

SPRINGER BRIEFS IN PHARMACOLOGY
AND TOXICOLOGY

Vartika Jain · Surendra K. Verma

Pharmacology of
Bombax ceiba Linn.

SpringerBriefs in Pharmacology and Toxicology

For further volumes:

<http://www.springer.com/series/10423>

Vartika Jain · Surendra K. Verma

Pharmacology of
Bombax ceiba Linn.

Dr. Vartika Jain
Department of Botany
University College of Science
Mohanlal Sukhadia University
Udaipur 313003, Rajasthan
India

Dr. Surendra K. Verma
Department of Medicine
Indigenous Drug Research Centre
RNT Medical College
Udaipur 313001, Rajasthan
India

ISSN 2193-4762
ISBN 978-3-642-27903-4
DOI 10.1007/978-3-642-27904-1
Springer Heidelberg New York Dordrecht London

e-ISSN 2193-4770
e-ISBN 978-3-642-27904-1

Library of Congress Control Number: 2011946211

© The Author(s) 2012

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Foreword

The bio-cultural diversity of nature has gifted wide range of resources of therapeutically important ethno-medicinal plants. Presently numerous plants and their molecules have been screened and identified as natural bioactive products, which not only enrich the therapeutic compendium but also provide rich source of new pharmaceuticals, cosmetics, agrochemicals and others. The pharmaceutical industries are working on proving the benefits of various botanicals for our health and nutraceuticals for another rapidly expanding market. I found that this comprehensive treatise on *Bombax ceiba* Linn. has highlighted on the reported activities and traditional claims on this plant, which possesses immense potential as hypotensive, hypoglycemic, hypolipidemic, hepatoprotective, chemopreventive, antioxidant, fibrinolytic etc. The information presented in this volume will have a considerable impact on the pharmacological and therapeutic profile of *Bombax ceiba* Linn. The examples and evidences presented in this book strongly support the ethno-medicinal importance, quality parameters as well as the different screening profiles of this species.

It is thus of great interest to have the present book dealing with the approach that can be followed in the evaluation of therapeutic efficacy of *Bombax ceiba* Linn., which is a timely attempt of Dr. S. K. Verma and Dr. Vartika Jain to write a book on the “Pharmacology of *Bombax ceiba* Linn.” I greatly appreciate their efforts and I am sure this will be very useful for all who works on development of evidences based on the claim of traditional medicine as well as to all research workers in the field of natural products.

Pulok K. Mukherjee, M.Pharm, Ph.D, FRSC
Director School of Natural Product Studies
Jadavpur University
Kolkata, India

Preface

Nature has been kind enough to humans by providing a wide range of plants having therapeutic potential. Screening of plants for isolation and identification of the natural bioactive products not only enrich the therapeutic compendium but also provide a cheaper, effective and safe alternative approach for treating diseases. It is a combined effort of botanists and clinicians for utilizing these plants for research and developing new drugs in controlling the growing epidemic of dreadful diseases such as myocardial infarction, diabetes, cancer, stroke etc. *Bombax ceiba* Linn. is one such plant species which possesses immense potential pharmacological actions. Last decade has revolutionized research on this plant showing its hypotensive, hypoglycemic, hypolipidemic, hepatoprotective, chemopreventive, antioxidant and fibrinolysis enhancing properties in various animal and human studies. This has led us towards the present compilation in order to provide a desk ready reference on everything which one needs to know about *B. ceiba*.

The present book entitled “Pharmacology of *Bombax ceiba* Linn.” is a first monograph on the plant *Bombax ceiba* Linn., popularly known as Red Silk Cotton tree. It is in fact a compendium on this plant species containing total seven chapters and compiling all about *B. ceiba* starting from its historical and spiritual importance, distribution, botanical characterization and ethnobiological uses to modern phyto-pharmacy.

Bombax ceiba is well mentioned in the oldest written scriptures such as *Rigveda*, *Mahabharata* and *Ayurveda* along with a special role in many tribal cultures world wide. This handsome, deciduous tree is a part of tropical and subtropical forest ecosystem. Each part of the plant possesses immense medicinal value. A variety of chemical constituents including flavanoids, sesquiterpenoids, naphthoquinones, phenols, steroids, carbohydrates and amino acids have been isolated and many are yet to be discovered. List of the phytoconstituents along with chemical structures of some important bioactive molecules is also provided in [Chap. 3](#) for better understanding the chemistry of action. The fragmented research work done on its various biological activities in animal and human studies has been compiled in [Chap. 4](#) with appropriate discussion. Further, toxicological profile of the plant is also discussed. Thorough analysis of its phytochemical

profile and scientifically validated phyto-pharmacological properties will lead the way for research of newer phyto-pharmaceutical molecules beneficial for human health. Therefore, this book will prove a good reference material to go through.

The plant is not only rich in its history, ethnobiology, phytochemistry and pharmacology, but also possesses immense commercial and ecological importance. Hence, special chapters on these issues are provided which will be of interest to ecologists, agriculturists, foresters, industrialists and even to common people. Furthermore, the book has also incorporated some conservation strategies along with a case report on the sustainable conservation efforts done to preserve this plant species which is rapidly declining in many parts of the world due to ignorance of its importance. All photographs incorporated in the book are original and captured by authors themselves.

It is hoped that because of its vast scope and multifaceted coverage, the book will further accelerate the speed of research on this plant in various spheres world over which will rejuvenate this plant species for the betterment of health of future generation, a tree of infernal region will become the ornamental tree of gardens, an important project of research laboratories and a source of novel phyto-pharmaceutical compound for the treatment of dreadful diseases.

Undoubtedly, there may remain some errors in the text due to ignorance or misinterpretation of some aspects of the scientific literature. Authors welcome all critical comments and suggestions in order to improve the quality of future editions.

Acknowledgments

Authors thank the publishing house and all promoters of this project for their co-operation, support and for keen interest to bring this book in time. Thanks are also due to Dr. Preetesh Jain, USA, Prof. S.S. Katewa, Department of Botany, Mohanlal Sukhadia University, Udaipur and Dr. Phool Chander, Govt. Ayurvedic Officer, Punjab for providing immense help in literature collection. We also thank Mr. Rajesh Sharma for preparing an excellent artwork.

Dr. Vartika Jain
Dr. Surendra K. Verma

Contents

1	Introduction	1
1.1	Distribution	2
1.2	Botanical Characterization and Pharmacognostical Details	2
1.3	Importance in Traditional Medicinal Systems	7
	References	9
2	Ethno-biology	11
2.1	Introduction.	11
2.2	Medicinal Uses	12
2.3	Socio-Cultural Importance.	12
2.4	Magico-Religious Beliefs	17
2.5	Ethno-conservation.	19
	References	20
3	Phytochemical Studies	25
3.1	Introduction.	25
3.2	Root	34
3.3	Stem Bark.	42
3.4	Leaf	42
3.5	Flower	43
3.6	Seed	44
3.7	Gum.	45
	References	45
4	Pharmacological Investigations and Toxicity Studies	51
4.1	Introduction.	51
4.2	Antioxidant Activity	52
4.3	Antimicrobial Activity	53
4.4	Anthelmintic Activity	55
4.5	Larvicidal Activity	55

4.6	Anti-inflammatory Activity	55
4.7	Analgesic Effect	56
4.8	Antipyretic Activity	57
4.9	Anti-angiogenic and Antimutagenic Activities	57
4.10	Hepatoprotective Activity	58
4.11	Hypotensive Activity	59
4.12	Hypoglycemic Activity	59
4.13	Fibrinolysis-Enhancing Activity	60
4.14	Androgenic and Anabolic Activity	60
4.15	Other Biological Activities	61
4.16	Toxicity Studies	63
4.17	Conclusion	65
	References	65
5	Commercial Importance	69
5.1	Introduction	69
5.2	Floss	69
5.3	Wood	70
5.4	Oil	71
	References	71
6	Ecological Importance and Need of Conservation	73
6.1	<i>Bombax ceiba</i> : A Multipurpose Tree Species	73
6.2	The Need of Conservation	76
6.2.1	Case Study	77
6.2.2	Conservation Efforts	77
6.2.3	Awareness Campaign	78
6.2.4	In Situ Conservation	79
6.2.5	Ex Situ Conservation	83
6.2.6	Conclusion	85
	References	85
7	Future Research	89
	Index	91

Abbreviations

ABTS	2,2'-Azino-di-[3-ethylbenzthiazoline sulphonate]
ACE	Angiotensin converting enzyme
ALT	Alanine transaminases
AST	Aspartate transaminases
ALP	Alkaline phosphatase
BMI	Body mass index
BP	Blood pressure
CCL ₄	Carbon tetrachloride
COX	Cyclooxygenase
DMSO	Dimethyl sulfoxide
DNA	De-oxyribonucleic acid
DPPH	1,1-Diphenyl-2-picryl-hydrazyl
DW	Dry weight
EC	Effective concentration
ED	Effective dose
FA	Fibrinolytic activity
FAS	Fatty acid synthase
FRAP	Ferric reducing ability of plasma
g	Gram
GAE	Gallic acid equivalent
GPX	Glutathione peroxidase
GSH	Reduced glutathione
H ₂ O ₂	Hydrogen peroxide
HAEC	Human aortic endothelial cell
HDL-C	High density lipoprotein cholesterol
HMG CoA	Hydroxymethylglutaryl coenzyme A
HUVEC	Human umbilical venous endothelial cells
IC	Inhibitory concentration
IL	Interleukin
iNOS	Inducible nitric oxide synthase
IgE	Immunoglobulin E

I.P.	Intraperitoneal
I.V.	Intravenous
Kg	Kilogram
LD	Lethal dose
LDL-C	Low density lipoprotein cholesterol
LPS	Lipopolysaccharide
MIC	Minimum inhibitory concentration
<i>n</i>	Number of subjects
NO	Nitric oxide
NS	Not significant
OHA	Oral hypoglycemic agents
ORAC	Oxygen radical absorbance capacity
PGE	Prostaglandin E
SRB	Sulphorhodamine B
TAS	Total antioxidant status
TBARS	Thiobarbituric acid reactive substance
TEAC	Trolox equivalent antioxidant capacity
TLC	Thin layer chromatography
TNF	Tumor necrosis factor
TPA	12-O-tetradecanoylphorbol-13-acetate
UV	Ultraviolet
VLDL-C	Very low density lipoprotein cholesterol