3.3.2 Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during last five year

Sl No.	Name of the teacher	Title of the book/chapters published	National/international	Year of publication	ISBN/ISSN number of the proceeding	Affiliating institute at the time of publications	Name of the publisher
1	Dr. Manjunath PM,Dr. Uday Raj Sharma	Text book of Pharmacology II	National	2019	ISBN -N3998	ABMRCP	Nirali Prakashan, 1312, Abhyudaya Pragathi, Shivagi Nagar, Off JM Road, Pune Maharashtra-411005
2	Dr. Manjunath PM,Priyanka P.	Practical manual of Pharmacology II	National	2019	ISBN - N4002	ABMRCP	Nirali Prakashan, 1312, Abhyudaya Pragathi, Shivagi Nagar, Off JM Road, Pune Maharashtra-411005
3	Dr. Manjunath PM,Dr.Haribabu T	Practical manual of Pharmacology III	National	2019	ISBN -N4093	ABMRCP	Nirali Prakashan, 1312, Abhyudaya Pragathi, Shivagi Nagar, Off JM Road, Pune Maharashtra-411005
4	Mr. Pulak Majumder	Pharmaceutical Microbiology	National	2019	ISBN9788176603409	ABMRCP	Everest Publishing House
5	Dr Venkatesh DP,Dr. B PrakashRao	INTRO DUCTION TO BIOPHARMACEUTICS AND PHARMACOKINETICS	National	2020	ISBN 938994459-7	ABMRCP	Nirali Prakashan, 1312, Abhyudaya Pragathi, Shivagi Nagar, Off JM Road, Pune Maharashtra-411005
6	Dr. Manjunath PM,Dr. Uday Raj Sharma	Text book of Pharmacology III	National	2020	ISBN -N4083	ABMRCP	Nirali Prakashan, 1312, Abhyudaya Pragathi, Shivagi Nagar, Off JM Road, Pune Maharashtra-411005
7	Dr. Sateesha SB	Physical Pharmaceutics-Principles of Formulation	National	2020	978-81-944400-8-6	ABMRCP	Emmess Medical Publishers, #33/2, griund floor 9th A cross, west of chord road, bengaluru-560086
8	Dr. Manjunath P M,Dr. Uday Raj Sharma	Pharmacology (second year Diploma in Pharmacy)	National	2020	ISBN-9354517129	ABMRCP	Nirali Prakashan, 1312, Abhyudaya Pragathi, Shivagi Nagar, Off JM Road, Pune Maharashtra-411005
9	Dr. Manjunath P M	Practical book of Pharmacology	National	2020	ISBN-9354517307	ABMRCP	Nirali Prakashan, 1312, Abhyudaya Pragathi, Shivagi Nagar, Off JM Road, Pune Maharashtra-411005

10	Dr Manjunatha PM, Mrs Nageena Taj,Mrs Priyanka Pamba	TEXT BOOK OF PHARMACOLOGY-I	National	2021	ISBN -978-81-951022-5-9	ABMRCP	Emmess medical publishers, Bangalore
11	Dr.Uday Raj Sharma, Dr. Divakar Goli	Pharma marketing management	National	2021	ISBN -978-93-5451-061-8	ABMRCP	Nirali Prakashan, 1312, Abhyudaya Pragathi, Shivagi Nagar, Off JM Road, Pune Maharashtra-411005
12	Dr. Uday Raj Sharma,Dr. Divakar Goli	Pharmaceutical marketing Management	National	2021	978-93-81962-88-6	ABMRCP	Nirali Prakashan, 1312, Abhyudaya Pragathi, Shivagi Nagar, Off JM Road, Pune Maharashtra-411005
13	Dr. RAJESH R	Pharmaceutical Analysis-I	National	2021	978-93-84875-65-7	ABMRCP	Unnati Publications, 9, Sona Enclave, Modinagar (UP)-201204
14	Dr. Manjunath P M,Mrs. Nageena Taj,	Pharmacology-I Sem-IV, B.Pharma	National	2021	ISBN-935451143-0	ABMRCP	Nirali Prakashan, 1312, Abhyudaya Pragathi, Shivagi Nagar, Off JM Road, Pune Maharashtra-411005
15	Dr. Hemalatha K	A Text Book of Pharmacognosy and Phytochemistry vol-II	National	2023	ISBN-978-93-90620-41-8	ABMRCP	I.K International Pvt. Ltd.New Delhi

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SEMESTER-V

PHARMACOLOGY-II

Dr. MANJUNATHA P. MUDAGAL

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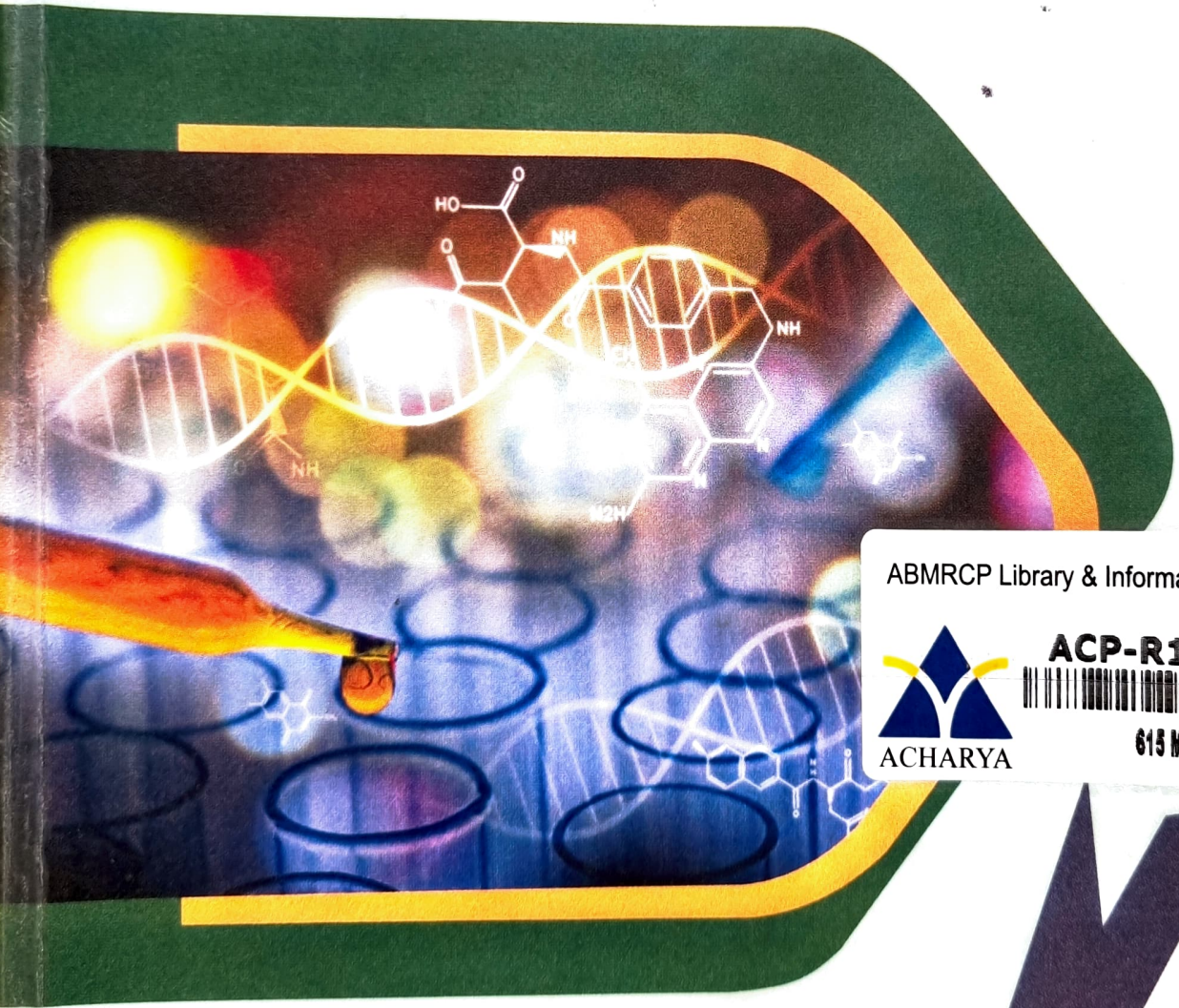

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Dr. Uday Raj Sharma
Associate Professor
Department of Pharmacology,
Acharya Dr. Sarvepalli Radhakrishna Road
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Preface

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Sincere efforts have been made to present theoretical aspects in details along with flowcharts/ pictorial for easy understanding the mechanism of actions of drugs and its pharmacological aspects. Most aspects are described stating examples with an intention to scaffold theoretical concepts and easy attempted during Pharmacology Practical sessions to various global organizations.

The major objective of this book is to provide students, collective information about subject in simple and lucid language. We have kept in mind the difficulties which the students generally face.

The salient features of the book are:

1. It covers all the topics prescribed in "**Bachelor of Pharmacy (B. Pharm) course regulations 2014**" by Pharmacy council of India.
2. The language used is simple and lucid.
3. Questions: The book contain MCQs, short, long questions on each chapter.

We hope that this book shall be found useful by the students and quick lessons for teaching faculty.

We are thankful to the management of Acharya & BM Reddy College of Pharmacy, Bengaluru for their keen interest and timely encouragement that made it possible to bring out this first volume.

We are highly indebted to **Dr. Divakar Goli**, Campus director, Acharya Institutes, Bengaluru for his constant motivation and guidance.

Suggestions and comments are always welcome and they shall be gratefully acknowledged.

Manjunatha P Mudagal

Uday Raj Sharma

■■■

Syllabus

Unit I **[10 Hrs.]**

1. Pharmacology of Drugs Acting on Cardio Vascular System

(a) Introduction to Hemodynamic and Electrophysiology of Heart.
(b) Drugs used in Congestive Heart Failure.
(c) Anti-hypertensive Drugs.
(d) Anti-anginal Drugs.
(e) Anti-arrhythmic Drugs.
(f) Anti-hyperlipidemic Drugs.

Unit II **[10 Hrs.]**

1. Pharmacology of Drugs Acting on Cardio Vascular System

(a) Drug used in the Therapy of Shock.
(b) Hematinics, Coagulants and Anticoagulants.
(c) Fibrinolytics and Anti-platelet Drugs.
(d) Plasma Volume Expanders.

2. Pharmacology of Drugs Acting on Urinary System

(a) Diuretics.
(b) Anti-diuretics.

Unit III **[10 Hrs.]**

3. Autocoids and Related Drugs

(a) Introduction to Autacoids and Classification.
(b) Histamine, 5-HT and their antagonists.
(c) Prostaglandins, Thromboxanes and Leukotrienes.
(d) Angiotensin, Bradykinin and Substance P.
(e) Non-steroidal Anti-inflammatory Agents.
(f) Anti-gout Drugs.
(g) Antirheumatic Drugs.

Unit IV **[08 Hrs.]**

5. Pharmacology of Drugs Acting on Endocrine System

(a) Basic Concepts in Endocrine Pharmacology.
(b) Anterior Pituitary Hormones-analogues and their Inhibitors.
(c) Thyroid Hormones-analogues and their Inhibitors.
(d) Hormones regulating Plasma Calcium LEVEL-Parathormone, Calcitonin and Vitamin-D.
(d) Insulin, Oral Hypoglycemic Agents and Glucagon.
(e) ACTH and Corticosteroids.

Unit V **[07 Hrs.]**

5. Pharmacology of Drugs Acting on Endocrine System

(a) Androgens and Anabolic Steroids.
(b) Estrogens, Progesterone and Oral Contraceptives.
(c) Drugs acting on the Uterus.

6. Bioassay

(a) Principles and Applications of Bioassay.
(b) Types of Bioassay
(c) Bioassay of Insulin, Oxytocin, Vasopressin, ACTH, d-Tubocurarine, Digitalis, Histamine and 5-HT.

■■■

Contents

■■■

Unit I

Chapter ... 1

Introduction to Hemodynamic and Electrophysiology of Heart

♦ LEARNING OBJECTIVES ♦

After completing this chapter, reader should be able to understand:

- *Pathophysiology of hypertension, atherosclerosis, arrhythmia.*

1.1 CARDIOVASCULAR HEMODYNAMICS

Haemodynamics is the term used to describe the interactions of the physiological parameters that govern the behaviour of the CVS.

1.1.1 Introduction

- The cardiovascular system is concerned with the circulation of the blood. Essentially it consists of heart, which works as pump, and the blood vessels, which carry the blood. The blood carries oxygen and nutrients, and circulates through various tissue of the body.
- The word **hemodynamics – means circulation of blood in the human body.**
- Cardiovascular hemodynamics comprises of blood circulation to the heart and in turn the blood circulation regulated by the heart.

1.1.2 Coronary Blood Flow

- Resting coronary blood flow in human average is approximately 225ml/minute, which is 0.7 to 0.8 ml per gram of the heart muscle.
- During the diastole, cardiac muscle relaxes completely and no longer obstructs the blood flow through left ventricular capillaries.
- This is phasic changes in coronary blood flow during cardiac muscle compression.
- During cardiac contraction – Intra myocardial pressure in the inner layer of the heart muscle is so much greater than the outer layer.
- It compresses the sub endocardial blood vessels far more than it compresses the outer vessel.

Control of Coronary Blood Flow:

- Oxygen demand is a major factor in local blood flow regulation.
- Determinants of oxygen consumption.
- Importance of increase in coronary blood flow in response to myocardial oxygen usage.
- Reactive hyperemia in coronary system.

About the Authors

Dr. Manjunatha P. Mudagal, M. Ph, Ph. D, Professor & HOD, Dept. of Pharmacology, Acharya & BM Reddy College of Pharmacy, Bengaluru. He is reputed teacher with more than 20 years of teaching experience to UGs and PGs. He has been a member of BOS-PG for Rajiv Gandhi University of Health Sciences, Bengaluru & Member secretary, Indian pharmaceutical association -Karnataka branch where advocacy issues will be discussed and resolved. He has received grants to tune of 1 crore from various funding agency and industry consultancy. He is technical consultant to various Pharmaceutical /Biotech/Ayurvedic/ phytochemical industry and till dated completed 52 nos. of consultancy to various industries. Guided 25+ M. Pharm students and published 25 research papers, of which several have been cited in peer revived journals.

Dr. Uday Raj Sharma has excellent academic career in Pharmacy. He is Associate Professor in the Department of Pharmacology at Acharya & BM Reddy College of Pharmacy, Bengaluru, Karnataka, India. He is having 15 Years of Experience in the field of Teaching, Research and Administration.

He has completed Masters in Pharmacology from Rajiv Gandhi University of Health Sciences, Bengaluru and Ph.D. from Acharya Nagarjuna University, Guntur. His Area of Expertise includes: Neuropharmacology and Oncology. He has published 18 National and 10 International publications in various journals. He has guided seven M. Pharm students for their dissertation work.

He is the author of book, Title- Pharmaceutical Marketing Management, with Nirali Prakashan, Pune, recipient of State and University Rank in Diploma, Bachelor and Master degree. He is a recipient of Distinguished Alumni award.

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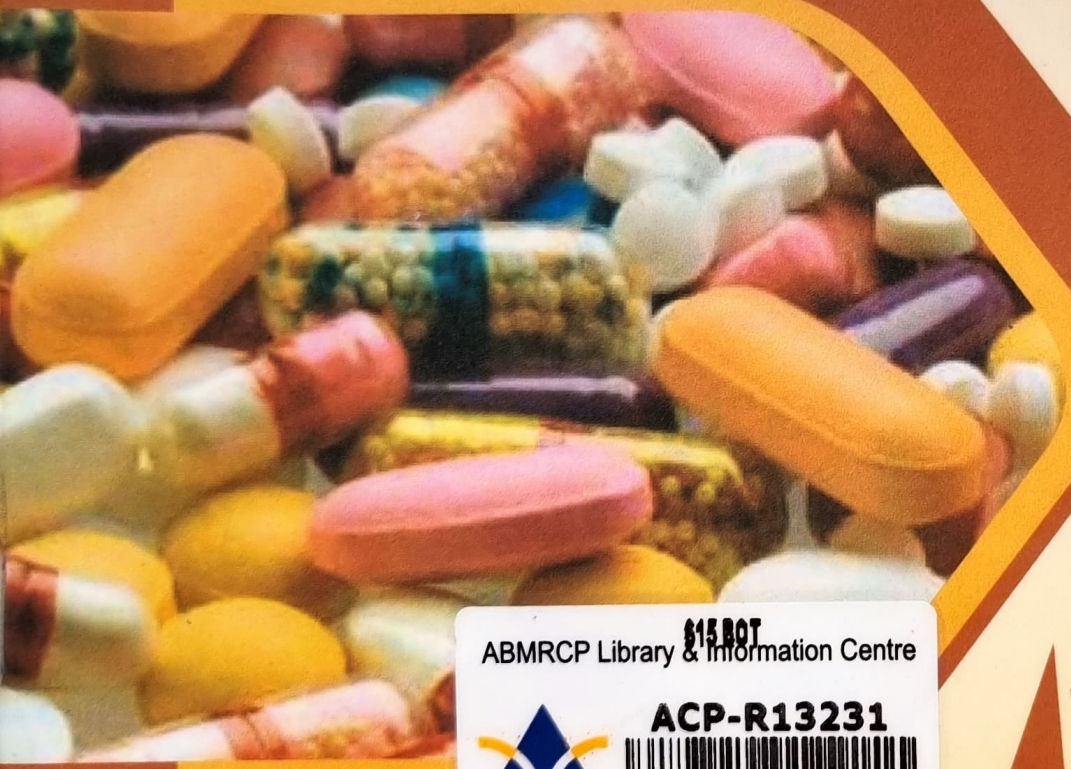

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Department of Pharmacology,
Acharya Dr. Sarvepalli Radhakrishna Road
Acharya PO, Soladevanahalli,
Bengaluru-560 107, Karnataka, India

Mrs. Pamba Priyanka
Assistant Professor
Department of Pharmacology,
Acharya Dr. Sarvepalli Radhakrishna Road
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Sincere efforts have been made to present experimental details along with pre-experimental aspects like information about laboratory appliances used in experimental pharmacology. Most experiments are described stating examples with an intention to scaffold experimental procedures attempted during Pharmacology Practical sessions to various global organizations.

Core concepts and underlying principles have been discussed for every experiment, making the practical study meaningful and helpful to understand the objective of the experiments. Diagramatic illustrations of the equipment, assembly used, dissection details, precautions and overcoming errors will act as a pragmatic guideline for the students.

We are thankful to the management of Acharya & BM Reddy College of Pharmacy, Bengaluru for their keen interest and timely encouragement that made it possible to bring out this first volume.

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Suggestions and comments are always welcome and they shall be gratefully acknowledged.

Dr. Manjunatha P Mudagal
Mrs. Pamba Priyanka

Syllabus

1. Introduction to *in-vitro* pharmacology and physiological salt solutions.
2. Effect of drugs on isolated frog heart.
3. Effect of drugs on blood pressure and heart rate of dog.
4. Study of diuretic activity of drugs using rats/mice.
5. DRC of acetylcholine using frog rectus abdominis muscle.
6. Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively.
7. Bioassay of histamine using guinea pig ileum by matching method.
8. Bioassay of oxytocin using rat uterine horn by interpolation method.
9. Bioassay of serotonin using rat fundus strip by three point bioassay.
10. Bioassay of acetylcholine using rat ileum/colon by four point bioassay.
11. Determination of PA_2 value of prazosin using rat anococcygeus muscle (by Schilds plot method).
12. Determination of PD_2 value using guinea pig ileum.
13. Effect of spasmogens and spasmolytics using rabbit jejunum.
14. Anti-inflammatory activity of drugs using carrageenan induced paw-edema model.
15. Analgesic activity of drug using central and peripheral methods

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Contents

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INTRODUCTION TO EXPERIMENTAL PHARMACOLOGY

Originating in the seminal work of German, French, and English physiologists, the discipline of pharmacology was formalized in the work of Ehrlich and Langley, who independently conceptualized the existence of *"receptive substances"* or receptors, on cells. This led to the seminal *"lock and key"* hypothesis that now, more than a century after publication, remains the unifying element for drug discovery irrespective of target type. Pharmacology, while overshadowed for a period of nearly three decades at the end of the 20th century by an overtly reductionist, biotechnology-driven focus on technology-based approaches, has now re-emerged at center stage as the driving force for successful drug discovery. Acting as central integrative discipline for the drug discovery process, pharmacology develops a hypothesis and then recruits the appropriate biological disciplines to gather information from in vitro, tissue, and whole animal systems to support or refute the hypothesis. Molecular pharmacology, molecular biology, pharmacokinetics, recombinant protein expression, cloning, cell transfection, behavior, and animal disease models are all disciplines used in pharmacology.

Pharmacology is based on three basic concepts :

1. The existence of specific molecular drug targets both on, and within, the cell.
2. Receptor theory based on the Law of Mass Action (LMA), defining the pharmacodynamic outcome of the ligand interaction with its cognate receptor(s)/ target(s) as being dose and concentration dependent, reversible, and selective; and
3. A null hypothesis – based integrative approach to experimentation.

Pharmacology, unlike molecular biology, is a quantitative rather than qualitative science, with compound activity being characterized in terms of its IC_{50}, EC_{50}, K_i, pA_2 value(s). These values reflect both pharmacokinetics (PK) and pharmacodynamic (PD) actions of the compound – the former representing the effect of the host environment on the NCE and the latter representing the effect of the NCE on the host environment.

Experiment No. 1 : Study of Laboratory Appliances used in Experimental Pharmacology

Aim : To study the laboratory appliances used in experimental pharmacology.

Laboratory appliances commonly used in experimental pharmacology :

Suturing needle :

These are mainly of two types :

- Cutting-edged suturing needle.
- Round-edged suturing needle.

These needles are of different sizes, which are used to suture the skin (cutting-edged) and other smooth muscles (round-edged).

Bull-dog clip : It is used to occlude blood vessels temporarily.

Fig. 1.1 : Bull-dog clip

About the Authors

Dr. Manjunatha P. Mudagal, M. Ph., Ph.D, Professor & HOD, Department of Pharmacology, Acharya & BM Reddy College of Pharmacy, Bengaluru. He is reputed teacher with more than | 20 years of teaching experience to UGs and PGs. He has been a member of BOS-PG for Rajiv Gandhi University of Health Sciences, Bengaluru & Member secretary, Indian pharmaceutical association -Karnataka branch where advocacy issues will be discussed and resolved. He has received grants to tune of 1 crore from various funding agency and industry consultancy. He is technical consultant to various Pharmaceutical /Biotech/Ayurvedic / phytochemical industry and till dated completed 52 nos. of consultancy to various industries. Guided 25+ M. Pharm students and published 25 research papers, of which several have been cited in peer revived journals.

Mrs. Pamba Priyanka, M. Pharm, Asst Professor, Department of Pharmacology, Acharya & BM Reddy College of Pharmacy, Bengaluru. She is reputed teacher with more than 09 years of teaching experience. She has been actively co-ordinated in consultant projects of various Ayurvedic/ Phytochemical Industry. Mentored M.Pharm and BAMS projects from the year 2014. She is skilled in *in-vitro, in-vivo*, *in-silico* and various pharmacological screening methods

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Department of Pharmacology,
Acharya Dr. Sarvepalli Radhakrishna Road
Acharya PO, Soladevanahalli,
Bengaluru-560 107, Karnataka, India

Mr. T. Hari Babu
Assistant Professor
Department of Pharmacology,
Acharya Dr. Sarvepalli Radhakrishna Road
Acharya PO, Soladevanahalli,
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Preface

It is our immense pleasure to bring out the "First Edition" of this book which is dedicated to the students and faculty of B. Pharma institutes of this country. This book is designed and edited in accordance to the syllabus requirement of **"Pharmacology-III"** of third year (6^{th} Semester) B. Pharm course in pharmacy prescribed in **"Bachelor of Pharmacy (B. Pharm) course regulations 2014"** by Pharmacy council of India.

Sincere efforts have been made to present experimental details along with pre-experimental aspects viz., vehicle of choice, drug dissolution and volume selection rational, preparation of stock solution and working standards with examples used in experimental pharmacology. Most experiments are described stating examples with an intention to scaffold experimental procedures attempted during Pharmacology Practical sessions to various global organizations.

Core concepts and underlying principles have been discussed for every experiment, making the practical study meaningful and helpful to understand the objective of the experiments. Certain experiments adopted with OECD guidelines, Illustrations with observational values for few experiments, precautions and overcoming errors will act as a pragmatic guideline for the students and make students better understanding with the concepts.

We are thankful to the **management** of **Acharya & BM Reddy College of Pharmacy, Bengaluru** for their keen interest and timely encouragement that made it possible to bring out this first volume.

We are highly indebted to **Dr. Divakar Goli**, professor & Mentor, Acharya & BM Reddy College of Pharmacy, Bengaluru for his constant motivation and guidance.

Suggestions and comments are always welcome and they shall be gratefully acknowledged.

Manjunatha P. Mudagal

T. Hari Babu

Syllabus

1. Dose calculation in pharmacological experiments.
2. Antiallergic activity by mast cell stabilization assay.
3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model.
4. Study of effect of drugs on gastrointestinal motility.
5. Effect of agonist and antagonists on guinea pig ileum.
6. Estimation of serum biochemical parameters by using semi-autoanalyser.
7. Effect of saline purgative on frog intestine.
8. Insulin hypoglycemic effect in rabbit.
9. Test for pyrogens (rabbit method).
10. Determination of acute oral toxicity (LD50) of a drug from a given data.
11. Determination of acute skin irritation / corrosion of a test substance.
12. Determination of acute eye irritation / corrosion of a test substance.
13. Calculation of pharmacokinetic parameters from a given data.
14. Biostatistics methods in experimental pharmacology (student's t test, ANOVA).
15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test).

Contents

Experiment No. 01
Dose Calculation in Pharmacological Experiments

Aim: *To calculate dose in Pharmacological Experiments.*

Introduction:

Experimental animals have been of very important tools in the history of non-human research models for scientific purposes in almost every aspect of biomedical, behavioral researches and testing conducted in Colleges, Universities, Medical schools, Pharmaceutical companies, Research institutes, Farms and Commercial facilities that provide animal-testing services to industry. Experiments on animals are necessary in drugs discovery and development as well as to advance medical and biological knowledge. Dosage calculation and stock solution preparation based on dosage rationale formula are prerequisites to drug administration in experimental animals. However, drugs dosage calculations and stock solution preparations are not clearly explained in most scientific literatures involving the use of experimental animals, and this is a major challenge to some undergraduate students, post-graduate students and other researchers. Since over 90% of animals used in *in-vivo* experiments in medical, physiological, pharmacological, chemical, toxicological, biological, biochemical and genetic studies are rats and mice, this work is aimed to simplify calculation of doses, preparation of stock solution in experimental animal for the benefits of all researchers.

(a) Vehicle of choice, drugs dissolution and volume selection rationale:

- A vehicle is any substance that acts as a medium in which a drug is administered.
- Vehicle, which is an essential consideration in all animal research should be biologically inert, have no toxic effects on the animals and not also influence the results obtained for the compound under investigation. Example of suitable vehicles for animal research include; water, normal saline (0.9% sodium chloride), 50% polyethylene glycol, 5 to 10% Tween 80, 0.25% methyl cellulose or carboxy methyl cellulose (CMC).
- In most researches involving experimental animals, dosages are usually calculated from stock solution of the test drugs dissolved in appropriate volume of solvent (vehicle).
- According to the OECD's (Organization of Economic Co-operation and Development) guidelines, dosage of drug (mg) should be constituted in an appropriate volume not usually exceeding 10 ml/kg (1 ml/100 g) body weight of experimental animals (mice and rats) for non-aqueous solvent in oral route of administration.
- In the case of aqueous solvents, 20 ml/kg (2 ml/100 g) body weight can be considered (OECD, 2000).
- Large dose volumes (40 ml/kg body weight) can cause unnecessary stress to animals and can also overload the stomach capacity and pass immediately into the small bowel or can result in passive reflux in the stomach, aspiration pneumonia, pharyngeal, esophageal, and gastric irritation or injury with stricture formation, esophageal and gastric rupture and stress.

About the Authors

Dr. Manjunatha P. Mudagal is presently working as Professor and HOD, Dept. of Pharmacology, Acharya & BM Reddy College of Pharmacy, Bengaluru. He is reputed teacher with more than 20 years of teaching experience to UGs and PGs. He has been a member of BOS-PG for Rajiv Gandhi University of Health Sciences, Bengaluru and Member secretary, Indian pharmaceutical association -Karnataka branch where advocacy issues will be discussed and resolved. He has received grants to tune of 1.2 crore from various funding agency and industry consultancy. He is technical consultant to various Pharmaceutical /Biotech/ Ayurvedic/ phytochemical industry and till dated completed 54 nos. of consultancy to various industries. Guided 27+ M. Pharm students and published 26 research papers, of which several have been cited in peer revived journals.

T. Hari Babu is presently working as assistant professor, Department of Pharmacology, Acharya & BM Reddy college of Pharmacy, Bengaluru, Karnataka. He has completed his post graduate and presently pursuing his Ph.D. in Pharmacology affiliated to Rajiv Gandhi University of Health Science, Bengaluru, Karnataka.

He is having more than 10 years of teaching and research experience. His areas of interest are metabolic disorders, Neuropharmacology and Cancer.

He has actively organized and participated-curricular and Co-curricular activities in field of Pharmacy.

He is a life member of IPA, APTI and IPS.

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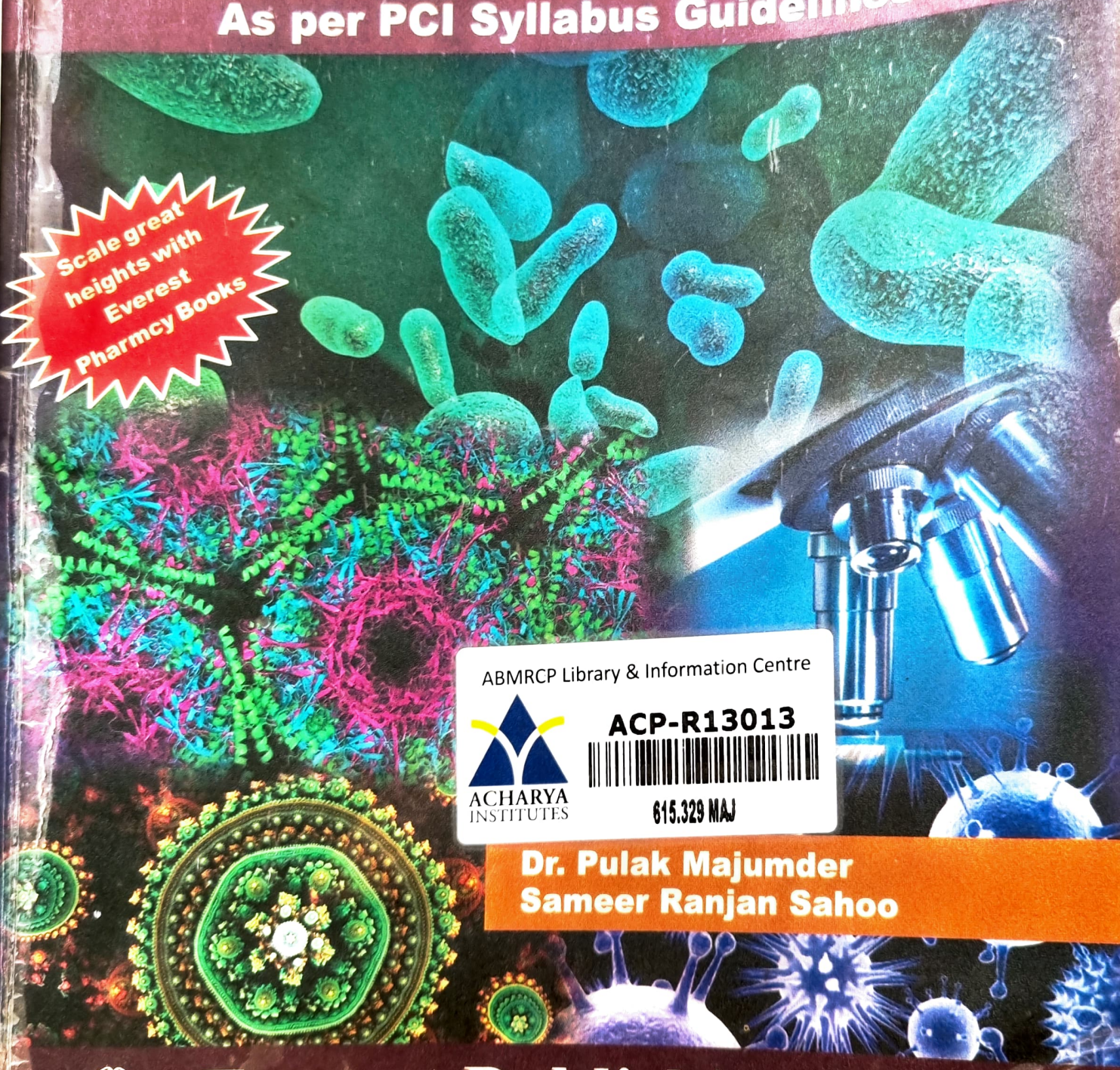

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Rajiv Gandhi University of Health Sciences, Bangalore, India
Ph. D in Pharmaceutical Sciences
PRIST University, Tamilnadu
PGDPH
Annamai University, Tamilnadu, India

◆ ◆ ◆

Prof. Sameer Ranjan Sahoo
B.Sc
Utkal University
MSc. in Microbiology
Orissa University of Agriculture And Technology
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Microbiology
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PREFACE

We are encircled by microscopic organisms which accounts almost a trillion in number on earth, of which 99.99% of species are yet to discover. This microbial life dwells within and around a system. Although most are harmless or even beneficiary, some are pathogenic to epidemic level but if left unchecked can create a pandemic crisis. Microbiology is the branch of science with study these microscopic organisms encompassing sub-disciplinarians i.e., virology, parasitology, mycology, immunology and bacteriology which is further grouped into applied branches like biotechnology, medical and industrial microbiology, food microbiology, pharmaceutical microbiology etc. Pharmaceutical microbiology is an applied branch which involves the study of microorganisms associated with the manufacture of pharmaceuticals and clinical conditions and assuring the sterility of pharmaceuticals. This text book is a responsible approach towards the students new to the subject need an introduction to the whole before concentrating on those parts of greatest interest to them. The book is suitable for courses with orientations ranging from basic microbiology to medical and applied microbiology. This book is aimed, at undergraduate pharmacy students as well as microbiologists entering the pharmaceutical industry. It is organized flexibly so that chapters and topics may be arranged in almost any order. Each chapter has been made as self-contained as possible to promote this flexibility. Some topics are essential to microbiology and have been given more extensive focus. This book provides an overview of the function of the pharmaceutical microbiologist and what they need to know, from laboratory design compendia tests and risk assessment tools

and techniques, validation, data analysis, bio burden, toxins, microbial identification, culture media, and contamination control etc.

Allied Pharmaceutical Microbiology is designed to be an effective teaching tool to students because of its easy readability, relatively simple and direct writing style, many section headings and an organized outline format within each chapter. The level of difficulty has been carefully set with the target audience in mind. Allied Pharmaceutical microbiology is composed of scientific illustrations. The illustrations are critical to a student's learning and enjoyment of microbiology, that illustration not only enhances the text's attractiveness but also increases each figure's teaching effectiveness. It is hoped that the book will provide a concise reading for pharmacy students and help to highlight those parts of a general microbiological training which impinge on the pharmaceutical industry.

Publication of a textbook requires effort of many people besides the authors. We wish to express special appreciation to the editorial and production staff of Everest Publishing House, Pune, for their excellent work. We would also like to thank Mrs Susmita Majumder for her encouragement, support and believe. Each of us wishes to extend our appreciation to people who assisted us individually in completion of this project. Finally, but most important, we wish to extend appreciation to our families for their patience and encouragement. To them, we dedicate this book.

Dr. Pulak Majumder

Prof. Sameer Ranjan Sahoo

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CONTENTS

UNIT 1a

SCIENCE OF MICROBIOLOGY

1.1 INTRODUCTION

Microbiology is the study of microbes. Microorganisms are microscopic forms of life—organisms that are too small to see with the unaided eye. They usually consist of a single cell and include bacteria, archaeons, fungi, protozoa, and algae. Viruses are not living, but they are microscopic; they utilize biological molecules and cellular machinery (borrowed from their host) to replicate, and they can cause infectious diseases like some microorganisms. While viruses are not microorganism, it can be refer as microbes, a more general term that includes microorganisms and viruses.

Our relationship with the microbial world is complex and dynamic. On one hand, harmful bacteria, viruses, fungi, and protozoa kill millions of people each year, and sicken billions. On the other hand, beneficial microbes associated with our bodies help us digest food, and protect us from potentially harmful microbial invaders. Some microbes cause crops to fail, while others provide essential nitrogen to plant roots through symbiotic relationships. Some microbes cause food to rot, but others carry out fermentations that produce yogurt, wine, beer, and other foods and beverages. In the past few decades, we have learned so much about the molecular machinery of life through the study of microbes such as the bacterium Escherichia coli that scientists now routinely alter microbial cells to produce high-value, lifesaving medical products. Whether helpful or harmful, the microbial world is deeply intertwined with our lives, and with the very fabric of life on Earth

Microorganisms have a tremendous impact on all life and the physical and chemical make-up of our planet. They are responsible for cycling the chemical elements essential for life, including carbon, nitrogen, sulfur, hydrogen, and oxygen; more photosynthesis is carried out by microorganisms than by green plants. It has been estimated that 5×10^{30} microbial cells

About Everest's Prestigious Authors

Dr. Pulak Majumder holds a Bachelor of Pharmacy and Master of Pharmacy from the Rajiv Gandhi University of Health Sciences, Bangalore, India and completed his Ph. D from PRIST University, Tamilnadu, in Pharmaceutical Sciences. He also gained PGDPH form Annamai University, Tamilnadu, India.

He is serving as Faculty of Pharmacognosy at Acharya and BM Reddy College of Pharmacy at Bangalore, India. He is credited with more than 30 researches and review papers in various National and International Scientific arenas and also ascribed with two books. He has authored various scientific oral and posters in National/International events or conferences especially in areas related to phyto-medicine. He is also credit with an Indian patent on Herbal Formulation. He is concomitant as principal investigate or co-investigator in various disciplinary or interdisciplinary funded research projects on phyto-medicine. He is the serving editorial board members of more than 6 national and international journals.

Currently, researching on the development of poly herbal phyto-medicines, formulations, monograph of herbs and screening of plant secondary metabolites, plant antibiotics, Biological assay and microbial pigmentation.

Sameer Ranjan Sahoo completed his B.Sc from Utkal University and MSc. in Microbiology from Orissa University of Agriculture And Technology. He is currently working as a Research Assistant and Lecturer in Microbiology at Acharya B.M. Reddy College of Pharmacy, Bangalore, India.

He is credited with six research publications in national/ international journals and actively participated and presented various research papers in various national/international scientific platforms. He has skill on various areas like bio-remediation, isolation, purification and identification of microbial Pigments, isolation and purification of fibrinolytic enzyme from microbe, 16s r RNA analysis, Ultrasound application on microbial growth, Bioinformatics.

Currently he is researching on secondary metabolites from halophilic bacteria and purification and enhancing the yield of specific metabolite.

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Bengaluru-560 064.

Dr. Venkatesh D.P.
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Dept. of Pharmaceutics.
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Preface

It is our immense pleasure to bring out the "First Edition" of this book which is dedicated to the students and faculty of B. Pharma institutes of this country.

This book is designed and edited in accordance to the syllabus requirement of "Introduction to Biopharmaceutics and Pharmacokinetics" for third year (VIth Semester) B. Pharm course in pharmacy prescribed in "Bachelor of Pharmacy (B. Pharm) course regulations 2014" by Pharmacy council of India.

Sincere efforts have been made to present theoretical aspects in details along with flowcharts/ pictorial for easy understanding the mechanism of actions of drugs and their pharmacological aspects. Most aspects are described stating examples with an intention to scaffold theoretical concepts and easy attempted during study.

The major objective of this book is to provide students, collective information about subject in simple and lucid language. We have kept in mind the difficulties which the students generally face.

We hope that this book shall be found useful by the students and quick lessons for teaching faculty.

We are thankful to the Publisher Mr. Dineshbhai Furia, Mr. Jignesh Furia and the Staff of Nirali Prakashan, Pune for bringing out nicely printed book.

Suggestions and comments are always welcome and they shall be gratefully acknowledged.

Dr. B. Prakash Rao
Dr. Venkatesh D.P.
Mrs. N.V.L. Sirisha Mulukuri
Dr. Beny Baby

Syllabus

UNIT-I **10 Hours**

Introduction to Biopharmaceutics

Absorption; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes.

Distribution: Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs.

UNIT-II **10 Hours**

Elimination: Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non-renal routes of drug excretion of drugs.

Bioavailability and Bioequivalence: Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

UNIT-III **10 Hours**

Pharmacokinetics: Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extravascular administrations. Pharmacokinetics parameters - K_E, $t_{1/2}$, V_d, AUC, K_a, Clt and CLR- definitions methods of eliminations, understanding of their significance and application.

UNIT-IV **08 Hours**

Multicompartment Models: Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.

UNIT-V **07 Hours**

Non-linear Pharmacokinetics:

(a) Introduction.

(b) Factors causing Non-linearity.

(c) Michaelis-Menton method of estimating parameters, Explanation with example of drugs.

***

Contents

***

Chapter ... 1

INTRODUCTION TO BIOPHARMACEUTICS

♦ LEARNING OBJECTIVES ♦

After completing this chapter, reader should be able to:

- ❖ Describe the concept of Biopharmaceutics, Drug absorption, Factors affecting drug absorption process, Non-per oral routes for drug absorption.
- ❖ Describe factors influencing of drug distribution and drug protein binding process in the body and its significance.

1.1 INTRODUCTION

Biopharmaceutics deals with the interrelationship with physicochemical properties of the drug, drug products or dosage form and pharmacological effects, in which many factors influencing the rate and amount of drug enters into the systemic circulation. The drug kinetics of ADME is depicted in the Fig. 1.1.

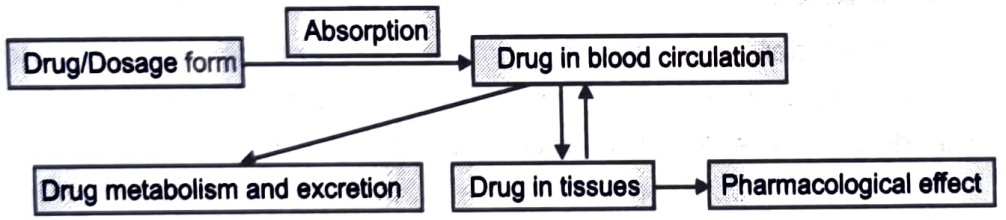

Fig. 1.1: Interrelationship with Drug, Drug Product and the Pharmacological effects

Biological Membrane: Biological membrane is composed of amphipathic phospholipid bilayer. This layer is having number of polar heads and non-polar tails. Polar heads are oriented towards aqueous environment as shown in the Fig. 2.2. In the phospholipids, proteins are embedded in the bilayer. These proteins form a number of aqueous filled pore channels. In these channels only water soluble molecules can pass through this routes. Drug molecules are transferred from one side of the membrane to other side of the membrane by two routes; paracellular route and intracellular route. In paracellular route favoured for

About the Authors

Dr. B. **PRAKASH RAO** is a Professor in Pharmaceutics in Acharya B. M. Reddy College of Pharmacy, Bangalore. Dr. Prakash Rao received his Ph. D in Pharmaceutics from Rajiv Gandhi University of Health Sciences, Karnataka. One patent has been granted. He has 33 Years of Experience in teaching Pharmaceutical Subjects, Consultant and reviewer for National and International Journals. He is the author and co-author of more than 60 publications.

Dr. VENKATESH D. P. obtained B.Pharm from National College of Pharmacy, Shimoga, Karnataka. He obtained M Pharm degree with specialization in pharmaceutics from Nitte Gulabi Shetty Memorial Institute of Pharmaceutical Sciences, Mangalore, and Karnataka affiliated to RGUHS, Bengaluru. He obtained Ph.D. degree from Jawaharlal Nehru Technical University, Hyderabad Telagana in the year 2016. He has 14 years of teaching and academic research experience. He is currently working as Associate Professor and HOD in the Dept.of Pharmaceutics, Acharya and BM Reddy College of Pharmacy, Bengaluru. He has published 25 research articles in peer reviewed journals, He is Ph.D. research guide, recognized under RGUHS, guided 15 M.Pharm PG students & guiding 1 Ph.D. student for their research work, He has participated in more than 35 National conferences and one international conference in Dubai. He has co-authored for Practical Experimental Pharmaceutics text book. He is lifetime member for professional bodies such as IPA, APTI and ISTE. He has on-going research projects funded by RGUHS and completed industry consultancy projects.

Mrs. N. V. L. SIRISHA MULUKURI has a Brilliant academic record with Masters in Pharmacy (2010) from NIPER KOLKATA and excelled in Bachelors of Pharmacy from Shri Vishnu college of Pharmacy, Andhra University, currently she is working as Asst Prof., at Nitte College of Pharmaceutical Sciences affiliated to Rajiv Gandhi University of Health sciences, Bangalore. She has 10 years of teaching experience, during her teaching journey she has taught many subjects under Pharmacy curriculum, and expertise in various multi-disciplinary research areas with 12 number of Publications in Peer reviewed indexed journals. She has received a research Project Grant under Rajiv Gandhi University of Health Sciences. She is Life member for various professional bodies like IPA and APTI.

Dr. BENY BABY is Associate Professor and HOD Of Pharmaceutics in Karnataka College of Pharmacy, Bangalore. She Has Experience in Industry and Academics, also Honorary Director of Avani Pharma Pvt Ltd, Bangalore. Dr. Beny Baby received the Ph. D. in Pharmaceutics from JNTU, Andhra Pradesh. She is the Author and Co Author of more than 40 Publications.

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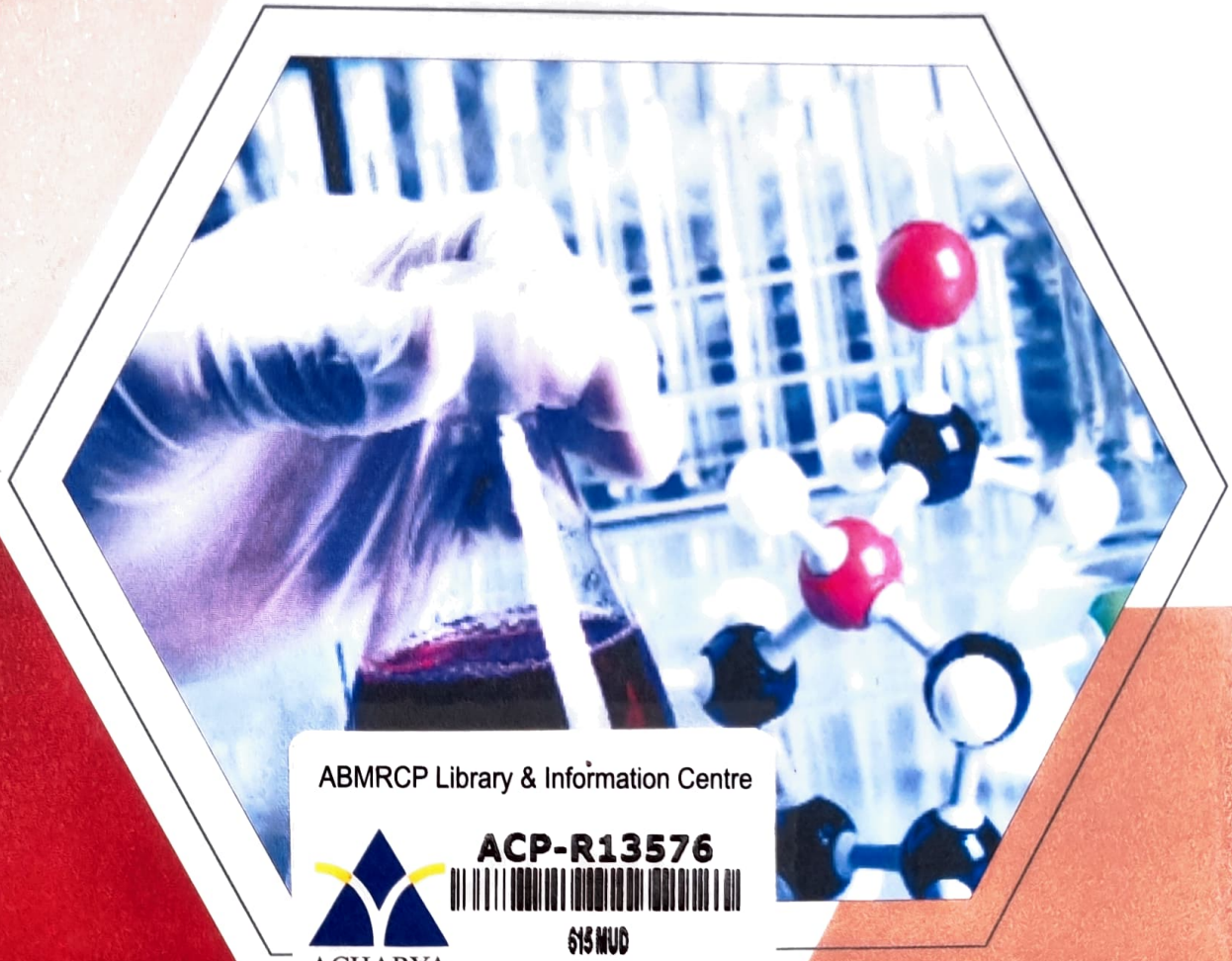
AS PER PCI REGULATIONS
THIRD YEAR B. PHARM

SEMESTER-VI

PHARMACOLOGY-III



Dr. MANJUNATHA P. MUDAGAL
Dr. UDAY RAJ SHARMA

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A Text Book of

PHARMACOLOGY - III

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As Per PCI Regulations

THIRD YEAR B. PHARM.

Semester - VI

ACP-R13 7 8

Dr. Manjunatha P. Mudagal
Professor & HOD,
Department of Pharmacology,
Acharya Dr. Sarvepalli Radhakrishna Road
Acharya PO, Soladevanahalli,
Bengaluru-560 107, Karnataka, India.

Dr. Uday Raj Sharma
Associate Professor
Department of Pharmacology,
Acharya Dr. Sarvepalli Radhakrishna Road
Acharya PO, Soladevanahalli,
Bengaluru-560 107, Karnataka, India.

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Syllabus

UNIT-I **10 Hours**

1. Pharmacology of Drugs Acting on Respiratory System

a. Anti-asthmatic drugs
b. Drugs used in the management of COPD
c. Expectorants and antitussives
d. Nasal decongestants
e. Respiratory stimulants

2. Pharmacology of Drugs Acting on the Gastrointestinal Tract

a. Antiulcer agents.
b. Drugs for constipation and diarrhoea.
c. Appetite stimulants and suppressants.
d. Digestants and carminatives.
e. Emetics and anti-emetics.

UNIT-II **10 Hours**

3. Chemotherapy

a. General principles of chemotherapy.
b. Sulfonamides and cotrimoxazole.
c. Antibiotics - Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides

UNIT-III **10 Hours**

4. Chemotherapy

a. Antitubercular agents
b. Antileprotic agents
c. Antifungal agents
d. Antiviral drugs
e. Anthelmintics
f. Antimalarial drugs
g. Antiamoebic agents

UNIT-IV **08 Hours**

5. Chemotherapy

(a) Urinary tract infections and sexually transmitted diseases.
(b) Chemotherapy of malignancy.

6. Immunopharmacology

(a) Immunostimulants
(b) Immunosuppressant
(c) Protein drugs, monoclonal antibodies, target drugs to antigen
(d) Biosimilars

UNIT-V **07 Hours**

7. Principles of toxicology

a. Definition and basic knowledge of acute, subacute and chronic toxicity.
b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity.
c. General principles of treatment of poisoning.
d. Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning.

8. Chronopharmacology

a. Definition of rhythm and cycles.
b. Biological clock and their significance leading to chronotherapy.

***

Contents

Unit - I

Unit - V

***

Unit - I

Chapter ... 1

ANTI-ASTHMATIC DRUGS

♦ LEARNING OBJECTIVES ♦

After completing this chapter, reader should be able to:

- ❖ Describe the classes of Anti asthmatic drugs and their indications for use.
- ❖ Explain mechanism of action and ADR.
- ❖ Summarize an appropriate treatment regimen for asthma.

1.1 ASTHMA

This is defined as a condition in which a person's airways become inflamed, narrow and swell and produce extra mucus, which makes it difficult to breathe.

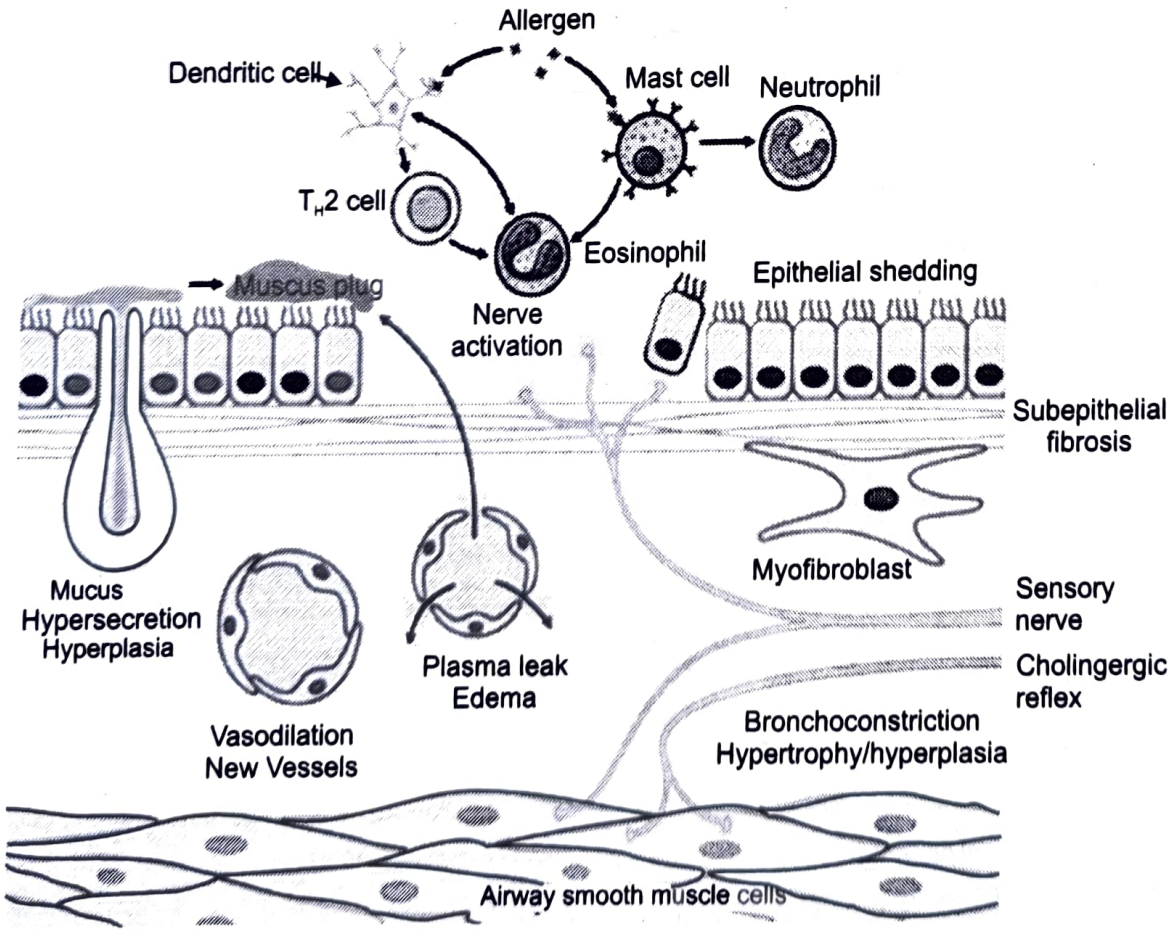
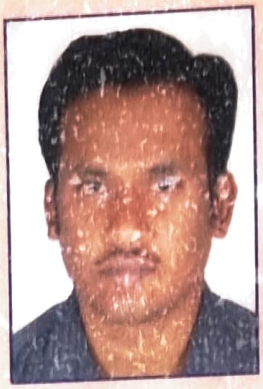


Fig. 1.1

About the Authors



Dr. MANJUNATHA P. MUDAGAL

He is reputed teacher with more than 20 years of teaching and research. He has been a member of BOS-PG for Rajiv Gandhi University of Health Sciences, Bengaluru & Member secretary, Indian pharmaceutical association -Karnataka branch where advocacy issues will be discussed and resolved. He has received grants to tune of **1.5 crore** from various funding agency and industry consultancy. He is technical consultant to various Pharmaceutical /Biotech/Ayurvedic/ phytochemical industries and till dated completed 56 nos. of consultancy to various industries. Guided 29+ M. Pharm students and published more than 29 research papers, of which several have been cited in peer revived journals. He has attended 20+ International and 50+ National conferences, attended 30+ National and International workshops and presented scientific papers in conferences.

Dr. UDAY RAJ SHARMA

He has excellence academic career in Pharmacy. He is Dean-Students Affairs, Associate Professor in the Department of Pharmacology at Acharya & B M Reddy College of Pharmacy, Bengaluru, Karnataka, India. He is having 16 Years of Experience in the field of Teaching and Research.

He has completed Masters in Pharmacology from Rajiv Gandhi University of Health Sciences, Bengaluru and Ph.D. in Biotechnology from Acharya Nagarjuna University, Guntur. His Area of Expertise includes: Neuropharmacology and Oncology. He has published 18 National and 10 International publications in various journals. He has guided seven M. Pharm students for their dissertation work and guiding two Ph.D. students. He has attended 20 International and 35 National conferences, attended 11 National and 10 International workshops and presented posters in 25 conferences.

He is the author of books, Pharmaceutical Marketing Management, Pharmacology-II with Nirali Prakashan, Pune. He has received 6th Rank in D. Pharm in Karnataka State, 7th Rank in B. Pharm, and 4th Rank in M. Pharm, Rajiv Gandhi University of Health Sciences. He is a recipient of Distinguished Alumni Award.

He has completed many consultancy project and technology transfer with Industries. He has also completed many research projects with different government industries.

He has been elected continuously three times as EC member in Karnataka State Branch IPA, he is also certified trainer for MSR program approved by LSSDC. He is a president of Institution Innovation Council of Acharya & BM Reddy College of Pharmacy under MHRD, Government of India.

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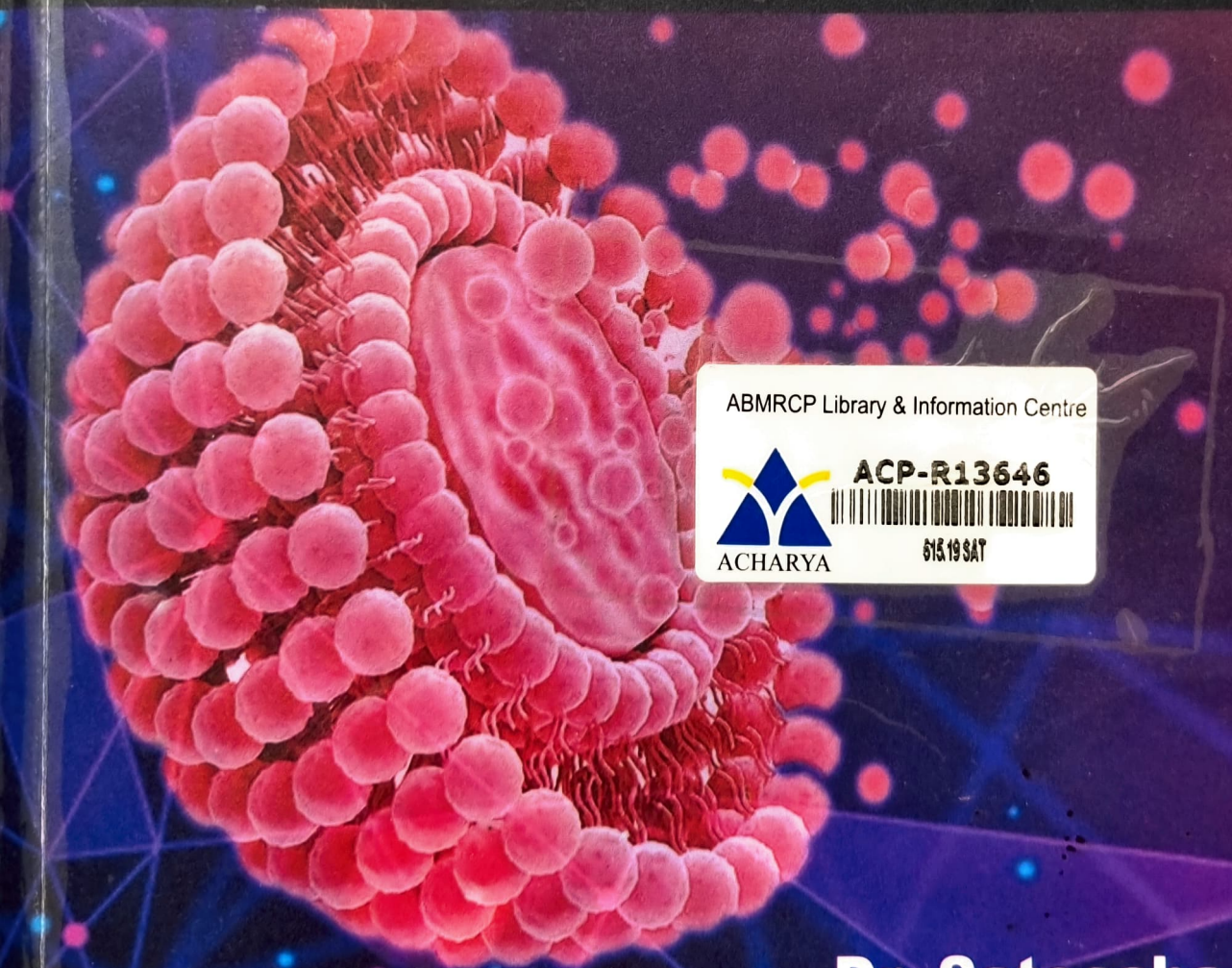
First Edition

Physical Pharmaceutics

Principles of Formulation



Dr. Sateesha SB
Dr. Rajamma AJ

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Physical Pharmaceutics

Principles of Formulation

Dr. Sateesha SB, M.Pharm, Ph.D.,
Professor
Department of Pharmaceutics
Acharya & BM Reddy College of Pharmacy
Bengaluru-560107

Dr. Rajamma AJ, M.Pharm, Ph.D.,
Professor
Department of Pharmacognosy
KLE College of Pharmacy,
Bengaluru-560010

EMMESS Medical Publishers
No. 33/2, Ground Floor, 9th 'A' Cross, West of Chord Road,
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Physical Pharmaceutics - Principles of Formulation

- **Dr. Sateesha SB**
- **Dr. Rajamma AJ**

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Contributors :

Dr. Shekar HS, M.Pharm, Ph.D.,
Professor
Department of Pharmacy Practice
Visweswarapura Institute of Pharmaceutical Sciences
Bengaluru-560070.

Dr. Anirbandeep Bose, M.Pharm, Ph.D.,
Head Quality Assurance and Regulatory Affairs
TAAB Biostudy Services
Jadavpur, Kolkata-700032

Dr. Anudeep Balla, M.Pharm, Ph.D.,
Assistant Professor
Department of Pharmaceutics
Acharya & BM Reddy College of Pharmacy
Bengaluru -560107

Dedication

To our parents
Smt. Ningamma and Sri. Boregowda
for their enduring support

PREFACE

Physical pharmaceutics, the science of pharmaceutics that attempts to integrate the principles of physics and chemistry to understand the design, formulation and testing of dosage forms. Physical pharmaceutics is associated with the quantitative and theoretical principles of pharmaceutical technology as they apply to the practice of pharmacy. Physical pharmaceutics serves as ideology that guides the pre-formulation aspects of stable formulation development. It also serves as a basis for the understanding of solubility, stability, absorption and biologic action of drug products. Physical pharmaceutics deals with the application of scientific principles which are associated to the development of a drug product which involves, study of physico-chemical properties of drug and excipients, and transforming that information to develop a stable formulation keeping biologic performance of the drug as a main goal.

The book "Physical Pharmaceutics" was written in an attempt to bring together the theory and practice of pharmaceutics. This book must make its way among students, teachers, and professional pharmaceutical researchers. Professionals engaged in research and development, manufacturing, teaching may find it helpful to gain required knowledge in designing of formulation. This book has integrated the knowledge of chemistry, physics, pharmacology and bio-pharmaceutics for the intimate understanding of the concepts underlying in drug development process.

This book is designed and concisely written keeping the interest of pharmacy students and professional pharmacy teachers, therefore we expect that this book will be a resource guide to the teacher and mark a turning point in the study pattern of the student. The major objective of writing this book is to present the information in a logical, condensed and organized form, to accommodate specifically the needs of undergraduate students of pharmacy. Understanding of course material is primarily the responsibility of the student. A teacher can guide, explain, clarify and inter-relate the knowledge ultimately to make the student to appreciate the subject.

The mathematical expression is an intrinsic part of physical pharmaceutics, and it is important to see how a particular expression is obtained. In some cases, we have judged that a derivation is too long, too detailed, or too different in level for it to be included in the text. Derivations are limited to the level of detail that the concept demands, and made it easier to review material.

This book consists of 14 chapters. All of them were elaborately drafted keeping the curriculum of **III and IV semester of B.Pharm proposed by Pharmacy Council of India** as a reference. The concepts illustrated in the book were extensively supported by number of figures and in the form of tables. We feel that information and concepts are readily appreciated and understood by the readers.

Authors would very much appreciate receiving critical suggestions for improvement and refinement of the text in future and can be contacted at sbsateesh@gmail.com.

Sateesha SB
Rajamma AJ

Acknowledgements

We the authors express deep sense of gratitude to our Parents for their love, inspiration and stimulation in our life. We thank all our family members for their affection, warmth and invaluable support.

We take this opportunity to express our special thanks to the Principal and Management of the institutions, Acharya & BM Reddy College of Pharmacy and KLE College of Pharmacy, Bengaluru, for their encouragement and motivation. We also acknowledge the contribution, encouragement and constructive criticism of all our friends and colleagues. We like to appreciate our students who helped in framing the contents.

We appreciate the Emmess Medical Publisher's who graciously volunteered to make the publication of this book a reality. We appreciate the Ahana Graphics designers and all the team members of publication process for their relentless effort in bringing this book in an appealing form.

Sateesha SB
Rajamma AJ

CONTENTS

Chapter 1

Solubility of Drugs

At the conclusion of this chapter the reader should have the knowledge about

1. Solubility of solids, liquids and gases
2. Solubility expressions
3. Solute-solvent interactions
4. Intermolecular forces of solute and solvent
5. Hildebrand solubility parameter and Hansen solubility parameter
6. Solvation & association
7. Co-solvent and solubility of drugs
8. Gibb's phase rule
9. Raoult's law, ideal solutions and real solutions
10. Henry's law and Boyle's law

About Authors

Dr. Sateesha SB, Professor of Pharmaceutics, Acharya & BM Reddy College of Pharmacy, Bengaluru, affiliated to RGUHS, Bengaluru. Graduated from JSS College of Pharmacy, Mysore, M.Pharm in pharmaceutics from Government College of Pharmacy, Bengaluru. Holds Ph.D in Pharmaceutical Sciences from JNTU, Hyderabad. Dr Sateesha has nearly 20 years of multifaceted experience in academic, industry and consultancy. Till date, guided 25 to M.Pharm and Guiding Ph.D, students at the University of Horticulture Sciences, Bagalkote, Karnataka. Published 25 research papers in national and international journals. A much-consulted formulation expert and has transferred formulation technology to Micro lab, Ltd., to the tune of Rs. 13 lakhs.

Dr. Rajamma AJ, Professor, KLE College of Pharmacy, Bengaluru, affiliated to KAHER, Belgavi. Holds M.Pharm in Pharmacognosy from Government College of Pharmacy, Bengaluru. Dr. Rajamma has 18years of experience in academic and Research. Guided 01 PhD student and guiding 02 students at the KAHER, Belgavi, Karnataka. Her research activities are collaborated with various research laboratories/institutes. Published 27 research papers in national and international journals. Her research "Bioassay guided isolation of mosquito Larvicidal principles from Western Ghat plants" is supported by ICMR of Rs.23 lakhs.

About the book

Physical pharmaceutics, the science of pharmaceutics is written in an attempt to comprehend the principles of pharmaceutical formulation development. There are numerous features in this book that are designed to make learning physical pharmaceutics more effective and more enjoyable.

Chapters included in the book are the curriculum of **III and IV semester of B.Pharm** proposed by **Pharmacy Council of India.** The highlights of this book that make the subject overwhelming are the absolute sum of information. We have used several strategies for organizing the material. It begins with chapter objectives that introduce information to be learned in the chapter, and key concept boxes highlight relevant concepts. In addition, illustrative examples, and extensive number of tables and figures included in every chapter reinforce the chapter content.

The notable part of this book is inclusion of a set of review questions and multiple choice questions to the end of every chapter to strengthen concepts learned in the text. Review questions are intended to encourage reflection on the material and to view it in a broader context than is obtained by solving numerical problems.

With the discussion of basic principles of the pharmaceutical formulation development, this book could be a guide to pharmaceutical pre-formulation studies. It describes the important concepts and methods used in pre-formulation with the underlying theory. Indeed, this book has a valuable text for undergraduate and postgraduate courses in industrial pharmacy and pharmaceutical technology

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SECOND YEAR
DIPLOMA IN PHARMACY
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PHARMACOLOGY

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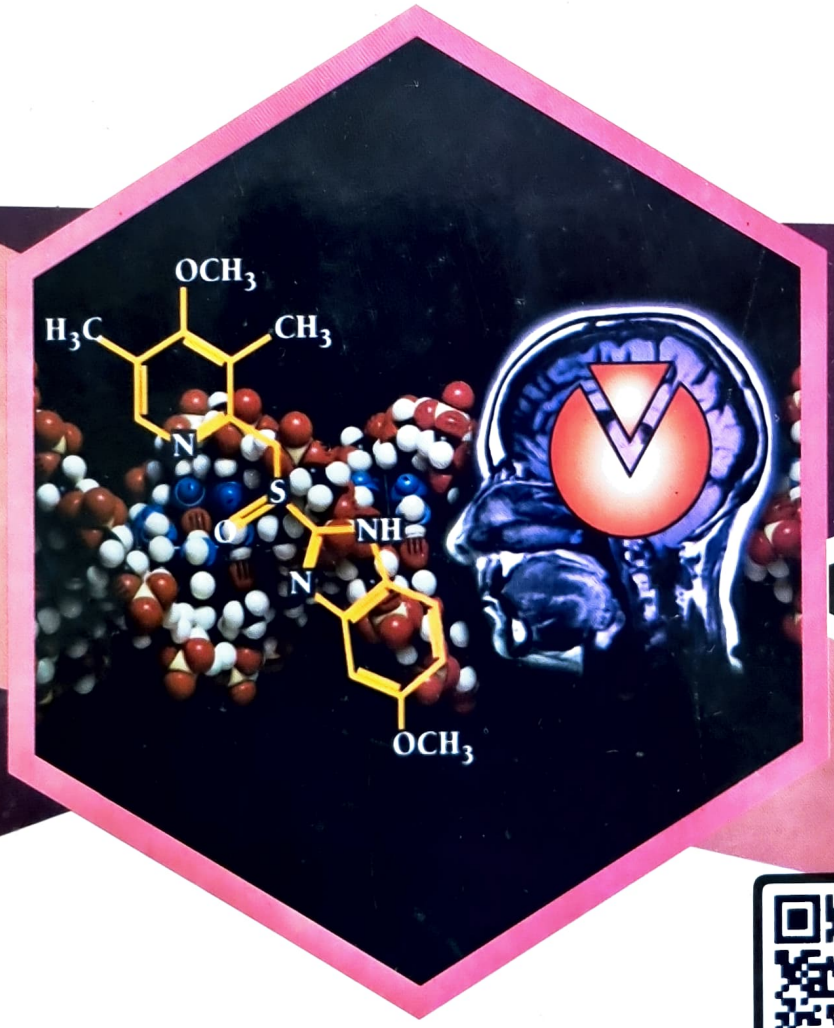

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A TEXT BOOK OF

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SECOND YEAR D. PHARM.
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(E.R. 2020)

Dr. MANJUNATHA P. MUDAGAL
Professor & Head
Department of Pharmacology
Acharya & BM Reddy College of Pharmacy
Acharya Dr. Sarvepalli Radhakrishnan Road
Acharya PO, Soladevanahalli
Bengaluru-560 107, Karnataka, India.

Dr. UDAY RAJ SHARMA
Associate Professor
Department of Pharmacology
Acharya & BM Reddy College of Pharmacy
Acharya Dr. Sarvepalli Radhakrishnan Road
Acharya PO, Soladevanahalli
Bengaluru-560 107, Karnataka, India.

Mrs. SEEMA R. KENJALE
Assistant Professor
P.D.E.A's Shankarrao Ursal College of Pharmacy (Diploma),
Kharadi, Pune.

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Rasdhara Co-op. Hsg. Society Ltd., 'D' Wing Ground Floor, 385 S.V.P. Road
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Email : niralimumbai@pragationline.com

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BENGALURU

Nirali Prakashan
Maitri Ground Floor, Jaya Apartments,
No. 99, 6th Cross, 6th Main,
Malleswaram, Bengaluru 560003
Karnataka; Mob : 9686821074
Email : bengaluru@niralibooks.com

NAGPUR

Nirali Prakashan
Above Maratha Mandir, Shop No. 3,
First Floor, Rani Jhanshi Square,
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Tel : (0712) 254 7129
Email : nagpur@niralibooks.com

KOLHAPUR

Nirali Prakashan
438/2, Bhosale Plaza, Ground Floor
Khasbag, Opp. Balgopal Talim
Kolhapur 416 012, Maharashtra
Mob : 9850046155
Email : kolhapur@niralibooks.com

JALGAON

Nirali Prakashan
34, V. V. Golani Market, Navi Peth,
Jalgaon 425001, Maharashtra
Tel : (0257) 222 0395
Mob : 94234 91860
Email : jalgaon@niralibooks.com

SOLAPUR

Nirali Prakashan
R-158/2, Avanti Nagar, Near Golden
Gate, Pune Naka Chowk
Solapur 413001, Maharashtra
Mobile 9890918687
Email : solapur@niralibooks.com

marketing@pragationline.com | www.pragationline.com

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Preface ...

It is our immense pleasure to bring out the **"First Edition"** of this book which is dedicated to the students and faculty of D. Pharm. institutes of this country. This book is designed and edited in accordance to the syllabus requirement of **"Pharmacology"** of second year D. Pharm. course in pharmacy prescribed in **"Diploma in Pharmacy (D. Pharm.) Course Regulations 2020"** by Pharmacy Council of India.

Sincere efforts have been made to present theoretical aspects in details along with flowcharts/diagrams for easy understanding of the mechanism of actions of drugs and their pharmacological aspects. Most aspects are described stating examples with an intention to scaffold theoretical concepts and easy attempted during Pharmacology sessions to various global organizations.

The major objective of this book is to provide students, collective information about subject in simple and lucid language. We have kept in mind the difficulties which the students generally face.

The salient features of the book are:

1. It covers all the topics prescribed in **"Diploma in Pharmacy (D. Pharm.) Course Regulations 2020"** by Pharmacy Council of India.
2. The language used is simple and lucid.
3. Questions: The book contains Exercise questions at the end of every chapter.

We hope that this book should be found to be useful for the students, as well as teaching faculties.

We are thankful to the management of Acharya & BM Reddy College of Pharmacy, Bengaluru for their keen interest and timely encouragement that made it possible to bring out this first volume.

Our sincere thanks are to Shri Dineshbhai Furia and Shri Jignesh Furia of Nirali Prakashan, Pune, for their co-operation and interest taken in publishing this book. We are also thankful to the staff of Nirali Prakashan, especially Roshan Khan, Mr. Akbar Shaikh, Mrs. Varsha Bodake and Mr. Ravindra Walodare of Nirali Prakashan for bringing out this nicely printed book.

Suggestions and comments are always welcome and they shall be gratefully acknowledged.

Dr. Manjunatha P. Mudagal

Dr. Uday Raj Sharma

Mrs. Seema Kenjale

■■■

Syllabus...

PHARMACOLOGY – THEORY

Course Code: ER20-21T **75 Hours (3 Hours/week)**

1. General Pharmacology **(10 Hours)**

- Introduction and scope of Pharmacology
- Various routes of drug administration - advantages and disadvantages
- Drug absorption - definition, types, factors affecting drug absorption
- Bioavailability and the factors affecting bioavailability
- Drug distribution - definition, factors affecting drug distribution
- Biotransformation of drugs - Definition, types of biotransformation reactions, factors influencing drug metabolisms
- Excretion of drugs - Definition, routes of drug excretion
- General mechanisms of drug action and factors modifying drug action

2. Drugs Acting on the Peripheral Nervous System **(11 Hours)**

- Steps involved in neurohumoral transmission
- Definition, classification, pharmacological actions, dose, indications, and contraindications of
  - (a) Cholinergic drugs
  - (b) Anti-Cholinergic drugs
  - (c) Adrenergic drugs
  - (d) Anti-adrenergic drugs
  - (e) Neuromuscular blocking agents
  - (f) Drugs used in Myasthenia gravis
  - (g) Local anaesthetic agents
  - (h) Non-Steroidal Anti-Inflammatory drugs (NSAIDs)

3. Drugs Acting on the Eye **(2 Hours)**

Definition, classification, pharmacological actions, dose, indications and contraindications of

- Miotics
- Mydriatics
- Drugs used in Glaucoma

4. Drugs Acting on the Central Nervous System **(8 Hours)**

Definition, classification, pharmacological actions, dose, indications, and contraindications of

- General anaesthetics
- Hypnotics and sedatives
- Anti-Convulsant drugs
- Anti-anxiety drugs
- Anti-depressant drugs
- Anti-psychotics
- Nootropic agents
- Centrally acting muscle relaxants
- Opioid analgesics

5. **Drugs Acting on the Cardiovascular System** **(6 Hours)**
   Definition, classification, pharmacological actions, dose, indications, and contraindications of
   - Anti-hypertensive drugs
   - Anti-anginal drugs
   - Anti-arrhythmic drugs
   - Drugs used in atherosclerosis and
   - Congestive heart failure
   - Drug therapy for shock
6. **Drugs Acting on Blood and Blood Forming Organs** **(4 Hours)**
   Definition, classification, pharmacological actions, dose, indications, and contraindications of
   - Hematinic agents
   - Anti-coagulants
   - Anti-platelet agents
   - Thrombolytic drugs
7. Definition, classification, pharmacological actions, dose, indications, and contraindications of **(2 Hours)**
   - Bronchodilators
   - Expectorants
   - Anti-tussive agents
   - Mucolytic agents
8. **Drugs Acting on the Gastrointestinal Tract** **(5 Hours)**
   Definition, classification, pharmacological actions, dose, indications, and contraindications of
   - Anti-ulcer drugs
   - Anti-emetics
   - Laxatives and purgatives
   - Anti-diarrheal drugs
9. **Drugs Acting on the Kidney** **(2 Hours)**
   Definition, classification, pharmacological actions, dose, indications, and contraindications of
   - Diuretics
   - Anti-Diuretics
10. **Hormones and Hormone Antagonists** **(8 Hours)**
    Physiological and pathological role and clinical uses of
    - Thyroid hormones
    - Anti-thyroid drugs
    - Parathormone
    - Calcitonin
    - Vitamin D

- Insulin
- Oral hypoglycemic agents
- Estrogen
- Progesterone
- Oxytocin
- Corticosteroids

11. Autocoids **(3 Hours)**

- Physiological role of Histamine, 5 HT and Prostaglandins
- Classification, clinical uses, and adverse effects of antihistamines and 5 HT antagonists

12. Chemotherapeutic Agents **(12 Hours)**

Introduction, basic principles of chemotherapy of infections, infestations and neoplastic diseases, Classification, dose, indication and contraindications of drugs belonging to following classes:

- Penicillins
- Cephalosporins
- Aminoglycosides
- Fluoroquinolones
- Macrolides
- Tetracyclines
- Sulphonamides
- Anti-tubercular drugs
- Anti-fungal drugs
- Anti-viral drugs
- Anti-amoebic agents
- Anthelmintics
- Anti-malarial agents
- Anti-neoplastic agents

. Biologicals **(2 Hours)**

- Definition, types, and indications of biological agents with examples

■■■

Contents ...

■■■

Chapter ... 1

GENERAL PHARMACOLOGY

♦ LEARNING OBJECTIVES ♦

After completing this chapter, reader should be able to understand:

- Introduction and Scope of Pharmacology
- Various Routes of Drug Administration - Advantages and Disadvantages
- Drug Absorption - Definition, Types, Factors affecting Drug Absorption
- Bioavailability and the factors affecting Bioavailability
- Drug distribution - Definition, Factors affecting Drug distribution
- Biotransformation of Drugs - Definition, Types of Biotransformation Reactions, Factors Influencing Drug Metabolisms
- Excretion of Drugs - Definition, Routes of Drug Excretion
- General Mechanisms of Drug Action and Factors modifying Drug Action

1.1 SCOPE OF PHARMACOLOGY

Pharmacology:

- The word pharmacy is derived from the Greek word "Pharmakon", meaning medicine or drug.
- 'Pharmakon' means drug (substance used to prevent the disease) and 'Logy' means study or science.
- Pharmacology is the science or study of drugs.
- Pharmacology is a branch of science which deals with,
  1. Sources of drugs,
  2. History of drugs,
  3. Biochemical and physiological effects,
  4. Mechanism of action,
  5. Therapeutic uses of drugs.

Divisions or Branches of Pharmacology:

- **Pharmacodynamics:** Mechanism of action and therapeutic effect of drugs (effect on the body).
- **Pharmacokinetics:** It includes the study of Absorption, Distribution, Metabolism and Excretion of drugs (Effect on drugs in the body).
- **Pharmacotherapeutics:** Diagnosis and treatment of diseases by using appropriate (correct) drugs.
- **Clinical Pharmacology:** It deals with the study of drug effects in healthy humans and patients (diseased persons).

ABOUT THE AUTHORS

Dr. Manjunatha P. Mudagal, M. Pharm, Ph. D, Professor, Acharya & B. M. Reddy College of Pharmacy, Bengaluru. He is reputed teacher with more than 20+ years of teaching experience to UGs and PGs. He has been a member of BOS-PG for Rajiv Gandhi University of Health Sciences, Bengaluru & Member Secretary, Indian Pharmaceutical Association-Karnataka branch where advocacy issues are discussed and resolved. He has received grants to tune of 1.60 Crore from various funding agencies and industry consultancies. He is technical consultant to various Pharmaceutical/Biotech/ Ayurvedic/Phytochemical industries and till dated completed 65 nos. of consultancy to various industries. He had guided 30+ M. Pharm students, published 52 research papers, of which several have been cited in peer revived journals and authored 6 text books.

Dr. Uday Raj Sharma has excellent academic career in Pharmacy. He is Associate Professor in the Department of Pharmacology at Acharya & BM Reddy College of Pharmacy, Bengaluru, Karnataka, India. He is having 15 Years of Experience in the field of Teaching, Research and Administration.

He has completed Masters in Pharmacology from Rajiv Gandhi University of Health Sciences, Bengaluru and Ph.D. from Acharya Nagarjuna University, Guntur. His Area of Expertise includes: Neuropharmacology and Oncology. He has published 18 National and 10 International publications in various journals. He has guided seven M. Pharm students for their dissertation work.

He is the author of book, Title- Pharmaceutical Marketing Management, with Nirali Prakashan, Pune, recipient of State and University Rank in Diploma, Bachelor and Master degree. He is a recipient of Distinguished Alumni award.

Mrs. Seema R. Kenjale was D.Pharm. topper of Bharati Vidyapeeth's Institute of Pharmacy, Pune. She has completed her B.Pharm. from Bharati Vidyapeeth's Poona College of Pharmacy, Pune and M.Pharm. (Pharmacology) from P.D.E.A's Seth Govind Raghunath Sable College of Pharmacy, Saswad under the Pune university. She worked as an Assistant Professor at P.D.E.A's Seth Govind Raghunath Sable College of Pharmacy (Polytechnic) Saswad and Currently at P.D.E.A's Shankarrao Ursal College of Pharmacy (Diploma), Kharadi Pune. She has total 17 years of Teaching experience. She has published two text books. She is a member of Association of Pharmaceutical Teachers of India (APTI). She attended 34 seminars, Workshops and Faculty Developments Programmes sponsored by AICTE, MSBTE and various universities.

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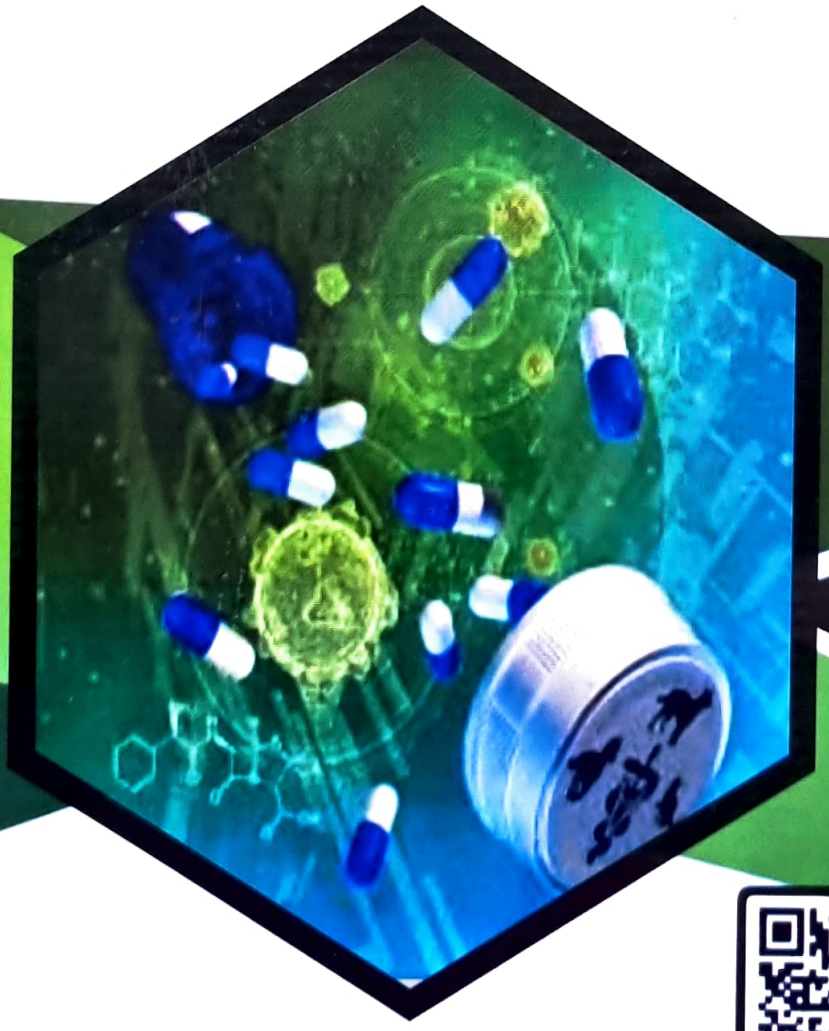
Dr. MANJUNATHA P. MUDAGAL



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Dr. MANJUNATHA P. MUDAGAL
M.Pharm., Ph.D.
Professor and Head,
Department of Pharmacology,
Acharya and BM Reddy collage of Pharmacy,
Acharya Dr. Sarvepalli Radhakrishna Road
Acharya PO, Soladevanahalli,
Bengaluru-560 107, Karnataka, India

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Syllabus

PHARMACOLOGY (PRACTICAL) **Practical : 3 Hrs./week**

Practicals:

Introduction to the following topics pertaining to the experimental pharmacology have to be discussed and documented in the practical manuals.

1. Introduction to experimental pharmacology
2. Study of laboratory animals
   (a) Mice; (b) Rats; (c) Guinea pigs; (d) Rabbits
3. Commonly used instruments in experimental pharmacology
4. Different routes of administration of drugs in animals
5. Types of pre-clinical experiments: In-Vivo, In-Vitro, Ex-Vivo, etc.
6. Techniques of blood collection from animals

Experiments:

Note: Animals shall not be used for doing / demonstrating any of the experiments given. The given experiments shall be carried- out / demonstrated as the case may be, ONLY with the use of software program(s) such as 'Ex Pharm' or any other suitable software.

1. Study of local anaesthetics on rabbit eye
2. Study of Mydriatic effect on rabbit eye
3. Study of Miotic effect on rabbit eye
4. Effect of analgesics using Analgesiometer
5. Study of analgesic activity by writhing test
6. Screening of anti-convulsant using Electro Convulsiometer
7. Screening of Muscle relaxants using Rota-Rod apparatus
8. Screening of CNS stimulants and depressants using Actophotometer
9. Study of anxiolytic activity using elevated plus maze method
10. Study of effect of drugs (any 2) on isolated heart
11. Effect of drugs on ciliary motility on frog's buccal cavity
12. Pyrogen testing by rabbit method

Assignments:

The students shall be asked to submit written assignments on the following topics (One assignment per student per sessional period. i.e., a minimum of THREE assignments per student)

1. Introduction to Allergy Testing
2. Introduction to Toxicity Studies
3. Drug Facts Labels of US FDA
4. Pre-clinical studies in new drug development
5. Medicines and meals: Before or After food
6. Pre-clinical studies in new drug development
7. Drugs available as paediatric formulations
8. Drug information apps.

Contents

Experiment No. 1
INTRODUCTION TO EXPERIMENTAL PHARMACOLOGY

Aim: *Goals of Experimental Pharmacology are:*

1. *To find a medicinal agent that is safe for humans to utilize.*
2. *To investigate drug mechanisms and sites of action.*
3. *To investigate a drug's toxicity.*

Because experimental pharmacology entails the discovery of new medications (or) the investigation of the activities of existing pharmaceuticals, it is divided into two stages:

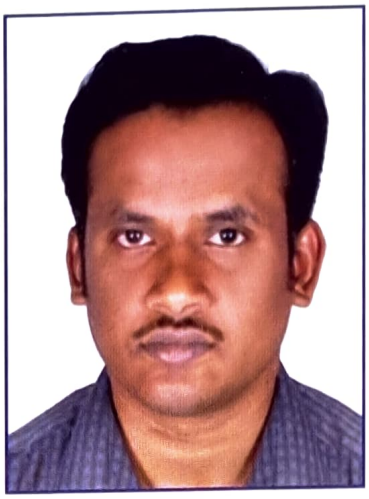
1. Preclinical pharmacology begins with identifying as well as optimization of unique chemical lead structures, as well as testing for biological effects on animals, tissues, and organs.
2. To determine bioavailability, safety, and efficacy in humans, medications being examined on healthy subjects as well as patients within clinical stage.

Because pharmacists interact with pharmaceuticals at every stage of development, including synthesizing to pharmacologic assessment via drug formulation and distribution, it is understandable that a pharmacy student would have adequate experimental pharmacology knowledge and exposure.

The purpose of experimental pharmacology is to develop a scientific foundation for the use of chemical agents in prevention, diagnosis, treatment or cure of diseases. The pharmacological experiments may be qualitative or quantitative in nature. The response to a particular drug in a living tissue or organ or the organism as a whole is observed in qualitative experiments, while the intensity of action is measured to specify the concentration in quantitative experiments.

The experiments may be carried out in whole animal or in isolated organs. In whole animal experiments (e.g. Dog blood pressure) the effect of drug on any organ is influenced by a variety of factors such as metabolic state, blood supply, nervous control, hormonal control, factors of bio-availability etc. It is difficult to estimate and control factors of bio-availability and many other diverse factors. The interpretation of the action of drug may become difficult in such cases. The use of isolated (*in-vitro*) preparations provides a distinct advantage and facilitates the experimental investigations concerning mode of action of drugs. The experimental conditions may be precisely controlled in these experiments. The effect of drug can be studied independent of the influence of other systems. The isolated preparations are commonly used in experiments because of these advantages. The intact preparation (*in-vivo*) experiments (i.e. whole animal experiments) are also of importance to study the effects of drugs, the interaction between the body factors and drugs.

ABOUT THE AUTHOR



Dr. MANJUNATHA P. MUDAGAL

Dr. Manjunatha P. Mudagal, M. Pharm, Ph. D., Professor, Acharya & B. M. Reddy College of Pharmacy, Bengaluru. He is reputed teacher with more than 20 years of teaching experience to UGs and PGs. He has been a member of BOS-PG for Rajiv Gandhi University of Health Sciences, Bengaluru & Member Secretary, Indian Pharmaceutical Association-Karnataka branch where advocacy issues are discussed and resolved. He has received grants to tune of 1.60 Crore from various funding agencies and industry consultancies. He is technical consultant to various Pharmaceutical/Biotech/Ayurvedic/Phytochemical industries and till dated completed 65 numbers of consultancy to various industries. He had guided 30+ M. Pharm students, published 52 research papers, of which several have been cited in peer revived journals and authored 6 text books.

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First Edition

TEXTBOOK OF PHARMACOLOGY - I

Manjunath PM
Priyanka Pamba
Nageena Taj

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Mrs. Priyanka Pamba
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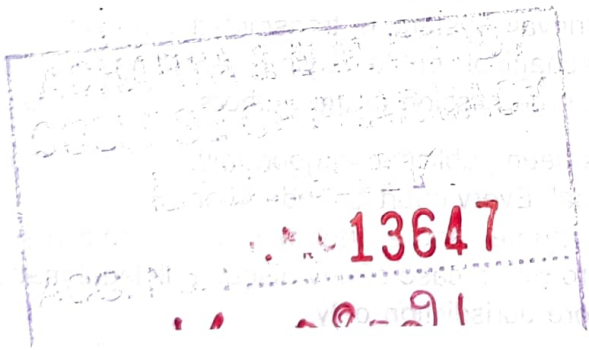

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Textbook of Pharmacology - I

- **Dr. Manjunath PM**
  Mrs. Priyanka Pamba
  Mrs. Nageena Taj

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PREFACE

The Pharmacy graduates play vital role in determining the safety and efficacy of pharmaceutical products whereas the pharmacology is the backbone which gives fundamental information from cell to molecular level that reinforce research and development of new drug entities.

The textbook of '**Pharmacology I**' is primarily meant to serve the undergraduate students of pharmacy with due emphasis on general pharmacology principles, drugs acting on autonomic nervous system, peripheral nervous system and central nervous system as per syllabus provided by pharmacy council of India. Each unit of this textbook starts with learning outcomes, concepts regarding organizations, functions, general principles of pharmacology, classification of drugs, pharmacology of drugs and ends with questions for practice.

This textbook will also serve as a quick reference for basic pharmacological concepts to post graduate students as well as professors.

Dr. Manjunath PM
Mrs. Priyanka Pamba
Mrs. Nageena Taj

CONTENTS

Chapter - 1

Introduction to General Pharmacology

Learning objectives:

- Understand the significance of various routes of drug administration.
- Describe each route of administration with their advantages and disadvantages.
- Describe various sources of drugs.

Introduction to general pharmacology

Definition: It is a pharmaceutical science, which deals with the study of drugs on living system.

Pharmacology is derived from Greek word *'pharmacon'* means drugs and *'logos'* means study.

Source of drugs:

The various sources of drugs are:

- **Primitive Medicine:** Folklore/traditional witchcraft (these medicines were discovered by observing the reaction of some animals to particular herbs)

  Eg: Quinine was discovered from Africa; used for malaria

  Lime juice for Ascorbic acid/Vitamin C -used for scurvy and gum bleeding

Dr. Manjunatha P Mudagal, M.Ph, Ph.D, Professor & HOD, Dept. of Pharmacology, Acharya & BM Reddy College of Pharmacy, Bengaluru. He is reputed teacher with more than 20 years of teaching experience to UGs and PGs. He has been a member of BOS-PG for Rajiv Gandhi University of Health Sciences, Bengaluru & Member secretary, Indian pharmaceutical association -Karnataka branch where advocacy issues will be discussed and resolved. He has received grants to tune of 1.5Crore from various funding agency and industry consultancy. He is technical consultant to various Pharmaceutical /Biotech/Ayurvedic/ phytochemical industry and till dated completed 65 nos. of consultancy to various industries. Guided 27+ M. Pharm students and published 31 research papers, of which several have been cited in peer revived journals.

Mrs. PambaPriyanka, M. Pharm, Assistant Professor, Dept. of Pharmacology,Acharya & BM Reddy College of Pharmacy, Bengaluru. She is reputed teacherwith more than 10 years of teaching experience. She has been actively co-ordinated in consultant projects of various Ayurvedic/ phytochemical industry.Co-guided M.Pharm and BAMS projects from the year 2014. She also wrote apractical manual of subject Pharmacology II for III year B.Pharmacy Vsemester. She was also actively participated in Fluorosis Mitigation Researchand Resource center, Hubli. She is skilled in in-vitro, in-vivo, in-silico andvarious pharmacological screening methods.

Mrs NageenaTaj, M Pharm, Assistant Professor, Department of Pharmacology, Acharya & BM Reddy College of Pharmacy, Bengaluru.She is a reputed teacher with more than 2 years of teaching experience and has been actively coordinated in consultant projects of various ayurvedic and phytopharmaceutical industries. She has also worked as a medical writer and has extensive experience in content writing, scientific writing, and proofreading. She is skilled in in vitro, in vivo, in silico and various pharmacological screening models. She has published research and review articles in both national as well as international journals

Highlights of the book

- Includes detailed concept of general pharmacology and pharmacology of drugs acting on PNS and CNS.
- Classifications epitomized as flowcharts for the ease of readers.
- Pictorial representation of concepts.
- Textbook is drafted such that it act as quick revision/ ready reference.

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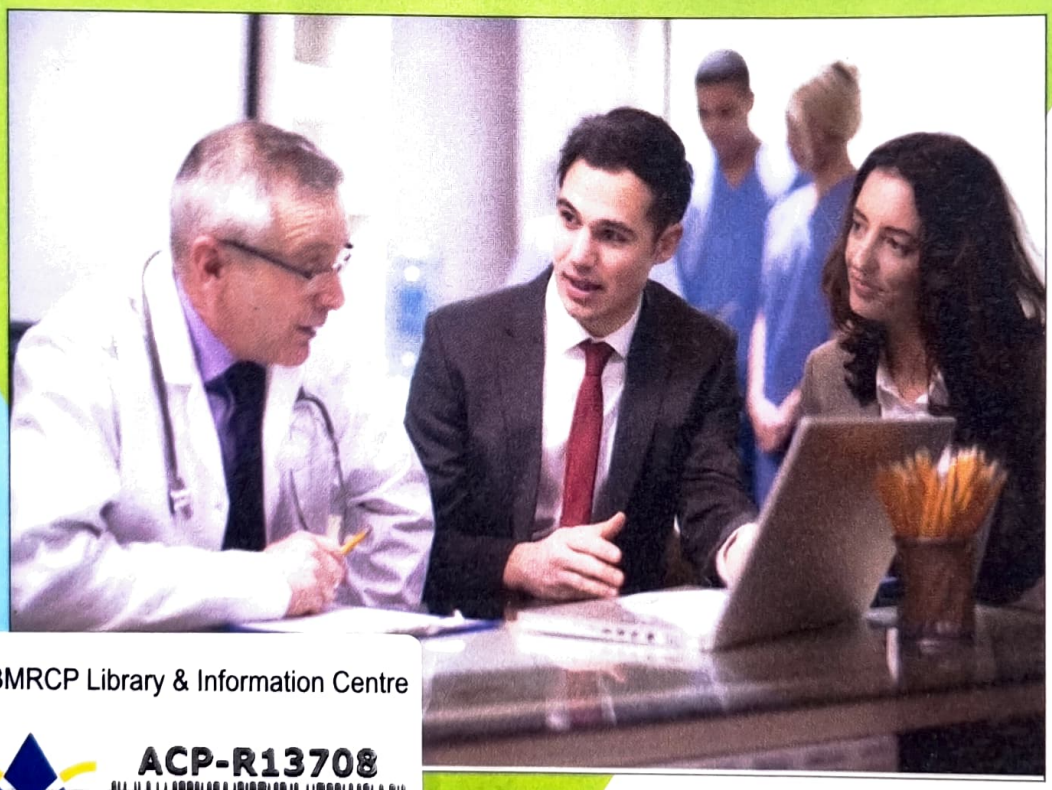
PHARMA MARKETING MANAGEMENT

Dr. UDAY RAJ SHARMA
Dr. DIVAKAR GOLI



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Semester - VIII

Dr. Uday Raj Sharma
M. Pharm., PhD
Professor, Department of Pharmacology
Acharya and BM Reddy College of Pharmacy
Bengaluru, 560 090.

Dr. Divakar Goli
M. Pharm., PhD
President/Vice Chancellor
Raffles University, Rajasthan.
Editor-IJPS and Emeritus Professor - RGUHS

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NIRALI PRAKASHAN
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Nirali Prakashan : Above Maratha Mandir, Shop No. 3, First Floor,
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DELHI

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BENGALURU

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Dedication

Dedicated

To our Parents

Acknowledgement

We honestly acknowledge the blessings of his *Holiness of GOD.*

Words are poor substitutes to express one's feelings passably whenever overwhelmed with emotions of gratitude. The wisdom, commitment and effort of many people were a source of inspiration to carry out this work. Many people provided us valuable contributions and gave helpful comments. However, as a compromise, it is great pleasure for us to acknowledge all those who have contributed towards the conception, origin and nurturing of this book and who made our task less onerous.

We express our sincere thanks to **Shri. *B.M. Reddy, President, JMJ Education Society, Mr. Premnath Reddy, Chairman, Acharya Institutes, Mrs. Shalini Reddy, Executive Director, Acharya Institutes, Mr. Krishna, Director, Acharya Institutes,*** for providing us an opportunity and facility for completion of this book.

We express our sincere thanks to *all* ***Teaching Staff and supporting staff*** of Acharya and BM Reddy College of pharmacy, for their worthy suggestions, encouragement and intense support which have boosted our interest in academics.

Last but not the least, I, **Uday Raj Sharma,** express my warmest of warm and most important acknowledgement by far, is to my **Baba, Mr. Tirtha Raj Sharma, Ma, Ms. Durga Devi Sharma, Wife, Kala Sharma, Son, Master Riyan and all other family members** whose moral support and encouragement with deep appreciation for their indispensable aid, Patience, devotion, Compassion, Generosity in failing courtesy and everlasting love that served a source of my inspiration, strength, determination and enthusiasm at each & every front of my life to transfer my dreams in to reality .

A special thanks to the authors mentioned in the bibliography page. Without you, this book would have never been written.

Finally, it is our great privilege to thank all the people who directly or indirectly involved in the completion of this work.

Place: Bengaluru **Authors**

■■■

Preface

Marketing is an interesting subject to everyone, whether it is of marketing goods, services, properties, people, places, events, informations, idea/organization. Marketing and businessman has maintained its respected position among students, educated people. Pharma marketing management has been kept up-to-date and contemporary. Students and instructors feel that the book conveys the message directly to them in terms of both content and delivery.

This book is intended for use to undergraduate and graduate pharma marketing management courses. This text covers all the essential managerial elements of marketing with sufficient detail to provide a review for marketing background and challenge for the students to the next level of understanding pharma marketing.

Authors

■■■

Syllabus

UNIT I **[10 Hours]**

Marketing:

Definition, General Concepts and Scope of Marketing; Distinction between Marketing and Selling; Marketing Environment; Industry and Competitive Analysis; Analyzing Consumer Buying Behavior; Industrial Buying Behavior.

Pharmaceutical Market:

Quantitative and Qualitative Aspects; Size and Composition of the Market; Demographic Descriptions and Socio-psychological Characteristics of the Consumer; Market Segmentation and Targeting. Consumer Profile; Motivation and Prescribing Habits of the Physician; Patients' Choice of Physician and Retail Pharmacist. Analyzing the Market; Role of Market Research.

UNIT II **[10 Hours]**

Product Decision:

Meaning, Classification, Product Line and Product Mix Decisions, Product Life Cycle, Product Portfolio Analysis; Product Positioning; New Product Decisions; Product Branding, Packaging and Labeling Decisions, Product Management in Pharmaceutical Industry.

UNIT III **[10 Hours]**

Promotion:

Meaning and Methods, Determinants of Promotional Mix, Promotional Budget; An Overview of Personal Selling, Advertising, Direct Mail, Journals, Sampling, Retailing, Medical Exhibition, Public Relations, Online Promotional Techniques for OTC Products.

UNIT IV **[10 Hours]**

Pharmaceutical Marketing Channels:

Designing Channel, Channel Members, Selecting the appropriate Channel, Conflict in Channels, Physical Distribution Management: Strategic Importance, Tasks in Physical Distribution Management.

Professional sales representative (PSR):

Duties of PSR, Purpose of Detailing, Selection and Training, Supervising, Norms for Customer Calls, Motivating, Evaluating, Compensation and Future Prospects of the PSR.

UNIT V **[10 Hours]**

Pricing:

Meaning, Importance, Objectives, Determinants of Price; Pricing Methods and Strategies, Issues in Price Management in Pharmaceutical Industry. An Overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority).

Emerging Concepts in Marketing:

Vertical and Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.

■■■

Contents

■■■

Chapter ... 1

MARKETING AND PHARMACEUTICAL MARKET

♦ LEARNING OBJECTIVES ♦

After completing this chapter, reader should be able to:

- *Describe importance and components of marketing.*
- *Describe environment of pharmaceutical marketing.*
- *Explain socio-psychological characteristics of the consumer.*
- *Explain Concept of market research and segmentation.*

1.1 INTRODUCTION

Scope of Marketing: Marketing comes in a wide range of flavours based on audience, media platform and business in today's evolving and dynamic market place. Therefore, marketers define what they do differently. Before we go on to study of what pharmaceutical marketing is all about, it is important to understand the definition of marketing.

According to the American Marketing Association (AMA) Board of Directors, **Marketing** is, *"The activity, set of institutions and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners and society at large".*

Dr. Philip Kotler defines **Marketing** as *"The science and art of exploring, creating and delivering value to satisfy the needs of a target market at a profit. Marketing identifies unfulfilled needs and desires. It defines measures and quantifies the size of the identified market and the profit potential. It pinpoints which segments the company is capable of serving best and it designs and promotes the appropriate products and services."*

Markets can be viewed as "gaps" that separate parties interested in an exchange. Marketing removes the gaps between the parties through various actualization processes. The role of marketing is to influence or direct activities from the manufacturer to the patient:

- The right products
- In the right quantity
- At the right place
- For the right price
- At the right time

Marketing is a broad concept. In simple words, it means the process through which the goods and services move from the producer to the ultimate user of the products. Philip Kotler, the father of Marketing says, *"Marketing is a social process by which a need is created, offered and exchanged via products (goods,services or an idea):*

ABOUT AUTHORS

Dr. Uday Raj Sharma, has excellence academic career in Pharmacy. He is **Dean-Students Affairs,** Professor in the Department of Pharmacology at Acharya & B M Reddy College of Pharmacy, Bengaluru, Karnataka, India. He is having 17 years of experience in the field of Teaching and Research.

He has completed Masters in Pharmacology from Rajiv Gandhi University of Health Sciences, Bengaluru and Ph.D. in Biotechnology from Acharya Nagarjuna University, Guntur. His Area of Expertise includes: Neuropharmacology and Oncology. He has published 26 National and 15 International publications in various Peer review journals. He has guided Nine M. Pharm. students for their dissertation work and guiding Two Ph.D. students. He has attended 22 International and 43 National conferences, attended 16 National and 20 International workshops and presented posters in 29 conferences.

He is the author of **three** books, namely **Pharmaceutical Marketing Management**, **Pharmacology-II** and Pharmacology-**III** with **Nirali Prakashan**, Pune. He has received 6th Rank in D. Pharm. in Karnataka State, 7th Rank in B. Pharm., and 4th Rank in M. Pharm. Rajiv Gandhi University of Health Sciences. He is a recipient of Distinguished Alumni Award.

He has completed many consultancy project and technology transfer with Industries. He has also completed many research projects with different government industries.

He is been elected continuously three times as EC member in Karnataka State Branch IPA, he is also certified trainer for MSR program approved by LSSDC. He is a president of Institution Innovation Council of Acharya & BM Reddy College of Pharmacy under MHRD, Government of India.

Dr. Divakar Goli, has excellence academic, research and administration career. Currently, he is President/Vice Chancellor in Raffles University, Rajasthan, Editor of IJPS and Emeritus Professor RGUHS.

He is also former Campus Director of Acharya Institutes, Bengaluru and Former Professor and Principal of Acharya & BM Reddy College of Pharmacy, Bengaluru.

He is the Editor of Indian Journal of Pharmaceutical Sciences, the official scientific publication of The Indian Pharmaceutical Association from 2014. Honorary President and Director at Iphar Pharmaceuticals Limited and at Du Laboratories Limited; Secretary of the Education Division and Associate Secretary of the Indian Pharmaceutical Association; Chairman of the 50th Golden Jubilee Celebration Committee of National Pharmacy Week in 2011; Secretary of the International Society of Pharmaceutical Engineering (ISPE), Bangalore chapter, and member of many academic and professional bodies. In 2014 and 2018 (two times), Dr. Goli received the coveted Principal of the year award from the Association of Pharmaceutical Teachers of India. He is also the recipient of the prestigious fellowship of The Indian Pharmaceutical Association, and fellow of Association of Biotechnology and Pharmacy, and Institution of Chemists (India). Active in his field of specialization, pharmaceutical biotechnology and management studies, he is a member of many professional organizations and has presented at numerous National and International conferences. Dr. Goli has published 120+ research articles in professional publications and is also coauthor of two books. Dr. Goli has earned Ph.Ds. in both Pharmaceutical Sciences and Commerce and Management Studies from Andhra University, Visakhapatnam, and well as a Post Graduate Diploma in computer applications. He is also Consultant of various Industries and Author of Four books.

NIRALI PRAKASHAN
ADVANCEMENT OF KNOWLEDGE

Abhyudaya Pragati, 1312,
Shivaji Nagar, Off. J M Road ,
Pune 411005 • Tele: 25512336/37/39
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Dr. UDAY RAJ SHARMA
Dr. DIVAKAR GOLI

NIRALI PRAKASHAN
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A Book Of

PHARMACEUTICAL MARKETING MANAGEMENT

Dr. Uday Raj Sharma
M. Pharm., PhD
Assistant professor, Department Of Pharmacology
Acharya and B. M. Reddy College of Pharmacy
BENGALURU-560 090

Dr. Divakar Goli
M. Pharm., PhD
Principal and Professor
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❖ Dedicated ❖

To Our Parents

Preface

The Pharmaceutical industry currently tops the charts among India's science based industries with wide ranging capabilities in the complex field of drug manufacturing and technology. A highly organized sector, the Indian Pharmaceutical Industry is estimated to be worth $ 4.5 billion, growing at about 8 to 9 percent annually. It ranks from simple headache pills to sophisticated antibiotics and complex cardiac compounds, almost every types of medicine are now made in the Indian Pharmaceutical Industry.

The Pharmaceutical and Chemical industry in India is an extremely fragmented market with severe price competition and government price control. The Pharmaceutical Industry in India meets around 70 per cent of the country demand for bulk drugs, Pharmaceutical formulations, Chemicals, Tablets, Capsule, Orals and Injectables.

India's Pharmaceutical Industry is now third largest in the world and 14th in terms of volume. According to the data published by the Departments of Pharmaceuticals, Ministry of Chemicals and Fertilizers, the Indian Pharmaceutical market is expected to reach US$ 55 billion by 2020 from 12.6 billion in 2009. The market has further potential to reach US$ 70 billion by 2020 in an excessive growth scenario. Further estimated, the healthcare market in India will reach US$ 31.59 billion by 2020.

The importance of marketing in the pharmaceutical industry cannot be overemphasized. Marketing is undergoing something of a revolution as the pharmaceutical industry reacts to a multitude of challenges. Achievement in the pharmaceutical industry is all about victory in the market place, thus the need for studying Pharmaceutical Marketing Management as a comprehensive subject.

This book is intended for use to undergraduate and graduate marketing management courses. This text covers all the essential managerial elements of marketing with sufficient detail to provide a review of marketing background and challenges for the students to gain the next level of understanding marketing in the pharmaceutical industry. The book is intended to convey the message directly to the students and instructors alike in terms of both content and delivery.

We have endeavoured to present the most recent, most accurate, and most reliable information. However, any errors are wholly unintentional and we apologize for the same. Suggestions and comments for improvement of the text are most welcome.

Authors

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Acknowledgements

We sincerely acknowledge the blessings of *GOD.*

Words are poor substitutes to express ones feelings especially when one is overwhelmed with emotions of gratitude. The wisdom, commitment and efforts of many people were a source of inspiration during the writing of this book.

Many people provided us valuable contributions and gave helpful comments. It gives us great pleasure to acknowledge all those who have contributed towards the conception, origin and nurturing of this book and who made our task less onerous.

We are indebted to ***B. M. Reddy, President, JMJ Education Society, Mr. Premnath Reddy, Chairman, Acharya Institutes, Mrs. Shalini Reddy*** for providing us the opportunity and environment for the completion of this book. Words alone cannot express what we owe them for their encouragement which enabled us to complete this book.

We express our sincere thanks ***to Dr. Kalyani Divakar, Dr. Amit Kumar Das, Prof. Anup Kumar Roy*** and ***all other Teaching Staff and supporting staff*** of **Acharya** and **B. M. Reddy College of Pharmacy**, ***Dr. T Prakash***, ***Malareddy College of Pharmacy, Prof. S. B. Gokhale*** and ***Nirali Prakashan,*** for their worthy suggestions, encouragement and support.

We are also grateful for the kind co-operation of all our beloved **students,** who helped us in preparing this book and also take this opportunity to express our gratitude to ***Mr. V Surenda, Ms. Kajal Patel, Mr. Sajal, Mr. T. Hari, Mr. Nitesh and Mr. Munna.***

Last but not the least, I, Uday Raj Sharma, express my warmest and most heartfelt acknowledgement by far, to my **Baba, Mr. Tirtha Raj Sharma, Ma, Ms. Durga Devi Sharma, Sister, Ms. Arati, Brothers, Mr. Babu, Mr. Krishna, Mr. Mohan, Sister in law, Ms. Sabitri, Ms. Rekha, Brother in law, Mr. Heera, Aniket, Ishita, Krittika, Ayush** and all other family members for their moral support and encouragement, their indispensable aid, patience, devotion, compassion, generosity, and everlasting love that served as a source of my inspiration, strength, determination and enthusiasm at each and every front of my life to transfer my dreams in to reality.

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Finally, it is our great privilege to thank all the people directly or indirectly involved in the publishing of this work.

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Chapter 1

PHARMACEUTICAL MARKETING

Introduction

Marketing comes in a wide range of flavours based on audience, media platform and business in today's evolving and dynamic marketplace. Therefore, marketers define what they do differently. Before we go on to study what pharmaceutical marketing is all about, it is important to understand the definition of marketing.

According to the **American Marketing Association (AMA)** Board of Directors, **Marketing** is *"the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large".*

Dr. Philip Kotler defines **Marketing** as *"the science and art of exploring, creating, and delivering value to satisfy the needs of a target market at a profit. Marketing identifies unfulfilled needs and desires. It defines, measures and quantifies the size of the identified market and the profit potential. It pinpoints which segments the company is capable of serving best and it designs and promotes the appropriate products and services."*

Markets can be viewed as "gaps" that separate parties interested in an exchange. Marketing removes the gaps between the parties through various actualization processes. The role of marketing is to influence or direct activities from the manufacturer to the patient:

- The right products,
- In the right quantity,
- At the right place,
- For the right price,
- At the right time.

Pharmaceutical Marketing as **a sub-specialty of marketing** and can be defined as *"a process through which market for the pharmaceutical core is actualized".* It encompasses all the activities executed by different individuals or organizations to actualize market products.

1.1 PHARMACEUTICAL MARKETING

The Pharma industry has come a long way since 754 A.D. when Arabian pharmacists opened the first documented drugstore, which was likely filled with herbs, healing plants, and other mysterious remedies.

Pharmaceutical marketing is a dynamic field which has gained greater complexity in recent years. Pharmaceutical marketing like marketing in other industries is a social process manifested on the market. Rather than in an isolated vacuum, organizations operate in a complex dynamic environment.

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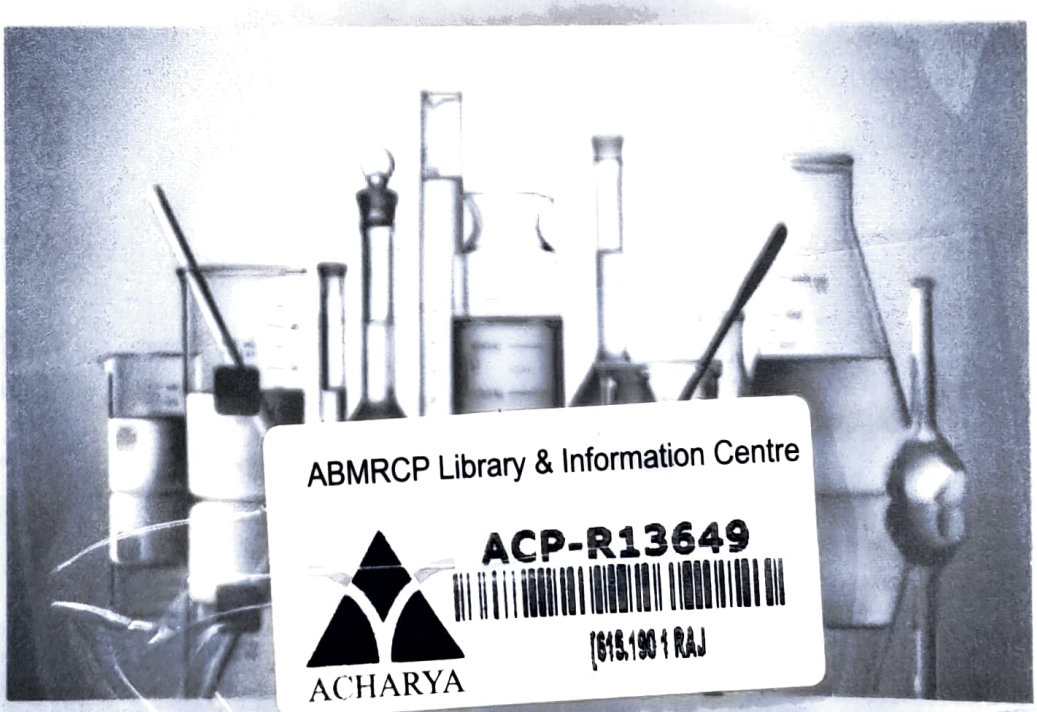

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PREFACE

Pharmaceutical analysis is a broader concept which can be described in many ways. It is the series of processes that are used for identification, determination, separation, purification, and structure elucidation of the given compound used in the formulation of pharmaceutical products. Over the years, pharmaceutical analysis has gained importance as this branch has witnessed technological advancement and enrichment.

This book explores the principles of pharmaceutical analysis in depth, including its types and relevant terminologies. Each chapter consists of the detailed discussion of the fundamental concepts, theories and principles commonly used in volumetric and electrochemical analysis and its pharmaceutical applications.

The idea of writing this book was conceived, when our students found it very difficult to get a book appropriate for their academic needs. This book is focused on the B.Pharm syllabus, as recommended by pharmacy council of India and adopted by most of the universities in the country.

I hope this book will help you to achieve your objectives. We would be thankful to all teachers and students who will be kind enough to identify errors that have missed our attention. Suggestions for further improvements will be greatly appreciated.

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31/01/2021

Dr. Rajesh R.

SYLLABUS

Unit I (a) Pharmaceutical analysis: Definition and scope i) Different techniques of analysis

ii) Methods of expressing concentration iii) Primary and secondary standards. iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate

(b) Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures

Unit II Acid base titration: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves.

Non aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl.

Precipitation titrations: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.

Complexometric titration: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.

Unit III Gravimetry: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate. Basic Principles, methods and application of diazotisation titration.

UNIT-IV Redox titrations: (a) Concepts of oxidation and reduction

(b) Types of redox titrations (Principles and applications), Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate.

UNIT-V Electrochemical methods of analysis: Conductometry- Introduction, Conductivity cell, Conductometric titrations, applications.

Potentiometry: Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications.

Polarography: Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications.

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Polarography: Principle, Ilkovic equation, construction and working of droppi mercury electrode and rotating platinum electrode, applications.

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Unit I

Pharmaceutical Analysis

Learning outcome

After successful completion of this chapter, the student will be able to

- Describe the principles, definitions and scope of the pharmaceutical analysis
- Explain the various pharmaceutical analytical techniques
- Discuss the preparation and standardisation of different molar and normal solutions

1.1 Pharmaceutical Analysis: Definition and Scope

Pharmaceutical analysis is a technique that uses manual, chemical or instrumental methods to identify or determine any sample/ compound or drug. In two main areas, pharmaceutical analysis has been applied, i.e. quantitative and qualitative analysis, although a variety of other applications are available.

A more appropriate definition of analytical chemistry is "the science of inventing and applying the concepts, principles and techniques for the measurement of chemical system characteristics". The development of new pharmacopoeial methods, stress tests to validate stabilisation-indicating approaches, impurity study and detection, herbal or animal material analysis, cleaning validations, degradation tests and stability studies may also be included in the pharmaceutical analysis tasks.

Pharmaceutical analysis explores the fundamentals of analytical chemistry and the concepts of electrochemical drug analysis. Analytical techniques

Pharmaceutical Analysis

About the author

Dr. Rajesh R. is an Associate Professor & HOD, Department of Pharmaceutical Analysis, Acharya & BM Reddy College of Pharmacy, Bengaluru, affiliated to Rajiv Gandhi University of Health Sciences, Bengaluru. He holds B.Pharm and M.Pharm from Tamil Nadu Dr. MGR Medical University, Chennai and PhD in Pharmacy from Sri Ramachandra Institute of Higher Education and Research, Chennai. Dr. Rajesh. R has 21 years of academic and research experience. He has guided eight M.Pharm students, published 25 research papers in reputed national and international journals and has presented 18 research articles in national and international seminar/conferences.

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Preface

The Pharmacy graduates play vital role in determining the safety and efficacy of pharmaceutical products. The pharmacologists bestow their knowledge in developing new drug therapies.

The intention of this practical manual titled '**Pharmacology-I**' is to provide the student an organized information to enable them to understand the laboratory aspects of pharmacology as well as to avail learning laboratory material and preparing for viva-voce and synopsis.

Each lab exercise is framed as complete module that demonstrates pharmacological principles as well as procedures to reinforce theoretical aspects and to give hands on laboratory experiences.

We are thankful to the management of Acharya & BM Reddy College of Pharmacy, Bengaluru for their keen interest and timely encouragement that made it possible to bring out this first volume.

Our sincere thanks are to **Shri Dineshbhai Furia** and **Shri Jignesh Furia** of **Nirali Prakashan, Pune,** for their co-operation and interest taken in publishing this book. We are also thankful to the staff of Nirali Prakashan, especially Roshan Khan, Mrs. Varsha Bodake, and Mr. Ravindra Walodare of Nirali Prakashan for bringing out this nicely printed book.

Suggestions and comments are always welcome and they shall be gratefully acknowledged.

Authors

Manjunatha P. Mudagal

Pamba Priyanka

Nageena Taj

Syllabus

BP 408 P. PHARMACOLOGY-I (Practical) (4 hours/week)

1. Introduction to experimental pharmacology.
2. Commonly used instruments in experimental pharmacology.
3. Study of common laboratory animals.
4. Maintenance of laboratory animals as per CPCSEA guidelines.
5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
6. Study of different routes of drugs administration in mice/rats.
7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
8. Effect of drugs on ciliary motility of frog oesophagus
9. Effect of drugs on rabbit eye.
10. Effect of skeletal muscle relaxants using rota-rod apparatus.
11. Effect of drugs on locomotor activity using actophotometer.
12. Anticonvulsant effect of drugs by MES and PTZ method.
13. Study of stereotype and anti-catatonic activity of drugs on rats/mice.
14. Study of anxiolytic activity of drugs using rats/mice.
15. Study of local anesthetics by different methods.

Index

INTRODUCTION TO PHARMACOLOGY EXPERIMENTS

The aim of pharmacology experiments is to:

1. **Find out a bioactive agent suitable for human use.**
2. **Study the toxicity of a bioactive/NCE's/drug.**
3. **Study the mechanism and site of action of drugs.**

The experimental pharmacology involves the discovery of new drugs (new chemical entities) or to study the actions of existing drugs (re-purposing) which will be done in two main stages, *i.e.*

(A) Preclinical research, which involves the identification and optimization of novel chemical lead structures and testing it on animals and animal tissues or organs for their biological actions.

(B) The second stage, where testing of drugs is done on human volunteers and patients for assessing the ADME parameter safety and efficacy in humans.

Since pharmacists come in contact with drugs at every stage of its development, right from synthesis, pharmacological testing, formulation of drugs to dispensing, it is quite apparent that a student of pharmacy to have adequate exposure and knowledge of experimental pharmacology.

About the Authors

Dr. Manjunatha P. Mudagal, M. Pharm, Ph. D, Professor, Acharya & B. M. Reddy College of Pharmacy, Bengaluru. He is reputed teacher with more than 20+ years of teaching experience to UGs and PGs. He has been a member of BOS-PG for Rajiv Gandhi University of Health Sciences, Bengaluru & Member Secretary, Indian Pharmaceutical Association-Karnataka branch where advocacy issues will be discussed and resolved. He has received grants to tune of 1.60 Crore from various funding agencies and industry consultancies. He is technical consultant to various Pharmaceutical /Biotech/Ayurvedic/ Phytochemical industries and till dated completed 65 nos. of consultancy to various industries. He had guided 30+ M. Pharm students, published 52 research papers, of which several have been cited in peer revived journals and authored 6 text books.

Mrs. Pamba Priyanka, M. Pharm, Assistant Professor, Dept. of Pharmacology, Acharya B. M. Reddy College of Pharmacy, Bengaluru. She is reputed teacher with more than 10 years of teaching experience. She has been actively co-ordinated in consultant projects of various Ayurvedic/ Phytochemical industries. She had co-guided M.Pharm and BAMS projects from the year 2014. She also wrote a practical manual of subject Pharmacology-II for Third year B. Pharm. Semester-V. She was also actively participated in Fluorosis Mitigation Research and Resource Center, Hubli. She is skilled in in-vitro, in-vivo, in-silico and various pharmacological screening methods.

Mrs. Nageena Taj, M. Pharm., Assistant Professor, Department of Pharmacology, Acharya & B. M. Reddy College of Pharmacy, Bengaluru. She is a reputed teacher with more than 3 years of teaching experience and She has been actively coordinated in consultant projects of various Ayurvedic and Phytopharmaceutical industries. She had also worked as a medical writer and has extensive experience in content writing, scientific writing, and proof reading. She is skilled in in-vitro, in-vivo, in-silico and various pharmacological screening models. She had published research and review articles in both national as well as international journals.

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A TEXTBOOK OF
PHARMACOGNOSY AND PHYTOCHEMISTRY

Pharmacognosy, known initially as Materia Medica, may be defined as the study of crude drugs obtained from plants, animals and mineral kingdom and their constituents. These are also used for treating various diseases, besides, in the cosmetics, textile and food industries. This book covers all the subjects comprehensively that are required by the student of Pharma. Topics like metabolic pathways in higher plants, secondary metabolic, isolation, identification and analysis of phytoconstituents, industrial production, phytochemistry, spectroscopy techniques, chromatography and its applications and electrophoresis.

This book is a precious resource of data for the students of allied botanical and phytochemical sciences.

Salient Features

- Precise language and simple narrative for understanding important concepts.
- Provide key knowledge on important topics like tracer methods, biosynthetic pathways, methods of extraction, quantification, industrial production of phytoconstituents, chromatography, and spectroscopy.
- Comprehensive coverage of isolation and estimation of phytoconstituents, concepts of phytochemistry and other medicine production in industry.
- Conceptual representation in diagrams for comprehension.

Hemalatha K, is Assistant Professor, Acharya and BM Reddy College of Pharmacy, Soladevanahalli, Bengaluru. Karnataka, India, She completed her M. Pharma and PhD from Rajiv Gandhi University of Health Sciences, Bangalore. She has over 18 years of academic experience at both the undergraduate and graduate levels. She has been awarded Darsh Vidya Saraswathi Rashtriya Puraskar's "Best Teacher Award 2021". She has over 40 publications, including reviews and research papers, in national and international journals, as well as two book chapters published by LAMBERT Academic Publications and several certification courses. She has conferred her analysis findings at many national and international conferences. She is a member of pharmaceutical organisations such as IPA, POWER, START HERB and others, as well as a member of the Scientific Editorial Board of several national and international scientific publications. She is now researching herbal formulations and nutraceutical developments for a variety of clinical diseases.

Pulak Majumder, is as Associate Professor, Sri Adichunchanagiri College of Pharmacy, Adichunchanagiri University, BG Nagar, Karnataka, India He completed his B. Pharm (2007) and M. Pharm (2010) from Rajiv Gandhi University of Health Sciences, Bangalore, PG Diploma in public health from Annamalai University (2015) and PhD from PRIST University, Tamandu, India. He has more than 12 years of academic experience. He has been awarded "Best research scholar" 2019, "Young Scientis Award 2020", "Research Excellence Award, 2020" He is also a Fellow Member (FSASS) of Scholars Academic and Scientific Society since 2021. He has more than 36 review and research papers in repuated national and international journals and authored two books, several book chapters published from Elsevier along with an Indian Patent to his credit. He has represented his research work and attended various national and international conferences. He is a member of various pharmaceutical organizations such as IPA, IFERP, INSc, BOS and faculty of health sciences (Adichunchanagiri University) etc,, and also serving a Scientific Editorial Board Member of various national and international scientific journals. Currently, he is researching on herbal formulation developments for various clinical conditions.

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PHARMACOGNOSY AND PHYTOCHEMISTRY

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A TEXTBOOK OF PHARMACOGNOSY AND PHYTOCHEMISTRY

VOL-I

Hemalatha K
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Experimental Pharmaceutics For I.BPharm (As per PCI Revised Syllabus)

Dr. Sajal Kumar Jha
Dr. Venkatesh D.P.
Dr. Roopa Karki
Dr. Divakar Goli

3.3.2 Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during last five year

	Name of the teacher	Title of the paper	Title of the proceedings of the conference	Name of conference	National/ international	Year of publication	ISBN/ISSN number of the proceeding
1	Abhishek Ghaara	Dual targeted pyrimidine derivatives in the treatment of inflamation related cancer	Xenobiotics in India second annual meeting	Xenobiotics in India second annual meeting	National	2017	
2	Giles D	Pyrimidine based cycloxygenase -2 and thymidlate synthase inhibitors: design, synthesis and in vitro biological evaluation	Xenobiotics in India second annual meeting	Xenobiotics in India second annual meeting	National	2017	
3	Gurubasavaraja Swamy P.M	Design and synthesis of novel pyrimidine derivatives as a priviledged scaffold in targeting Myb/ Myc induced acute Myeloid Leukemia	Xenobiotics in India third annual meeting	Xenobiotics in India third annual meeting	National	2018	
4	Abhishek Ghara	Coumarin derivatives as antiinflammatory and anticancer agent	Xenobiotics in India third annual meeting	Xenobiotics in India third annual meeting	National	2018	
5	Giles D	Coumarin derivatives as antiinflammatory and anticancer agent	Xenobiotics in India third annual meeting	Xenobiotics in India third annual meeting	National	2018	
6	Giles D	Pyrimidine derivatives as anti-inflamatory and anticancer agent	Xenobiotics in India third annual meeting	Xenobiotics in India third annual meeting	National	2018	
7	Ekta Singh	Pyrimidine derivatives as anti-inflamatory and anticancer agent	Xenobiotics in India third annual meeting	Xenobiotics in India third annual meeting	National	2018	
8	Gurubasavaraja Swamy P.M	Design and synthesis of novel benzodiazepines derivatives as a priviledge scaffold in targeting Her 2uced breast cancer	Xenobiotics in India third annual meeting	Xenobiotics in India third annual meeting	National	2018	
9	Jithu Jerin James	Nano particles of rerratiopeptidase for improved oral delivery : formulation, invitro evaluation using PAMPA , Caco-2 and bioavailability studies	Xenobiotics in India third annual meeting	Xenobiotics in India third annual meeting	National	2018	
10	Giles D	Prodrugs of Hydralazine for improved bioavailability	Xenobiotics in India third annual meeting	Xenobiotics in India third annual meeting	National	2018	
11	Gurubasavaraja Sw	Discovary of novel small molecule tyrosine kinase inhibitors of Egfr and Her -2 by ligand based virtual screening	ICDD-2020	ICDD-2021	Internatior	2020	
12	Giles D	Discovary of novel small molecule tyrosine kinase inhibitors of Egfr and Her -2 by ligand based virtual screening	ICDD-2021	ICDD-2022	Internatior	2020	

13	Uday Raj Sjharma	Cerebroprotective activity of Fumaria officinalis extract on rats	9th int. congress of society for ethnopharmacology , India	10th int. congress of society for ethnopharmacology , India	International	2022	
14	Nageena Taj	Cerebroprotective activity of Fumaria officinalis extract on rats	9th int. congress of society for ethnopharmacology , India	10th int. congress of society for ethnopharmacology , India	International	2022	
15	Surendra V	Cerebroprotective activity of Fumaria officinalis extract on rats	9th int. congress of society for ethnopharmacology , India	10th int. congress of society for ethnopharmacology , India	International	2022	
16	Manjunatha PM	Cerebroprotective activity of Fumaria officinalis extract on rats	9th int. congress of society for ethnopharmacology , India	10th int. congress of society for ethnopharmacology , India	International	2022	
17	Moumita Banerjee	Metaverse and Pharmacy	Current advances in pharmaceutical industry and development	Current advances in pharmaceutical industry and development	International	2023	ISBN:978-93-92106-20-0
18	Dr. Madhavi BLR	Formulation and evaluation ofantiviral herbal nasal drops containing tulshi and liquorice extract	Current advances in pharmaceutical industry and development	Current advances in pharmaceutical industry and development	International	2023	ISBN:978-93-92106-20-0

Xenobiotic Research in India
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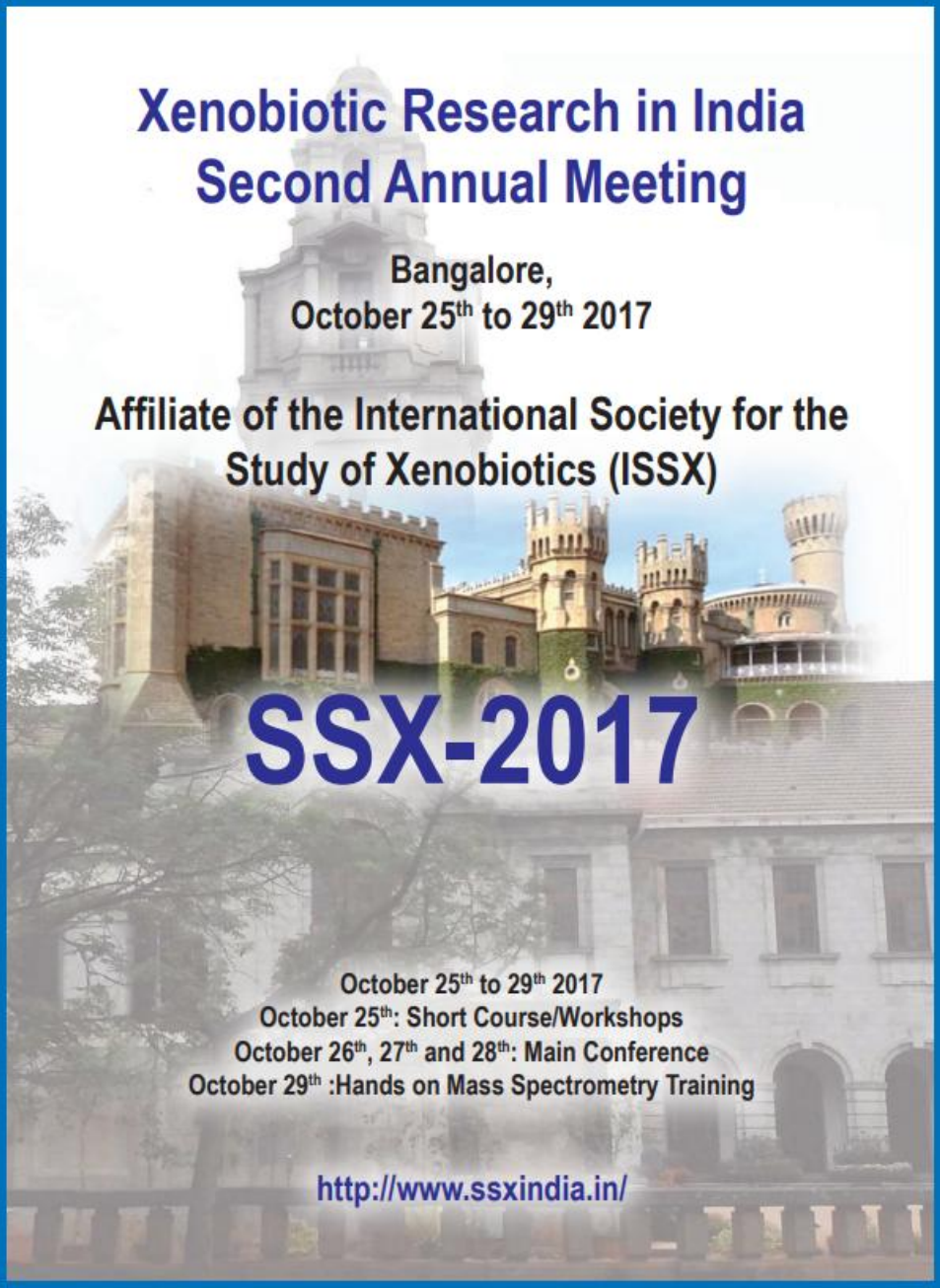

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October 26th, 27th and 28th: Main Conference
October 29th :Hands on Mass Spectrometry Training

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P-34

Dual targeted pyrimidine derivatives in the treatment of inflammation related cancer

Yeshna Gooljar, Abhik Debbarman, Giles D, Abhishek Gharra, MD Abdullah Alam
Acharya & BM Reddy College of Pharmacy, Soldevanhalli, Achit Nagar Post, Bengaluru, Karnataka.

Docking studies were carried out for several standard anticancer drugs in cyclooxygenase 2 (1CX2) and Thymidylate synthase (1HVY) receptors. The binding affinity and interaction with specific amino acid with receptors were studied. On the basis of above facts, several substituted pyrimidine derivatives were designed to bind with specific amino acid within the receptor similar to the standard anticancer drugs. Best hit molecules were selected on basis of their docking score, hydrogen bonding and physicochemical parameters. The best molecules were synthesized and confirmed by IR, H1NMR and Mass spectral data. The synthesized compounds were evaluated for their anti-inflammatory and anticancer activity. In vitro anticancer activities of synthesized compound were carried out using MCF-7 and EAC cell lines. The substituted derivatives, 4-chloro (3e), 3-bromo-4-methoxy (3j) and 3,4-dimethoxy (3l) showed better anti-inflammatory activity and 3j and 3l showed good anticancer activity. Presence of methoxy, chloro and nitro groups as substitution in benzene ring increases the pharmacological activity. Pyrimidine derivative containing indole ring showed excellent anti-inflammatory and anticancer activity.

P-35

Pyrimidine based cycloxygenase-2 and thymidylate synthase inhibitors: Design, synthesis and *in vitro* biological evaluation

Sai Prabha VN, Biswa Jyoti Nath, Giles D, Geetha S, Rajdeep Basu
Acharya & BM Reddy College of Pharmacy, Soladevanahalli, Achit Nagar Post, Bengaluru, Karnataka.

Docking as well as QSPR analysis for 35 standard anticancer drugs were carried out in 1HVY and 1CX2 receptors using Discovery Studio 3.5. Compounds 3c, 3d, 3b, 3l, 3a, 3j, 3e and 3i showed significant docking score in both 1HVY and 1CX2 receptors. Based on docking and QSPR studies, structures were designed to bind with the receptors more effectively. On the basis of docking studies a series of pyrimidine derivatives were designed and synthesized. The structures were confirmed by IR, 1H NMR and mass spectral data. Synthesized compounds were evaluated for their invitro anti-inflammatory and anticancer activities. In vitro anticancer activity was carried out for all the synthesized compounds using MCF-7 and EAC cell lines. Among all the synthesized compounds, 5-bromo-2-methoxy substituted and indole substituted derivatives showed significant anti-inflammatory and anticancer activity

SOCIETY FOR THE STUDY OF XENOBIOTICS, INDIA 3rd Annual Conference

Program and Abstracts

SSX-2018

October 10th 2018: Short Course/ Workshops
October 11th – 13th 2018: Main Conference

JN Tata Auditorium

Indian Institute of Science (IISc), Bangalore, India 560012

http://www.ssxindia.in/

P-47 Physiologically Based Pharmacokinetic Model Development for Pravastatin (OATP1B1 transporter substrate) to predict the Impact of Genetic Polymorphism on its Disposition

Aravind Rachapally[1], Mayur K. Ladumor[1], Bhagwat Prasad[2] and Saranjit Singh[1]
1Department of Pharmaceutical Analysis, National Institute of Pharmaceutical Education and Research (NIPER), Sector 67, S.A.S. Nagar 160 062, Punjab, India.
2Department of Pharmaceutics, University of Washington, Seattle, WA.

Objective: Pravastatin is a BCS class III drug, which is not significantly metabolized by cytochrome P450 enzymes. Biliary and renal clearance are its main elimination pathways, with each pathway contributing to 40% and 47% of the total clearance, respectively1. The hepatic sinusoidal uptake transporter, OATPIBI, and the canalicular efflux transporter, MRP2, are the major transporters involved in the hepatobiliary disposition of this drug in humans2. OATPIBI is encoded by the gene SLCOIBI, whose SNPs affect the uptake activity of the transporter and alters the PK profile of pravastatin3. In this study, a physiologically based pharmacokinetic (PBPK) model of pravastatin was developed and used to highlight its utility to predict the impact of genetic polymorphism in SLCOIBI gene on disposition of the drug.

Method: The disposition model of the drug was developed using GastroPlusTM version 9.6 via the middle-out approach. The developed model was verified by predicting drug-drug interaction (DDI) with OATPIBI inhibitor drugs, such as cyclosporine, gemfibrozil and rifampicin. The verified model was then extrapolated to quantify the effect of SLCOIBI genetic polymorphism on the PK of the drug by making use of genotype dependent transporter abundance data across varied population4-7.

Results: The developed model gave good visual predictions against clinical observed data. The predicted exposure parameters (Cmax and AUC0-t) were within 0.5-2 fold of the clinically observed data. The predicted DDI result was comparable to literature-based observed DDI result. The extrapolated model was able to well predict the PK profile of the drug in genetically variant population.
Conclusion: This study presents a method to improve the prediction accuracy of PK of pravastatin in individuals having polymorphic variants of SLCOIBI, a gene encoding OATPIBI transporter.

P-48 Design and synthesis of novel pyrimidine derivatives as a privileged scaffold in targeting Myb/Myc induced Acute Myeloid Leukemia

Nahid Abbas[1], Gurubasavaraja Swamy P.M.[1]
[1]Department of Pharmaceutical Chemistry, Acharya and B.M. Reddy college of Pharmacy, Bangalore- 560107

In our current study we designed novel pyrimidine derivatives using ACDchem sketch and Discovery studio 3.5; a pharmacophore model was developed, promising ligands were docked with the c-*myb* proto-oncogene (MYB) which encodes the c-Myb transcription factor (PDB code lSBO), The c-Myb protein appears to be regulated by a large number of post-translational modifications that are likely to affect its interactions with co-regulators like C/EBPbeta and transcriptional co-activators like CBP or p300. The crystal structure of 87 aminoacids to form protein CBP reveals an active conformation poised to interact with our designed 108 novel ligands. The parameters namely, drug likeness, ADME and Toxicity and Docking score were calculated using various algorithms. Among 108 designed novel molecules 43 possessed good characteristics feature for the lead molecule as they had docking energy, Cdocker interaction energy, hydrogen bonding better than the standard and had same binding amino acids . Presence of pyrimidine linked with different hetero molecules could have caused the molecule to obtain the configuration necessary to bind with the target.

Most promising ligands with good receptor interactions and low toxicity were synthesized by using Clasein-Schmidt condensation and later by cyclization reaction the chalcones were reacted with guanidine hydrochloride to yield pyrimidine derivatives. After their characterization by FTIR, NMR and MASS Spectroscopy. *In vitro* cancer study on HL60, U937 and K562 leukemia cell line was recommended and RTPCR gene expression study especially for N75 and N32 was recommended.

P-49 *In-vitro* Screening of Soluble Epoxide Hydrolase Inhibition in Traditionally used Indian Medicinal Herbs having Anti Inflammatory Activity

Anitha K N [1], **Geetha K M** [2]

[1.] *Department of Pharmacology, College of Pharmaceutical Sciences, Dayananda Sagar University and Government college of Pharmacy Bangalore – 5600027, India*

[2.] *Department of Pharmacology, College of Pharmaceutical Sciences, Dayananda Sagar University, Kumaraswamy Layout, Bangalore-560078, India*

Introduction: Soluble epoxide hydrolase (sEH) offers hope for developing new agents for the control of both inflammatory and neuropathic pain. Soluble epoxide hydrolase (sEH) has been proved to be a key enzyme involved in inflammation progression, and inhibition of sEH is therefore very helpful or crucial for the treatment of inflammation-related diseases. In order to uncover new clues suggesting the presence of phytochemical-based sEH inhibitors, and to rationalize the utility of the inflammation-treating Indian medicinal herbs, the methanol and ethyl acetate extracts derived from I5 medicinal herbs, traditionally used for the treatment of inflammation-associated diseases in India, were tested for sEH-inhibition activity using a recently developed sensitive fluorescence- based assay.

Aim of the study: The aim of the present study was to screen soluble epoxide hydrolase inhibition (In vitro) by extracts derived from inflammation-treating Indain medicinal herbs

Experimental Methods: Dried plant extracts were solubilized at 10 mg/mL in DMSO. Their inhibitory potencies were measured against the human sEH using a fluorescent reporting system. Activity was measured by determining the appearance of the 6-methoxy-2-naphthaldehyde with an excitation wavelength of 330 nm and an emission wavelength of 465 nm for 10 min.

Results: Three extracts showed substantial inhibitions of sEH (inhibition rates >50%). The ethyl acetate extract of *Embelia ribes* (seed) possessed the strongest inhibitory activity against sEH IC_{50} 7.232 microg/mL.

Conclusion: These preliminary findings highlighted the presence of sEH inhibitor(s) in the plant kingdom, and the possibility that the inflammation-treating herbal medicines could be an untapped reservoir for sEH-inhibition agents.

Present address: College of Pharmaceutical Sciences, Dayananda Sagar University, Kumaraswamy Layout, Bangalore-560078, India

Key words: Soluble epoxy hydrolase inhibitor; *Embelia ribes*; Anti inflammatory

P-50 Coumarin Derivatives as Anti-inflammatory and Anticancer Agents

Abhishek Ghara[1], Rajdeep Basu[1], Vidhya Thomas[1], Giles D[1]

[1]Acharya & BM Reddy College of Pharmacy, Soldevanahalli, Achit Nagar Post, Bengaluru, Karnataka, India

A series of 4-hydroxy-3-(2-(2-[2-[(substituted phenyl)methylidene]hydrazin-l-yl]-l,3-thiazol-5-yl)- 1-phenylethyl)-2*H*-chromen-2-one (**4a-j**) derivatives were synthesized with various substitutions and tested their potential biological activity like anti-inflammatory and anticancer. The synthesized compounds were confirmed by physical and spectral data such as TLC, melting point, IR, NMR, and mass spectrometry. *In silico* docking study was performed for all the synthesized compounds to predict the binding conformations of the ligand into the active site. Anti-inflammatory activity and anticancer activity were carried out for all the synthesized compounds. Among all synthesized compounds, nitro substituted compounds exhibited good anti-inflammatory and anticancer activity.

P-51 Pyrimidine Derivatives as Anti-inflammatory and Anti-cancer Agents.

MD Abdullah Alam, Deepak Kumar Gupta, D Giles, Ekta Singh

Acharya & BM Reddy college of Pharmacy, Soldevanahalli, Achit Nagar post, Bengaluru, Karnataka- 560107

Several methoxy substituted pyrimidine derivatives were designed and synthesised for its pharmacological activity towards cancer-related inflammation. The compounds were synthesized from **I**, 3-Indanedione and the final derivatives were confirmed by the spectral data like IR, ^{1}H NMR and mass. The final compounds were subjected to pharmacological evaluation like anti-cancer and anti-inflammatory activity. Anti-inflammatory activity was carried out using carrageenan induced paw oedema method in rats and anti-cancer activity using EAC cells in mice. Compounds **2c** and **2g** were found to possess good anti-inflammatory activity. Moderate anticancer activity was observed for compound **2c**. Finally, it was concluded that methoxy group as substitution in pyrimidyl 1, 3-Indanedione can act as potent anti-inflammatory and anti-canceragent.

P-52 Design and Synthesis of Novel Benzodiazepines Derivatives as a Privileged Scaffold in Targeting Her2 induced Breast Cancer

Geetha. S[1], Nahid abbas[1], Bharatesh k.Bl, Gurubasvaraja P.M.[1]

Department Of Pharmaceutical chemistry, Acharya and B.M.Reddy college of Pharmacy, Bangalore- 560107

In our current designed novel benzodiazepines derivatives using discovery studio 3.5 a pharmacophore model was developed, promising ligands were docked with receptor tyrosine protein kinase proto-oncogene encoded by ErbB2 gene (PDB code 2A9l). The crystal structure of ErbB ectodomain reveals an active conformation poised to interact with other ERBB receptors. Ligands with good receptor interactions were synthesized by green chemistry approach. Microwave technique was employed to obtain benzodiazepine derivatives. Initially chalcones were synthesized using clasein-schmidt condensation reaction..The chalcones were further reacted with iodinated o-phenyl diamine to yield benzodiazepine derivatives. After their characterization by FITR, NMR and MASS Spectroscopy in vivo cancer study was conducted by inducing subcutaneous tumours by Ehrlich ascites carcinoma cells in adult male Swiss albino rats. This model targeted breast CANCER INDUCED CARDIOMYOPATHY IN RATS. In Ehrlich ascites carcinoma bearing rats, we found significant reduction in left ventricle internal diameter. we found higher muscle atrophy,

developed successfully.

P-55 A Study on Pharmacotherapeutic Pattern for Pain in Cancer Patients

Chinju Abraham*[1] Arya S Baiju*[1] Mahadevamma L[1] Manasa deepa R[2] K A Sridhar[3]

[1] *Department of Pharmacy Practice East West College of Pharmacy Bengaluru*

[2] *Department of Pharmaceutics East West College of Pharmacy Bengaluru*

[3] *Department of Pharmacology East West College of Pharmacy Bengaluru*

Corresponding Author Address: chinjuabraham995@gmail.com

Cancer pain is a complex, temporally changing symptom which is the end result of mixed mechanism pain such as inflammatory, neuropathic, ischemic etc at multiple site. Analgesic therapy is a prominent therapy to reduce the pain in cancer patients. Aim of the present study is to evaluate the pharmacotherapeutic pattern for pain in cancer patients. Based on the inclusion and exclusion criteria, 220 patients were subjected for prospective and observational studies. Studies data has been evaluated and statistically reported by SPSS software 20.0 ver. Study data reveals that mean pain score of patients having cancer was 3.84. Pain management with NSAIDs states that 82.2% patients were recovered and 12.2% were not recovered. Similarly in adjuant analgesics 81.31% were recovered and 18.69% were not recovered respectively. In case of analgesics along with anaesthetics treatment, data report states that 76.1% were recovered and 23.9% were not recovered. All the datas were significantly reported and found to be 0.05%. The data suggests that usage of analgesics and adjuant analgesics helps to minimize the pain in cancer patients, additionally drug monitoring, medical reconciliation, direct evidence based treatment can further aid the pain management in cancer patients.

Keywords: Cancer pain, Analgesics, Pain scores

P-56 Nanoparticles of Serratiopeptidase for improved oral delivery: Formulation, *In-vitro* evaluation using PAMPA, Caco-2 and bioavailability studies

Sumedha Kulkarni*, Sandhya KV*, Gayathri Devi S, Jithu Jerin James[1]

**Department of Pharmaceutics, Faculty of Pharmacy,*

M.S.Ramaiah University of Applied Sciences, Bangalore, India

[1]Acharya BM Reddy College of Pharmacy

Objective: Serratiopeptidase, a proteolytic enzyme when consumed in unprotected tablet or capsule form is destroyed by acid in the stomach. The main aim of the present investigation was to check whether the nanoparticulate formulations of serratiopeptidase could alter the permeability/ absorption of the drug using PAMPA and Caco-2 models. *In-vivo* studies were conducted in rabbits to study the pharmacokinetic parameters. Thus, the feasibility of using nanoparticulate system as a potential oral delivery for enhanced bioavailability of serratiopeptidase was studied.

Methods: Nanoparticles of chitosan were prepared by ionotropic gelation with sodium tripolyphosphate followed by ultrasonication immediately after the preparation. Serratiopeptidase loaded poly butyl cyanoacrylate (PBC) nanoparticles were prepared by emulsion polymerization of n- butyl cyanoacrylate monomer. The prepared nanoparticles were subjected to various evaluation parameters like drug entrapment, particle size distribution, stability etc. Further investigations of the nanoparticulate formulations of serratiopeptidase were studied to see if it altered the permeability/ absorption of the drug using PAMPA, a non-cell-based assay and Caco-2 assay, a cell monolayer system mimicking *in-vivo* GI epithelium cells. Bioavailability studies of the prepared formulations were performed using New-Zealand white rabbits. Thermo kinetica 4.4.1 version software was used to determine the pharmacokinetic parameters.

P-62 Prodrugs of hydralazine for improved bioavailability

Basavaraj M[1]*, Giles D[2], Das AK[2], Sakharam AG[2].

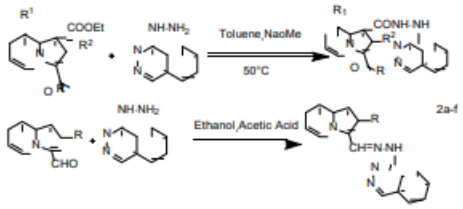
[1]*Vivekananda college of Pharmacy, Department of Pharmaceutical Chemistry, Rajajinagar, Bengaluru-55*

[2]*Acharya and BM Reddy College of Pharmacy, Department of Pharmaceutical chemistry, Bengaluru-107 E-mail: basavarajmetikurki@gmail.com*

Abstract:

Substituted Indolizine prodrugs of hydralazine were synthesized to overcome the stability problem. The synthesized prodrugs (**2a-i**) were subjected to hydrolysis at different pH l.2, 6.8, and 7.4. Drug conjugated with aromatic substituted indolizine showed better release kinetics than non-substituted hydralazine. It was observed that the prodrug 3-(2-pthalazin-1-yl)hydrazine)methyl indolizine (**2d**) showed good release kinetics at pH 7.4 when compared to that of other synthesized prodrugs.

Scheme:



2g-i

Code	R	R^1	R^2
2a	Phenyl	CN	H
2b	4-Chloro Phenyl	CN	H
2c	4-Bromo Phenyl	CN	H
2d	Phenyl	H	H
2e	4-Chloro Phenyl	H	H
2f	4-Bromo Phenyl	H	H
2g	Phenyl	H	H
2h	4-Chloro Phenyl	H	H
2i	4-Bromo Phenyl	H	H

Discovery of Novel Small-Molecule Tyrosine Kinase Inhibitors of Egfr and Her-2 by Ligand Based Virtual Screening.

Proceedings of International Conference on Drug Discovery (ICDD) 2020

Posted: 7 Feb 2020

Prasad Dhiwar
Acharya & BM Reddy College of Pharmacy

Gurubasvaraja Swamy P.M
Acharya & BM Reddy College of Pharmacy

Giles D
Acharya & BM Reddy College of Pharmacy

Date Written: February 4, 2020

Abstract

Abnormal signaling from the Protein tyrosine kinase (PTK) like receptor tyrosine kinase and intracellular tyrosine

JSS ACADEMY OF HIGHER EDUCATION & RESEARCH (DEEMED TO BE UNIVERSITY) MYSURU

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Evaluation of Cardio Protective Activity of Musa Acuminata in Ischemia-Reperfusion Induced Myocardial Infarction in Rats

PGPP-025

Simran Sultana[1]*,Uday Raj Sharma[1],Runashree Borah[1],Nageena Taj[1],Manjunatha PM[1]
[1]Department of Pharmacology, Acharya & BM Reddy College of Pharmacy, Bengaluru-560107, Karnataka, India.
Presenting Author: Simran Sultana MailID:simransultana19@gmail.com Mobilenumber:8660645827

Background: Reperfusion damage, once in a while called ischemia-reperfusion damage (IRI) or re-oxygenation damage, is the tissue harm caused when blood supply comes back to tissue (re- + perfusion) after a period of ischemia or lack of oxygen (anoxia or hypoxia) **Aim and Objective:** To evaluate the cardio protective effect of the extract of Musa acuminata L. in ischemia–reperfusion-induced myocardial infarction in rats. **Methods:** Rodents were anesthetized with thiopental sodium (40 mg/kg, i.p.). A left thoracotomy and pericardiotomy were performed, trailed by distinguishing the left front plummeting coronary corridor. A silk string was passed behind corridor and was impeded by a bunch for 30 min. The silk string was expelled after 30 min with the assistance of two bunch releasers to permit reperfusion of heart for 4 h. Where, as the trick control gathering exposed to whole surgery and string go underneath coronary course, however the coronary supply route was not ligated. **Results and Discussion:** The infarct size of the heart and the serum cardiac markers like Aspartate Amino transferase (AST/GOT), Alanine Amino transferase (ALT/GPT), creatinine kinase (CK) and lactate dehydrogenase (LDH) were evaluated. Pretreatment for 21 days with ethanol extract of Musa acuminate L. peel before ischemia-reperfusion has shown significant reduction in infarct size. The extract has shown significant effects on antioxidant enzymes and results have also been supported by histopathological studies. **Conclusion:** The ethanolic extract of Musa acuminata L. peel showed a significant cardio protective effect against ischemia reperfusion-induced myocardial infarction in rats.
Keywords: Musa acuminata L, cardioprotective, ischemia-reperfusion, myocardial infarction, cardiac markers.

Cerebroprotective Activity of Fumaria officinalis Extract on Rats.

PGPP-026

Uday Raj Sharma[1]*, Simran Sultana[1], Nageena Taj[1],Surendra V[1], Manjunatha PM[1]
[1]Department of Pharmacology, Acharya & BM Reddy College of Pharmacy, Bengaluru-560107,Karnataka,
PresentingAuthor:Mail ID:sharma.uday1@gmail.com Mobilenumber:9886237068

Background: A large population suffers at least one of the disorders of the nervous system. This resulted in the investigation of pathophysiological factors behind the various neurological disorders and their complications. **Aims and Objective:** The present study was carried out to evaluate the cerebroprotective activity of Fumaria officinalis Linn. **Methods:** The dose of 200 and 500 mg/kg was selected by performing acute toxicity studies. Experimental protocol for bilateral common carotid artery occlusion(BCCAO) for 30 min and followed by 4 h Reperfusion: Wistar Albino Rats (250-300g) were divided into five groups (n=6) and the drug treatment was done orally for 14days before the experiment, Group I: Sham: no ischemia, Group II: Ischemic reperfusion: Normal saline (10 ml/kg, ischemic control), Group III and IV were treated with EEFO extract 200 and 500 mg/kg respectively, Group V: Quercetin (10mg/kg). Animals were sacrificed and the brain was removed and homogenized. Estimation was carried out for LPO, SOD, CAT, GPx, GSH, GR and GST. **Results and Discussion:** The preliminary phytochemical screening of EEFO exhibited the presence of fatty acids, resins, alkaloids, proteins, glycosides, tannins, flavonoids and saponins. Our study revealed that EEFO may possess cerebroprotective activity by the significant restoration of biochemical enzymes and significant protection from cerebral ischemia-induced oxidation which may be due to the antioxidant property of EEFO. **Conclusion:** EEFO showed significant cerebroprotective effect. Histopathological reports confirmed protection from neuro degeneration in EEFO and quercetin treated group.
Keywords: Fumaria of icinalis; cerebroprotective; neuroprotective;

Pharmaceutical Industry And Development

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Metaverse & Pharmacy

[1]**Meghana BH, [2] Mrs. Moumita Banerjee**
[1&2] Acharaya & BM Reddy College of Pharmacy, India

Abstract

Application of different technologies in healthcare and development of medicines id the current research trend The current aspects of virtual reality augmented realities and metaverse like concepts are also welcomed in the healthcare and drug development and also considered as a billion dollar market, it has been observed that,many pharma giants are investing on this type of future technologies

In the overview a detail information of metaverse and its uses significance are covered by different internet problems like combination of virtual method relating attempts ,healthcare practices and various technologies ,implementing in teaching training and practical operation ,designing of facilities .

Even the drug discovery, intellectual property ,clinical trials reinventing the wholesaler-retailer and customer relationship enhancement and many other marketing strategies can be enhanced by metaverse .

Keywords

Metaverse, intellectual property, augmented realities, augmented realities, designing of facilities, practical operation, marketing strategies enhancement using metaverse

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ACHARYA

Formulation and Evaluation Ofantiviral Herbal Nasal Drops Containing Tulsi and Liquorice Extracts

[1]Bicky Kumar Yadav, [2]Sachin Chauhan, [3]M.K Dhananjaya, [4]Ravi Rauniyar, [5]Suraj Kumar Gupta Prerna, [6]Madhavi B L R
[1][2][3][4][5][6] Acharya &BM Reddy College of Pharmacy, India

Abstract

The 2019 coronavirus outbreak in China has caused numerous cases globally, with respiratory symptoms being the most common clinical features. Pathology data showede that the majority of patients had virus-positive nasopharyngeal and oropharyngeal swabs, indicating that the virus primarily invaded and infected the respiratory system. The majority of phytochemicals are reverse transcriptase inhibitors, which are critical for the prevention of viral infections. The present work intended to explore the potential of herbal actives towards prophylactic and therapeutic purpose towards viral infection. Nasal drops were tried to be formulated. The objectives were collection and authentication of plant material, preparation of extract and qualitative phytochemical screening -test for alkaloids, terpenoids,etc., formulation of herbal nasal drops, evaluation of herbal nasal drops for pH. Surface tension, viscosity, antibacterial activity, ex vivo mucosal compatibility study, etc and comparison of drops with commercial nasal drops. Nine formulations F1- F9 have been tried and evaluated. The pH was in the range of 6-7, surface tension 44-68 dyne/cm, viscosity 1.37-1.72cps, drop volume 0.02 - 0.07 ml. The developed nasal drops may be suitable for the treatment of conditions related to the nose either for local administration or suitable for systemic therapy also. In the present study , tulsi and liquorice extract have been successfully formulated as herbal nasal drops employing the cosolvents. Based on the evaluation parameters, antibacterial activity and comparison to commercial to nasal drop containing tulsi and liquorice extracts for suitable for antibacterial activity. Formulation F4 was found to be comparable to commercial Xylometazoline nasal drops related to the physical characteristics. Further studies have to be carried in detail regarding quantitative estimation of phytochemical constituents, dose estimation , isotonicity study , anti-viral activity and stability study.

Keywords

Tulsi, liquorice, nasal drops , Medicinal plant, anti-viral, extract

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