

**ETHNOBOTANY AND ANTIBACTERIAL ACTIVITIES OF SELECTED
MEDICINAL PLANTS OF NEPAL HIMALAYA**

A Dissertation Submitted to the
Institute of Science and Technology
Tribhuvan University,
Kirtipur, Kathmandu, Nepal

For the fulfillment of the Degree of Doctor of Philosophy (Ph.D.) in Botany

Shandesh Bhattarai

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Central Department of Botany
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Kirtipur, Kathmandu, Nepal

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CERTIFICATE

I have the pleasure of forwarding the thesis entitled “**Ethnobotany and Antibacterial activities of selected Medicinal Plants of Nepal Himalaya**” by Mr. Shandesh Bhattarai, for the fulfillment of the degree of Doctor of Philosophy (Ph.D.) in Botany. The thesis is based on original research work carried out under my supervision and has not been submitted for a degree to any other University.

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DECLARATION

I hereby declare that the work presented in this thesis has been done by myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by reference to the authors or institutions.

.....

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ABSTRACT

This study aims to explore medicinal plants from Manang and Mustang districts and examine their antibacterial activity *in vitro* against different strains of microorganisms. Field information was gathered by direct observation of locals through semi-structured interviews and information regarding the bioassay test was obtained through laboratory research.

A total of 157 ethnomedicinal plant species belonging to 56 families and 114 genera are reported from the study area. These 157 locally used medicinal plants treat 150 ailments. This study found that many different parts of medicinal plant species are used as medicine. It would follow that the most commonly used plant parts have been selected because they contain more active principles in the form of biologically active secondary metabolites in comparison to the least commonly used parts. Of 157 medicinal plants documented, 88 plants were used for multiple uses, such as for food, fence and fuelwood, ritual and religious, and others. Several medicinal plants, i.e., *Allium* species, *Hippophae* species, etc., with multiple uses have great medicinal value and high market price even in Kathmandu and Pokhara. Even though the market price of these species has been increasing steadily, the local consumption has not yet decreased. Therefore further bioprospecting research on these species could help with the conservation and management of these local resources as well perhaps benefits the local people economically.

In vitro antibacterial assays of 92 extracts from 79 ethnomedicinal plants used to treat diseases potentially caused by bacteria were examined. Overall, 73 % of plant extracts showed activity against Gram-positive *Staphylococcus aureus*, and *Bacillus subtilis*, and 69 % showed activity against Gram-negative *Escherichia coli*, and *Pseudomonas aeruginosa*. Although the nature and number of active antibacterial principles involved in each extracts are not clear, the broad spectrum of activity of several plants is promising.

Thirty-three selected plant species were extracted with methanol, dichloromethane and hexane, resulting in a crude separation of the chemical components into groups of varying polarity. The minimum inhibitory concentration (MIC) of these extracts against the same bacterial species was obtained, and gives insight into the chemical nature of the biologically active constituents. The strong activity of the highly non-polar hexane extracts (shown by the low MIC values) indicates that the bioactive chemical(s) of those plant species was best extracted in non-polar solvent, and therefore was likely to be non-polar as well.

Altogether 39 medicinal plants were prioritized and categorised as high, moderate or low priority in Manang and Mustang districts. Among the 39 prioritized species selected, 8 species were high priority, 29 were moderate priority, and 7 species were low priority. Bulk amounts of medicinal plant trade is seen from Manang and Mustang and if the process of trading of important medicinal plants continues on this scale for several years, species such as *Cordyceps sinensis*, *Dactylorhiza hatagirea*, etc, will become increasingly rare. Therefore I suggest immediate steps of cultivation of these species in the barren lands and use of sustainable harvesting approaches which may be helpful to conserve these species as well as other wild plant resources in their natural habitats.

In conclusion, this survey has shown that the local populations of Manang and Mustang districts have a wide knowledge on the use of wild plants for various purposes, including medicinal, food, fuelwood, fence, fodder, timber, household article, ritual, religious, etc. The present laboratory work lends support to the claims by traditional medicinal healers regarding the biological usefulness of the above plants. The antibacterial activities of the plants often explain their use by the local community.

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ABBREVIATIONS AND ACRONYMS

%	Percentage
IUCN	International Union for the Conservation of Nature and Natural Resources
⁰ C	Degree Centigrade
A.D.	<i>Anno Domini</i> (After death of Christ)
A/MDCK	Influenza virus/Madine-Carby Canine Kidney
ACA	Annapurna Conservation Area
ACAP	Annapurna Conservation Area Project
amsl	Above mean sea level
APG	The Angiosperm Phylogeny Group
ca.	About
C. India	Central India
CBS	Central Bureau of Statistics
CDB	Central Department of Botany
CH ₂ Cl ₂	Dichloromethane
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COPD	Chronic Obstructive Pulmonary Diseases
CSIR	Council of Scientific and Industrial Research, New Delhi, India
CTEVT	Council for Technical Education and Vocational Training
DADO	District Agriculture Development Office
eds.	Editors
EFEA	Environment and Forest Enterprise activity, New ERA, Kathmandu, Nepal
EHEC	Enterohaemorrhagic <i>Escherichia coli</i>
EPEC	Enteropathogenic <i>Escherichia coli</i>
ESON	Ethnobotanical Society of Nepal
ETEC	Enteroinvasive <i>Escherichia coli</i>

FAO	Food and Agriculture Organization of the United Nations, Rome, Italy
G	Gram
h	Hour
H ₂ S	Hydrogen Sulphide
HHs	Households
HIV	Human Immunodeficiency Virus
HMGN	His Majesty's Government of Nepal
ICIMOD	International Centre for Integrated Mountain Development
IPAs	Important Plant Areas
JAFTA	Japan Forest Technology Association, Tokyo
KATH	National Herbarium and Plant Laboratories, Godawari, Lalitpur
Kcal	Kilocalories
kg	Kilogram
KMTNC	King Mahendra Trust for Nature Conservation
M	Minute
MAPs	Medicinal and Aromatic Plants
MBC	Minimum Bactericidal Concentration
MENRIS	Mountain Environment and Natural Resources Information Service
MeOH	Methanol
Mg	Milligram
Mg/disc	Milligram per disc
Mg/mL	Milligram per milliliter
MIC	Minimum Inhibitory Concentrations
mL	Milliliter
MMI	Methanolic
MOFSC	Ministry of Forests and Soil Conservation
NCST	National Conference on Science and Technology
NRs.	Nepalese Rupees
NWFPs	Non Wood Forest Products
NTNC	National Trust for Nature Conservation
Ph.D.	Doctor of Philosophy
RECAST	Research Centre for Applied Science and Technology
S. Asia	South Asia
SATA	Swiss Association for Technical Assistance in Nepal
SchEMS	School of Environmental Management and Sustainable Development
SES	Socioeconomic Status
Sic.	Primitive
SNV-	Netherlands Development Organization-Nepal
Nepal	
sq. km.	Square Kilometer
TU	Tribhuvan University
TUCH	Tribhuvan University Central Herbarium

U.S.A.	United States of America
UCOs	Unit Conservation Offices
UMBCP	Upper Mustang Biodiversity Conservation Project
UNESCO	United Nations Educational Scientific and Cultural Organization
USSR	The Union of Soviet Socialist Republics
UTI	Urinary Tract Infection
UV-A	Ultra-violet
VDC	Village Development Committee
WHO	World Health Organization
WWF	World Wide Fund for Nature
g/disc	Microgram per discs
µl/mL	Micro Liters per Milliliter