PHYTOCHEMICAL INVESTIGATION ON THE RHIZOMES OF CURCUMA LEUCORRHIZA ROXB., CURCUMA CAESIA ROXB. AND CURCUMA AROMATICA SALISB. OF ZINGIBERACEAE FAMILY

(ABSTRACT)

THESIS SUBMITTED TO MANIPUR UNIVERSITY IN PARTIAL FULFILLMENT FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN CHEMISTRY

BY
ASEM SATYAVAMA DEVI
Ph. D. REGISTRATION NO. 2879/2011

DEPARTMENT OF CHEMISTRY
SCHOOL OF MATHEMATICAL AND PHYSICAL SCIENCES
MANIPUR UNIVERSITY
CANCHIPUR, IMPHAL -795003, MANIPUR, INDIA
2014
Phytochemical Investigation on the Rhizomes of *Curcuma leucorrhiza* Roxb., *Curcuma caesia* Roxb. and *Curcuma aromatica* Salisb. of Zingiberaceae Family

Medicinal plants have been used for centuries as remedies for human diseases. Treatments with the use of various plants have historically formed the basis of sophisticated traditional medicine, preceding the established scientific literature by thousands of years. With the advancement of science, the source of the medicinal properties associated with these treatments has been investigated. This quest for understanding has led to an explosion in the last hundred years in the areas of isolation, biological activity, structural elucidation and the chemical synthesis of natural products. Source of drug compounds from plants are currently on the market for the treatment of a variety of diseases and some of them are used as dietary supplements, as dyes, flavouring agents, or ingredients in the cosmetics industry for meeting demand for effective and safer use.

Zingiberaceae family is an important natural resource that provides many useful products for food, spices, medicines, dyes, perfume and aesthetics. It constitutes a vital group of rhizomatous medicinal and aromatic plants characterised by the presence of volatile oils and oleoresins of export value and widely distributed in India, and in tropical and subtropical regions of Asia. India is one of the richest and diverse regions for Zingiberaceae, having 22 genera and about 170 species. The NE region of India is a zone of greatest concentration where 19 genera and about 88 species are reported. Some *Curcuma* species are
used as different crude drugs and exhibit a wide spectrum of pharmacological properties. In view of the importance of Curcuma plants, three plants namely, *Curcuma leucorrhiza* Roxb., *Curcuma caesia* Roxb., and *Curcuma aromatica* Salisb. which are used in traditional medicines are selected for chemical studies.

The **First chapter** of the thesis describes a brief review on some medicinal plants of Zingiberaceae family. Generally, the rhizomes of this family are aromatic, tonic and stimulant. They are rich sources of essential oils that consist of numerous complex terpenoid mixture. The study of biological activities and uses of different members of this family have been reviewed. Some *Curcuma* sesquiterpinoids compounds with varied physiological activities - antimicrobial, antiarthritic, antioxidant, anticancer, anti-inflammatory, antidiabetic, anti-HIV, neuroprotective and larvicidal etc. have been reviewed in this chapter.

The **Second Chapter** describes the study of extraction, isolation, identification and characterisation of the extracts and compounds isolated from *Curcuma leucorrhiza* Roxb. The isolation and structure elucidation of a new guaianolide sesquiterpene lactone: Guai-1(10),5,7(11),8-tetradien-12,8-olide which show to have an antioxidant property has been reported. The antioxidant and antimicrobial activities of different solvent extracts of the rhizome of *Curcuma leucorrhiza* Roxb. against four human pathogenic bacterial strains and four plant pathogenic fungal strains are reported.
The **Third Chapter** consists of the study of extraction, isolation, identification and characterisation of the extracts and compounds isolated from *Curcuma caesia* Roxb. Sesquiterpenoids have been isolated along with a naturally polymer compound and a known steroid from the dried rhizomes of *Curcuma caesia* Roxb. Second harmonic generation (SHG) efficiency of zederone is found to be higher than that of KDP.

**Figure 1.** (a) The structure of guaianolide sesquiterpene lactone and (b) its ORTEP view of crystal structure

**Figure 2.** The structure of some compounds
The **Fourth Chapter** consists of the study of extraction, isolation, identification and characterisation of the extracts and compounds isolated from *Curcuma aromatica* Salisb. Many sesquiterpenes - isozedoarondiol, methylzedoarondiol, neocurdione, germacrone, curdione, (4S,5S)-germacrone4,5-epoxide, dehydrocurdione, procurcumenol, zedoarondiol and curcumenone have been reported from this plant. Herein, transformation of the bioactive compounds by semisynthesis are reported.

Figure 4. Preparation of Zederone Derivative

Figure 5. FT-IR spectrum of zederone (Z) and its derivative (ZNH)
The Fifth Chapter deals with green synthesis and characterization of Silver nanoparticles (AgNPs) using some Zingiberaceae plants - *Curcuma aromatica*, *Curcuma caesia*, *Curcuma leucorrhiza*, *Hedychium coccineum* and *Kaempferia galanga* and their antimicrobial activities. The use of plant extracts containing secondary metabolites acting as reductants and as stabilizers with green method have been reported. Compounds isolated from these plants are used for the synthesis of silver nanoparticles. The synthesized AgNPs are characterized with FT-IR, UV-Vis, EPR, XRD, EDX, SEM and TEM. The synthesized AgNPs showed the antibacterial activity against *Proteus mirabilis*, *Klebsiella pneumoniae*, *Escherichia coli*, *Salmonella paratyphi* and *Pseudomonas aeruginosa*. The catalytic activity of the synthesized AgNPs is established in the reduction of DPPH by BHT + AgNPs. The UV–VIS spectra have been recorded at regular intervals of time.
Figure 5. UV–vis spectra of synthesized AgNPs

Figure 6. TEM images of AgCL- a (the inset is the SAED pattern), b, c (HR TEM) and d (particle size distribution)
LIST of PUBLICATIONS


