. Keeping this perspective in mind, the quality of herbal medicines is equally important as allopathic medicines. To thwart the adulteration of herbal medicines with substandard or similar low-grade herbs is the prime objective of standardization for the maintenance of the quality of herbal medicines. Assessment of quality and purity of crude drugs using several parameters such as morphological, microscopical, physical, chemical & biological evaluation can be performed through standardization technique. A number of conventional standardization methods are available, but owing to their lackings in one or more aspects, modern standardization techniques are being opted for by many researchers nowadays. Amid all the novel standardization techniques, DNA fingerprinting method is the most important in the quality control of herbal medicines on account of its accuracy and consistency. DNA fingerprinting defines barcode-like DNA fragment patterns generated by multilocus probes after the electrophoretic parting of genomic DNA fragments. Hence, this chapter primarily emphasizes on DNA fingerprinting method as a tool for the standardization of herbal medicines.

Keywords: Fingerprinting, Herbal drug, Identification, Isolation, Standardization.

INTRODUCTION

Herbal drugs basically include natural plant-derived products that may be either herbs, minerals, vitamins, immunomodulators, antibacterial, or any other medicinal agent. They can be administered orally as solid or liquid or applied

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Raja Chakraborty & Saikat Sen (Eds.)

PHYTOPHARMACEUTICALS AND HERBAL DRUGS

PROSPECTS AND SAFETY ISSUES IN THE DELIVERY OF NATURAL PRODUCTS

EDITED BY

MANJU RAWAT SINGH

DEEPENDRA SINGH

PHYTOPHARMACEUTICALS AND HERBAL DRUGS

Prospects and Safety Issues in the Delivery of Natural Products

Edited by

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PHYTOPHARMACEUTICALS AND HERBAL DRUGS

PROSPECTS AND SAFETY ISSUES IN THE DELIVERY OF NATURAL PRODUCTS

EDITED BY MANJU RAWAT SINGH AND DEEPENDRA SINGH

Phytopharmaceuticals and Herbal Drugs: Prospects and Safety Issues in the Delivery of Natural Products explores the delivery aspects of plant-based drugs, providing insight into the formulation constraints associated with plant-based drugs to the development of novel delivery systems based on polymers or lipids, combining natural products with technological advancements in drug delivery. Some of the best-selling drugs for the treatment of diseases like cancer, ulcer, and malaria are either natural products or their derivatives. *Phytopharmaceuticals and Herbal Drugs* will be useful to researchers working in plant-derived medicines and development of their delivery systems.

Herbal drugs are well known for their ancestral therapeutic potentials such as hypoglycemic, antimalarial, antidiabetic, antioxidant, antimicrobial, anticarcinogenic, anticholinergic, antiinflammatory, etc. However, there are certain limitations which can be overcome by the development of novel delivery systems. Drug delivery systems for plant actives and extracts is an extensive field and requires an encyclopedia to describe all the technologies. Considering these aspects, this book highlights the current scenarios related to the expansion of novel herbal formulations utilizing the novel technologies with their mechanism, methodology, and applications.

This volume compiles descriptions of important approaches used in the delivery of plant-based drugs. It will be an important source of information for pharmaceutical scientists, pharmacognosists, drug delivery scientists, and pharmacologists working in academia as well as in the industry dealing with plant-based drugs. The first objective is to provide the reader with a sound knowledge of the utility of plant-based drugs, the challenges faced practically, and to enrich potential activity by modifying and selecting appropriate delivery systems. The second aim is to develop an appreciation for the importance of safety, regulatory aspects, and clinical aspects dealing with plant-based drugs, and thirdly, introduction of the concept of healing through plant-based drugs for the benefit of every individual in the community along with development of new targeted drug delivery systems and their various applications.

Key Features

- Includes perspectives from academic and industry research
- Provides information on the safety, regulatory aspects, and clinical aspects of dealing with plant-based drugs
- Introduces developments of new targeted drug delivery systems and their various applications
- Provides detailed facts and information for all scientists dealing with medicinal plants and their utility
- Summarizes various delivery systems for plant actives and extracts, novel techniques for extraction, and the limitations, and importance, of herbal extracts and their safety considerations and standardization

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CHAPTER

10

Herbal drug interaction and effects on phytopharmaceuticals

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1. Introduction

Herbal medicines are widely preferred throughout the world because of their effectiveness, easy availability, economic consideration, and safety attributes. According to WHO, herbal medicines are defined as finished, labeled therapeutic products containing a single or blend of active ingredients acquired from plant parts whether in an unrefined state or as plant preparations. These herbal medicines are utilized in pretty much all aspects of world since the existence of humankind for the treatment of diseases with their own practice in each culture. As these medications are obtained from natural sources and this inclination has prompted the growth in usage of these herbal medicines [1,2]. The absence of information on the collaboration potential along with an underreporting of herbal use represents a test for medical services suppliers and a wellbeing worry for patients [3]. According to WHO estimates, the market for herbal products would be worth $5 trillion annually by 2050 [4]. The increment in number of drug interactions with the quantities of clinical items devoured simultaneously has shown danger in parts of the viability, security, and nature of herbal items are the subjects of ongoing discussions. Simultaneous administration of herbs might disrupt the impact of medications [5]. A decent comprehension of the herb-drug interaction is additionally fundamental for surveying and limiting clinical dangers. In spite of this high

CHAPTER 2

Polymeric Nanoparticles as Drug Delivery System: Basic Concepts and Applications

Sakshi Tiwari[1], Bina Gidwani[2], Priya Namdeo[1], Atul Tripathi[4], Ravindra Kumar Pandey[2], Shiv Shankar Shukla[2], Veenu Joshi[3], Vishal Jain[1], Vikas Kumar Jain[5] and **Amber Vyas[1,*]**

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Keywords: Bioavailability, Controlled release, Diagnosis, Dispersion, Drug delivery system, Drug efficacy, Drug toxicity, Diffusion, Polymeric nanoparticles, Macromolecules, Natural polymers, Nanoprecipitation, Interfacial polymerization, Synthetic polymers, Targeted drug delivery, Potent drug delivery, Polymerization, Sustained release, Treatment, Solvent evaporation.

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The intricacy of specific diseases and the related toxicity of certain therapies progressively request novel courses for drug conveyance [1]. In the mid of the twentieth century, Paul Ehrlich conjectured the concept of "Magic bullet" that has

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Akhlesh K. Jain & Keerti Mishra (Eds.)

CHAPTER 4

Nanocarriers For Drug Targeting

Bina Gidwani[1], Varsha Sahu[2], Priya Namdeo[2], Sakshi Tiwari[2], Atul Tripathi[4], Ravindra Kumar Pandey[1], Shiv Shankar Shukla[1], Veenu Joshi[3], Vishal Jain[2], Suresh Thareja[5] and **Amber Vyas[2,*]**

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Keywords: Bioavailability, Blood-brain barrier, Drug delivery, Drug efficacy, Drug resistance, Drug targeting, Half-life, Intestinal barrier, Metabolic degradation, Nanocarriers, Site of action, Site-specific targets, Sustained release, Targeted drug delivery, Tissue distribution.

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Nanoparticles and Nanocarriers Based Pharmaceutical Formulations

Lipoidal Carrier as Drug Delivery System

Author(s): Bina Gidwani, Priya Namdeo, Sakshi Tiwari, Atul Tripathi, Ravindra Kumar Pandey, Shiv Shankar Shukla, Veenu Joshi, Vishal Jain, Suresh Thareja and Amber Vyas *

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Abstract

The delivery system plays a vital role in managing the pharmacokinetics and pharmacodynamics of a drug. The size of the carrier system contributes to its pharmacological action. Lipid-based carriers refer to the formulations containing a dissolved or suspended drug in lipidic excipients. Lipoidal systems as carriers are achieving heights due to their significant lipid nature and the size of particles in the delivery system. The micro/nano-sized lipid-based carriers possess versatility in improving the physic-chemical properties of drugs. Also, they are biocompatible and can be administered through all possible routes. Lipid-based drug delivery carrier systems of new and existing formulations can be commercialized to achieve the desired range of product specifications. Solubility of the drug in various lipids is a key factor in the development of the delivery system. Lipids as functional excipients are compatible with solid, liquid, and semi-solid dosage forms. Besides improving/enhancing the solubility and bioavailability, lipids provide multiple broad-based applications in the pharmaceutical delivery system.

Keywords: Bioavailability, BCS Class, Cancer, Carriers, Delivery system, Lipids, Micro/nano, Pharmacokinetics, Pharmacodynamics, Solubility, Liposomes, Solid Lipid Nanoparticles, Nanostructured lipid carrier, Lipid-drug conjugate, Liposphere, Topical, Oral, Parenteral, Pulmonary, Protein/peptide.

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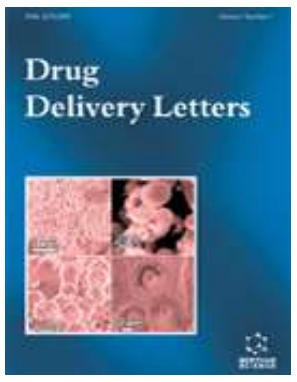

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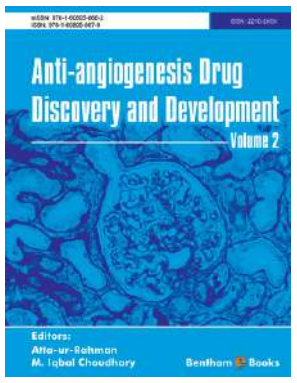

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2023, Pages 305-334

Chapter 18 - Use of plant-defense hormones against pathogen diseases

Priya Sutaoney [1 8], Dhananjay Pandey [2], Veenu Joshi [1], Amber Vyas [3], Neelu Joshi [4], Kamal Shah [5], Durgesh Nandini Chauhan [6], Nagendra Singh Chauhan [7]

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Abstract

Plants are constantly exposed to biotic stress in their natural surroundings. A wide variety of pathogens, viz. bacteria, fungi, and viruses repeatedly attack plants, which leads decline in their ability to survive. Plants are the primary source of energy for most of the creatures on the earth and have developed different types of defense mechanisms that are triggered in response to pathogen attacks. Plants have evolved molecular mechanisms for detecting infections as well as activating disease resistance. Phytohormones are chemicals that act in a complex network to govern many aspects of plant development and reproduction and their response to abiotic stress. Recent studies have been developed in studying the molecular mechanisms of hormonal networking. Major progress has been accomplished in recognizing the chief components as well understanding defense hormones, viz. salicylic acid, jasmonic acid, and ethylene. Other hormones, viz. abscisic acid, auxins, gibberellins, cytokinins, and brassinosteroids, are also linked with plant defense signaling pathways. However, very less is known about their functions. This chapter encompasses the latest developments in understanding the function and regulation of these hormones, molecular mechanisms, and their synergistic and antagonistic interactions against various disease-causing pathogens.

Previous Next

Keywords

Auxins; Cytokonins; Gibberellins; Jasmonic acid; Pathways; Plant defense; Salicylic acid

Hormonal Cross-Talk, Plant Defense and Development
Plant Biology, Sustainability and Climate Change
Plant Biology, sustainability and climate change
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Chapter 11 - Signaling crosstalk between cytokinins and abscisic acid in plant defense, growth, and development

Veenu Joshi [1], Akanksha Sahu [1], Neelu Joshi [2], Amber Vyas [3], Kamal Shah [4], Durgesh Nandini Chauhan [5], Nagendra Singh Chauhan [6]

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Abstract

Phytohormones are small low molecular weight signal compounds synthesized by plants that have crucial functions in growth, development, and physiological processes of the plant as well as defense response toward different stress conditions. The major phytohormones are auxins, cytokinins, gibberellins, abscisic acid, ethylene, salicylic acid, jasmonates, and brassinosteroids. The hormone signaling pathway triggered depends upon the type of stress. These signaling pathways are interlinked and controlled in such a complex manner that the crosstalk between different hormonal pathways is important to determine the type of response. Phytohormone cytokinins contribute to the development of shoot, regulation of nitrogen metabolism, and delaying senescence as well as in combating pathogen infection by triggering signaling pathways. Whereas, another hormone abscisic acid, which plays a pivotal role in dormancy and senescence, shows antagonistic action with cytokinin in regulating developmental processes and makes the plant prone to the pathogen attack. In this chapter, the roles of cytokinin and abscisic acid in developmental processes and regulating defense response against abiotic and biotic stresses have been discussed. Moreover, the chapter presents the recent studies focused on crosstalk among these hormones.

Previous
Next

Keywords

Abscissic acid; Crosstalk; Cytokinin; Gibberellins; Phytohormone; Plant defense

Carbon Allotropes and Composites: Materials for Environment Protection and Remediation

Chapter 11

Carbon Allotropes in Waste Decomposition and Management

Swati Sahu, Gajendra Singh Rathore, Sanjay Tiwari

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Fabrication and characterization of $CsSnI_3$ perovskite layer for solar cell applications

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ABSTRACT

Research of lead-free perovskite solar cells has gained speedy and growing attention with urgent intent to eliminate toxic lead in perovskite materials. The environmental friendliness and excellent thermal stability proves of stable perovskite Cesium Tin Iodide ($CsSnI_3$) as one of the promising materials for their potential application in solar field. In this paper, fabrication and characterization of $CsSnI_3$ perovskite layer has been reported. Fabrication of $CsSnI_3$ perovskite layer was made by spin coating method. One step coating processed $CsSnI_3$ layer have characterized by X-ray diffraction (XRD) and field-emission scanning electron microscopy (FESEM). Optical properties of layer have investigated by Vis-NIR spectrophotometer. It reveals that $CsSnI_3$ perovskite layer possess good absorption in the visible spectrum. XRD result confirms the crystal structure of orthorhombic phase with dominating peak at 27.5^0 ($2*\Theta$) corresponding (202) planes. Dense distributions of polycrystalline $CsSnI_3$ perovskite layer were recorded by FESEM images.

Keywords: Perovskite solar cells, fabrication, characterization, XRD, FESEM

1. INTRODUCTION

Perovskite solar cells (PSCs) have surpassed the power conversion efficiency (PCE) of 25%, marking a significant advancement in the conversion of solar energy to electricity[1]. Modern high PCE cells based on a perovskite photon absorber with lead incorporation have a structure of ABX_3 [A = Cs, MA (CH_3NH_3, methylammonium), or FA ($NH{=}CHNH_3$, formamidinium); X = I, Br, Cl. In ABX_3 structure, B indicates Pb metal which is widely used. But due to toxicity concerns for both humans and the environment, the exclusion of the heavy metal Pb is the essential task. However, when it is removed the effectiveness of these high-performing PSCs decreases. Pb-based halide perovskites are also being investigated for use in other applications, such as light-emitting diode (LED), photodetectors, solar cells, and transistors, because of their excellent optical and electrical qualities[2]. However, due to its toxicity, the usage of the Pb element could seriously hinder large production and commercialization. Additionally, the band gap (Eg) values of Pb-based halide perovskites are larger than the ideal Eg (1.34 eV) calculated from the Shockley-Queisser limit for single-junction solar-cell applications, ranging from 1.5 to 2.4 eV. As a result, it is essential to continue developing Pb-free halide perovskite materials with lower Eg. Many Pb-free halide perovskite derivatives have recently been investigated as alternatives, including ordered double perovskites ($A_2(I)(III)X_6$), layered Sb-based halide perovskites, molecular halide perovskites, and divalent Sn^-, Mn^-, and Ge^- based halide perovskites ($A(Sn, Mn, Ge)X_3$).. They are direct analogues of Pb-based halide perovskites with a three-dimensional crystal structure, and they also have narrower Eg values ranging from 1.2 to 2.2 eV. Among these, Sn-based halide perovskites is a particularly interesting alternative[3,4,5]. Moreover, among all the Pb-free halide perovskite materials, Sn-based halide perovskite solar cells have the greatest PCE of nearly 9%[6,7]. Due to the oxidation of Sn^{2+} to Sn^{4+} ions under an ambient-air condition, the stability and PCE of these PSCs are lower.

2. METHODOLOGY

Perovskite films can be synthesized by the solution method, vapor deposition method, compositional method, or crystal growth method. In the solution method, perovskite material is spin-coated by the one-step or two-step method.

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CHAPTER 2

Polymeric Nanoparticles as Drug Delivery System: Basic Concepts and Applications

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Abstract: Delivering drugs through various delivery systems into the body for successful treatment of diseases is most entrancing deeds for the pharmaceutical analyst. Conventional drug delivery systems have various hindrances like loss of medication and poor bioavailability of drugs. Polymer-based nanocarriers such as polymeric nanoparticles upgrade bioavailability of drug, delivery of drug to specific site and improve solubility of drugs. They are widely explored as controlled, precise, sustained and continuous release systems for drug delivery and are easily incorporated and appropriate for practically all parts of nanomedicines and bring new trust in field of drug conveyance by redesigning drug viability and diminishing drug toxicity. This chapter mainly focuses on polymers and techniques engaged with advancement of polymer-based nanoparticles and their applications in therapeutic intervention.

Keywords: Bioavailability, Controlled release, Diagnosis, Dispersion, Drug delivery system, Drug efficacy, Drug toxicity, Diffusion, Polymeric nanoparticles, Macromolecules, Natural polymers, Nanoprecipitation, Interfacial polymerization, Synthetic polymers, Targeted drug delivery, Potent drug delivery, Polymerization, Sustained release, Treatment, Solvent evaporation.

INTRODUCTION

The intricacy of specific diseases and the related toxicity of certain therapies progressively request novel courses for drug conveyance [1]. In the mid of the twentieth century, Paul Ehrlich conjectured the concept of "Magic bullet" that has

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CHAPTER 4

Nanocarriers For Drug Targeting

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Abstract: Drug targeting specific cells/tissues of the body without their becoming a part of the systemic circulation is a prominent area of research in drug delivery, with the main emphasis on improvement in formulation and development. Drug-targeting can improve the viability, lower/minimize the adverse/side effects, and can become cost-effective. Certain limitations like short circulating half-life, bioavailability issues, rapid metabolism and degradation, poor tissue distribution and penetration in the blood-brain barrier, intestinal absorption barriers, *etc*., are associated with the delivery of various therapeutic agents. Nanocarriers have arisen in the field of drug targeting with valuable delivery of drugs to site-specific/desired areas which is a significant therapeutic advantage since it keeps drugs from being conveyed to some unacceptable spots. Nanocarriers prevent the obstacles in clinical utilization of the therapeutic agents as they decrease the serious and critical side/adverse effects by targeted drug delivery and provide slow and sustained drug release. Nanocarriers bring new trust to drug targeting by upgrading the efficacy, defeating resistance, and minimizing toxicity. This chapter mainly focuses on the role and benefits of nanocarriers in drug-targeting and nanocarriers as prominent systems for targeting and delivering drugs to achieve maximum effects with improved therapeutic response.

Keywords: Bioavailability, Blood-brain barrier, Drug delivery, Drug efficacy, Drug resistance, Drug targeting, Half-life, Intestinal barrier, Metabolic degradation, Nanocarriers, Site of action, Site-specific targets, Sustained release, Targeted drug delivery, Tissue distribution.

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Akhlesh K. Jain & Keerti Mishra (Eds.)

Nanoparticles and Nanocarriers Based Pharmaceutical Formulations

Lipoidal Carrier as Drug Delivery System

Author(s): Bina Gidwani, Priya Namdeo, Sakshi Tiwari, Atul Tripathi, Ravindra Kumar Pandey, Shiv Shankar Shukla, Veenu Joshi, Vishal Jain, Suresh Thareja and Amber Vyas *

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Abstract

The delivery system plays a vital role in managing the pharmacokinetics and pharmacodynamics of a drug. The size of the carrier system contributes to its pharmacological action. Lipid-based carriers refer to the formulations containing a dissolved or suspended drug in lipidic excipients. Lipoidal systems as carriers are achieving heights due to their significant lipid nature and the size of particles in the delivery system. The micro/nano-sized lipid-based carriers possess versatility in improving the physic-chemical properties of drugs. Also, they are biocompatible and can be administered through all possible routes. Lipid-based drug delivery carrier systems of new and existing formulations can be commercialized to achieve the desired range of product specifications. Solubility of the drug in various lipids is a key factor in the development of the delivery system. Lipids as functional excipients are compatible with solid, liquid, and semi-solid dosage forms. Besides improving/enhancing the solubility and bioavailability, lipids provide multiple broad-based applications in the pharmaceutical delivery system.

Keywords: Bioavailability, BCS Class, Cancer, Carriers, Delivery system, Lipids, Micro/nano, Pharmacokinetics, Pharmacodynamics, Solubility, Liposomes, Solid Lipid Nanoparticles, Nanostructured lipid carrier, Lipid-drug conjugate, Liposphere, Topical, Oral, Parenteral, Pulmonary, Protein/peptide.

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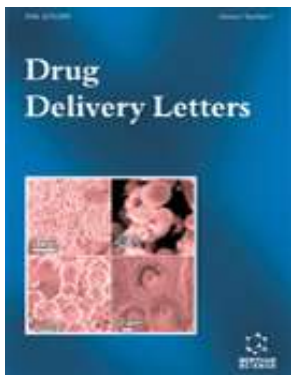

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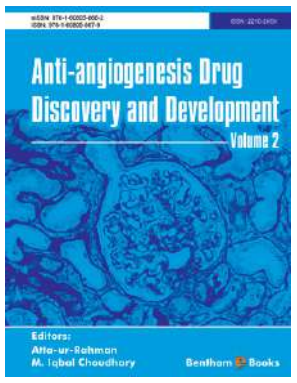

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Hormonal Cross-Talk, Plant Defense and Development
Plant Biology, Sustainability and Climate Change
Plant Biology, sustainability and climate change
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Chapter 18 - Use of plant-defense hormones against pathogen diseases

Priya Sutaoney [1 8], Dhananjay Pandey [2], Veenu Joshi [1], Amber Vyas [3], Neelu Joshi [4], Kamal Shah [5], Durgesh Nandini Chauhan [6], Nagendra Singh Chauhan [7]

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Abstract

Plants are constantly exposed to biotic stress in their natural surroundings. A wide variety of pathogens, viz. bacteria, fungi, and viruses repeatedly attack plants, which leads decline in their ability to survive. Plants are the primary source of energy for most of the creatures on the earth and have developed different types of defense mechanisms that are triggered in response to pathogen attacks. Plants have evolved molecular mechanisms for detecting infections as well as activating disease resistance. Phytohormones are chemicals that act in a complex network to govern many aspects of plant development and reproduction and their response to abiotic stress. Recent studies have been developed in studying the molecular mechanisms of hormonal networking. Major progress has been accomplished in recognizing the chief components as well understanding defense hormones, viz. salicylic acid, jasmonic acid, and ethylene. Other hormones, viz. abscisic acid, auxins, gibberellins, cytokinins, and brassinosteroids, are also linked with plant defense signaling pathways. However, very less is known about their functions. This chapter encompasses the latest developments in understanding the function and regulation of these hormones, molecular mechanisms, and their synergistic and antagonistic interactions against various disease-causing pathogens.

Previous Next

Keywords

Auxins; Cytokonins; Gibberellins; Jasmonic acid; Pathways; Plant defense; Salicylic acid

Hormonal Cross-Talk, Plant Defense and Development
Plant Biology, Sustainability and Climate Change
Plant Biology, sustainability and climate change
2023, Pages 149-170

Chapter 11 - Signaling crosstalk between cytokinins and abscisic acid in plant defense, growth, and development

Veenu Joshi [1], Akanksha Sahu [1], Neelu Joshi [2], Amber Vyas [3], Kamal Shah [4], Durgesh Nandini Chauhan [5], Nagendra Singh Chauhan [6]

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Abstract

Phytohormones are small low molecular weight signal compounds synthesized by plants that have crucial functions in growth, development, and physiological processes of the plant as well as defense response toward different stress conditions. The major phytohormones are auxins, cytokinins, gibberellins, abscisic acid, ethylene, salicylic acid, jasmonates, and brassinosteroids. The hormone signaling pathway triggered depends upon the type of stress. These signaling pathways are interlinked and controlled in such a complex manner that the crosstalk between different hormonal pathways is important to determine the type of response. Phytohormone cytokinins contribute to the development of shoot, regulation of nitrogen metabolism, and delaying senescence as well as in combating pathogen infection by triggering signaling pathways. Whereas, another hormone abscisic acid, which plays a pivotal role in dormancy and senescence, shows antagonistic action with cytokinin in regulating developmental processes and makes the plant prone to the pathogen attack. In this chapter, the roles of cytokinin and abscisic acid in developmental processes and regulating defense response against abiotic and biotic stresses have been discussed. Moreover, the chapter presents the recent studies focused on crosstalk among these hormones.

Previous
Next

Keywords

Abscissic acid; Crosstalk; Cytokinin; Gibberellins; Phytohormone; Plant defense