

**PROSPECTING FOR BOTANICAL PESTICIDES:
EVALUATION OF PLANT EXTRACTS FOR
PHYTOCHEMICALS AND BIOLOGICAL ACTIVITY**

By

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Submitted

in fulfillment of the requirements of the degree of

Doctor of Philosophy

to the



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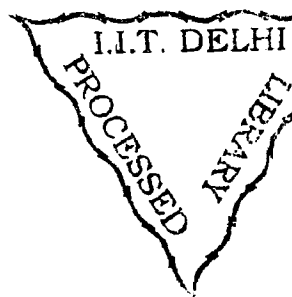
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CERTIFICATE

This is to certify that the thesis entitled, “**Prospecting for Botanical Pesticides: Evaluation of Plant Extracts for Phytochemicals and Biological Activity**” being submitted by **Mrs. Namrata Dilip Dhoke** to the Department of Chemistry, Indian Institute of Technology, Delhi, for the award of degree of **Doctor of Philosophy** is a record of bonafide research work carried out by her.

Mrs. Namrata Dilip Dhoke has worked under my guidance and supervision and has fulfilled the requirements for the submission of this thesis which, to my knowledge, has reached the requisite standard.

The results embodied in this thesis are original and have not been submitted, in part or in full, to any other University or Institute for the award of any degree or diploma.



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Namrata Dilip Dhoke

ABSTRACT

The thesis titled, “*Prospecting for Botanical Pesticides: Evaluation of Plant Extracts for Phytochemicals and Biological Activity*” concerns with the evaluation of several indigenous plant species as potential botanical pesticides using bioassay guided extraction protocols. The thesis has been divided into five chapters which describe the selection of plants species based on ethnopharmacological significance, the extraction procedures adopted, evaluation of bioactivities in the extractives derived from the plants and isolation and characterization of pure compounds from the extracts that contribute towards the prospective activity.

A vast range of plant based secondary metabolites are known to possess pesticidal activity. Their systemic authentication and scientific evaluation along with activity towards specific pests have been taken up in the present work. **Chapter I** gives an overview of the biocides derived from the indigenous plants of ethnopharmacological significance. Botanical pesticidal plant products other than those derived from the extensively explored *Azadirachta indica* (the neem tree) have been explicitly described. The chapter reviews the available literature on botanical pesticides with special emphasis on the source and target species, mode of action and structure of compounds identified so far and elicits a structure-activity relationship between the compounds and expressed activity.

Chapter II of the thesis describes the bioassay guided fractionation and evaluation of potential pesticidal activity in 22 medicinal plants selected on the basis of their ethnomedicinal and ethnobotanical literature. This chapter also includes authentic identification of the plant material, its preliminary processing and effective solvent extraction protocol adopted for bioassaying various parts of plant examined (roots, stems, twigs, leaves, flowers, fruits, bark or whole plant) in different seasons and stages

of maturity. Specific extracts have been evaluated for larvicidal, adulticidal, insect growth regulator (IGR), antifeedant, repellent and ovicidal activity against the agronomic pests. The usefulness of the species against the selected target pests is evaluated on the basis of the percentage of bioactivity of the extracts determined in terms of LD₅₀, LC₅₀, or ED₅₀. Plants with promising pesticidal activity have been further taken up for the development of pesticidal formulations for field use and their phytochemical evaluation.

Chapter III describes the extraction, isolation and characterization of components from the leaves of *Calotropis procera* which has been established as a potential resource for pesticidal composites. The identity of already known compounds was achieved by comparison with the data available in the literature and authentic samples while new compounds have been characterized by a combination of chemical and spectroscopic techniques (UV, ¹H NMR, ¹³C NMR, IR and MS techniques). The structures of novel compounds have been determined to be pentacyclic triterpenoids.

Chapter IV describes the assays for the evaluation of extracts from the leaves and inflorescence of *Calotropis procera* for pharmacologically significant and unexplored activities like antioxidant action and antibacterial activity against a panel of pathogenic gram positive and gram negative bacteria. The activities have been related to the ethnomedicinal relevance of the extractives from *C. procera* and have been evaluated based on conventional methods represented in literature. Quantitative evaluation of plant metabolites that probably contribute towards the observed bioactivity have been also achieved by analytical techniques like High Performance Thin Layer Chromatography (HPTLC).

Chapter V describes our preliminary work on development of economically viable formulations of the type emulsifiable concentrates from the selected active extracts obtained from *Calotropis procera* and *Plumbago zeylanica*. The formulations have been

assessed for dispersion stability and prediction of shelf life under accelerated conditions. Stable formulations have been further evaluated for pesticidal activity in comparison to the blank formulations prepared to reestablish the activity of the plant based active ingredients. Stable formulations with potential pesticidal activity were scaled up for field trials.

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