A Brief Review of Recent Nanotechnological and Pharmacological Potentials with Special Reference to Plectranthus amboinicus

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Abstract: Plectranthus amboinicus an excellent medicinal plant species belongs to the family Lamiaceae known to cure many diseases. Tribal people used plants as medicine without scientific knowledge but scientists still searching curative drugs for many immunological and biological diseases. Although it is essential to know the toxicological data with respect to particular plant species as they have different chemical constituents. Plectranthus amboinicus is also known as Indian borage, having unique medicinal properties it was the most important species in plant world. Present survey focuses on Nanoparticle, Ethno-medicinal, Toxicological aspects of Plectranthus amboinicus and to create research thrust in these areas.

Keywords: Plectranthus amboinicus; Pharmacological applications; Nanoparticles; Phytochemicals; Toxic effects

1. Introduction

Toxins are one of the most important biomolecules of life, as they can kill harmful bacteria or Cancer cells at right doses and at the same time it can harm host cell upon wrong doses of the same toxin [2, 4]. According to Paracelsus “All substances are poisonous, there is none that is not a poison, the right dose differentiates a poison from a remedy” [1]. Every single plant or animal produces biochemical toxins to protect themselves by predators either it may be bacteria or other organism. Plants produce most dangerous chemicals called “Phytotoxins” that have biomedical applications in animal world. Alkaloids in combination with other chemicals affect the organism in a toxic way but it will act as a best drug when alkaloid alone used [3].

Population explosion and unhygienic conditions in India has led many people prone to diseases like diarrhea, cholera, typhoid, [12, 13] etc. In order to control these diseases pharmacological industry made a robust impact in Human society. Synthetic drugs more are toxic than herbal drugs as herbal drugs contain a number of phytochemical mixtures whereas synthetic drugs contain a single chemical formula, many times people die because of the high dosage of synthetic drugs and the immune response of the human body against it [14,15]. To improve accuracy and effective drug delivery pharmacologists moved towards a new era of Phytomedical world, now scientists formulating drugs using plant resources in variety of forms.

Plectranthus amboinicus is an aromatic shrub and Medicinal plant that belongs to the family lamiaceae widely distributed in tropical Africa, Asia and Australia [6]. The leaves are fleshy, tomentose in nature [Figure 2]. Plectranthus genus is known to produce many bioactive compounds like flavonoids, saponins, tannins, steroids, volatile oils and terpinoids [5]. In India the plant is used as food, medicine, and aerosol in tribal communities. Nutrition is the main aspect of living organisms which plays an important role in Diet, containing 0.26% iron, 1.56% insoluble dietary fibers, proteins, vitamins and beta carotene as a major components P. amboinicus is a highly nutritious plant [7, 41, 42]. People are more dependent & attracted towards nature, World Health Organization estimated that more than 80% people dependent on plant and their extracts for better health management with reduced cost and side effects [9, 10]. Phytochemicals are the chemicals produced by plants as a result of metabolism or catabolism, to resist some ecological conditions; P. amboinicus contain 76 volatile [carvacrol and thymol] and 30 non-volatile [sesquiterpene hydrocarbons, monoterpene hydrocarbons, flavonoids, oxygenated monoterpenes and esters] compounds making itself a potential phytochemical manufacturer in its family [11].

1.1 Taxonomy of Plectranthus amboinicus

Domain: Eukaryote
Kingdom: Plantae
Phylum: Spermatophyta
Subphylum: Angiospermae
Class: Dicotyledonae
Order: Lamiales
Family: Lamiaceae
Genus: Plectranthus
Species: Plectranthus amboinicus

1.2 List of Chemical compounds obtained from Plectranthus amboinicus plant

| Chemical class of compounds | Compound name                          |
|-----------------------------|----------------------------------------|
| Flavonoids                  | 5-hydroxy-7,4′-dimethoxyflavone         |
|                             | 5-hydroxy-7,3,4′-trimethoxyflavone      |
|                             | 5,3′-dihydroxy-7,4′-dimethoxyflavone    |
|                             | 5,4′-dihydroxy-7,3′-dimethoxyflavone    |
Benzenoids
- Vanillic acid
- P-hydroxybenzoic acid
- Methylparaben

Quinol
- β-sitosterol
- β-sitostenone
- stigmasterone

Steroids
- 4-acetyl-3,5-dimethoxy-p-quinol

Lignan
- (+)-syringaresinol

Methylparaben

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Terpene
- Myrcene
- α-Pinene
- Linalool
- α-Terpinolene
- α-terpinene
- α-Terpineol
- Thymol
- Carvacrol
- Terpinen-1-ol-4
- Camphor
- Limonene
- (Z)-β-ocimene
- (E)-β-ocimene
- α-Phellandrene
- γ-Terpinene
- p-Cymene
- β-pinene
- calamenol
- delta-3-Carene
- α-Phellandrene
- Camphene
- β-cubebene
- 4 β,7 β-Aromadendrene Diol
- Farnesol
- β-bisabolene
- delta-cadinene
- Caryophyllene oxide
- (-)-α-Selinene
- α-Cadinol
- δ-Cadinol
- β-Guaiene
- α-humulene
- (Z)-β-Farnesene
- α-Bergamotene
- β-caryophyllene
- β-Elemene
- α-Cubebeene

Sesquiterpene
- 1-Octen-3-ol

1.3: Percentage of compounds extracted from Plectranthus amboinicus
2. Materials and methods

Our literature survey included peer review of scientific research papers, interpretation of results and conclusions. Throughout our survey we used many research search engine tools like Science direct, Google scholar, j-gate, Research gate, Citeseerx etc and also visited for the plant identification etc.

2.1 Photograph of Plectranthus amboinicus

3. Toxic effects of Plectranthus amboinicus

Major part of plant is leaves, most of the chemicals produce in the leaf itself, extraction of chemicals from leaf shown many toxicological properties, Patricia Fontes Pinheiro et al [16] assessed cytotoxic effects on L. sativawhich resulted in chromosomal alterations. The LC₅₀ of Larval and Pupal toxicity to four stages of Aedes aegypti was found to be 26.12, 35.36, 45.76, 52.32 and 63.82ppm respectively which show strong larvicidal effects [17]. Aqueous extract of dose 25 and 50mg/ml effectively inhibited 37% & 57% root growth of Allium cepa by cytotoxic activities [18].

4. Applications of Plectranthus amboinicus Nanoparticles

Nanoparticle was the most recently used drug delivery system in Pharmacological studies, using plant materials such as Leaf, Stem, Root, Fruit, etc. [Figure 2]. The Nanoparticles can be synthesized with proper protocols & utilizing metals like AgNO₃, ZnO. Nanoparticles were used in many industries including Textiles for the degradation process of many dyes; biosynthesized ZnO nanoparticles of P. amboinicus had shown degradation of Methyl red dye, and SnO biosynthesized Nanoparticle expressed degradation of Rhodamine B dye [19, 22]larvicidal activities at the concentration of 8 and 10µg/ml against Mosquito larvae of Anopheles stephensi, Culex quinquefasciatus, and Culex tritaeniorhynchus was shown by ZnO Nanoparticles[21].Silver has vital role in antimicrobial activity; this activity was increased by using plant extract of P. amboinicus, the synthesized nanoparticle displayed antimicrobial activity against E. coli, Penicillium spp. [20]. Methylene blue dye degradation was shown by Ag Nanoparticles and confirmed by instrumental techniques [23]. Nanoparticles had become advanced over traditional drugs exhibiting antiproliferative activity on T47D breastcancer cells via apoptotic pathway [24].

5. Pharmacological Applications

Most of the plants used in pharmacology are to improve human welfare; P.amboinicuswas reported having Antioxidant & Nephroprotective properties against Adriamycin induced acute toxicity in Male Wister rats at a dose of 400mg/kg body weight, Antilithiotic activities was observed at a dose of 500mg/kg/juice of leaf extract in 35-day study [25, 26, 31]. Inflammation is Rapid immune response against pathogens upon injury, in vitro & in vivo anti-inflammatory and analgesic activities of P. amboinicus aqueous extract was effective at doses 0.5 & 1.0g [27, 33].Anti-inflammatory, Anticancer activity on Paw edema and sarcoma-180, Ehrlich ascite carcinoma cells respectively shown by crude Hydro-alcoholic extracts in Female albino rats and mice at a dose of 100, 150, 250, & 300mg/kg [28], an experimental ethanolic extract dose of 300, 600, 900mg/kg expressed Hepatoprotective activity against paracetamol induced hepatotoxicity [29]. Diuretic activity, anti-gastric ulcer activity was found at doses of 500mg/kg& 200mg/kg in Wister rats [30, 32].

Diabetes the most affecting disorder in humankind, antihyperglycemic and antihyperlipidemic activities of P.amboinicus extracts is a promising basis for antidiabetic drug discovery [34]. Antianxiety effect, Immunostimulatory effect, antibacterial, antifungalicidal activity, Expectorant activity was reported on this plant species [35, 36, 37].

The actual mechanism behind anti-inflammatory activity was revealed by Jih-Hwa Guh et al. the research shown that P.amboinicusextract inhibits release of interleukin 1ß through which antiinflammation was activated [39].High Antibacterial activity over Klebsiella pneumonia was recorded for the chloroform and Methanolic extract of the plant [40].
6. Discussion

The world is full of plants, Humans greatly dependent on plants for daily needs. *P. amboinicus* is one of such plant in which human is benefited, it is also used in spicy foods in China & India. Because of its medicinal value many researches have done using plant extracts. Extraction of chemicals from plant sources include many sequential isolating steps using broad range of solvents like Methanol, Ethanol, Aqueous, Hydro-alcoholic extractions etc. The principle behind the use of solvents is that many Phytochemicals soluble in polar or nonpolar solvents according to their chemical nature. In this survey Toxicological research indicated cytotoxic effect and larvicidal activities, Pharmacological studies shown Antioxidative, Antihyperlipidemic, Antihyperglycemic, Antilithiotic, Immunostimulatory, Diuretic, Anti-inflammatory, Nephroprotective, Hepatoprotective, Anticancer activities, and Nanoparticle studies resulted data related to Antibacterial and Antiproliferative effects on various bacteria and cells. It indicates the high potency of a single plant species from *Plectranthus* genera.

7. Conclusion

The present survey focused species-specific data related to *Plectranthus amboinicus*, apart from medicinal uses the plant species lacking toxicological data like toxic effect on insects, toxicological endpoint for organisms, because the plant is capable of producing many types of alkaloids and terpenes. In Nanoparticle synthesis the plant is used for basic research & still more research has to be done related to emerging recent era of Nanopesticide fields. Biosynthesized nanoparticles show high degree of effect compare to solvent extracts.

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