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(REVIEW ARTICLE)

Phytochemical constituents, extraction and pharmacological activity of *Leucas aspera*

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Abstract

Leucas aspera, Traditionally, the plant was used as an insecticide and an antipyretic. Leucas leaves are used for the relief of rheumatism. *Leucas aspera* is an abruptly quadrangular, growing annual herb with a strong, hispid stem and branches. Every portion of the plant, includes the stem, leaves, roots, and flowers, shows pharmacological properties. Green nanoparticles are nanoparticles that can be developed using sustainable techniques. By extracting the material and taking it through several stages of synthesizing, a usable product was generated.

Keywords: *Leucas aspera*; Nanoparticles; Extraction; Pharmacological Use; Gold nanoparticles

1. Introduction

Leucas aspera, commonly referred to as "Thumbai," is a plant that spreads across India, from Ceylon to the Himalayas. This plant, whose was traditionally utilized for its ability to soothe fevers and repel insect species, has been proven in studies in science that it has a variety of pharmacological actions, such as antifungal, antioxidant, antibacterial, analgesic, and cytotoxic qualities(1,2).

Leucas leaves are used in traditional medicine for the relief of rheumatic ailments. Leucas has a wide range of phytochemical components in all of its plant parts, but the most common ones are terpenoids, fatty acids, nicotine, ursolic acid, glucoside, beta-sitosterol, sterols, diterpenes, and phenolic compounds. As a potential source of novel therapeutic medicines, it indicates promise due to its vast collection of medicinally active chemicals(3,4).

1.1. Botanical description

Moreover, the fast biogenic reduction of metal ions to their elemental forms—a process that may be effectively carried out at ambient temperature and pressure—is an essential process in the environmentally beneficial extraction *of leucas aspera*, also known as "green nanoparticles." Plant extracts modify the chemical makeup of the resulting nanoparticles by acting as both stabilizing and reducing agents in the synthesis the particles(5,6).

1.2. Morphological characteristics

Leucas aspera, which has a branching structure that grows to a height of 15 to 60 cm. Its branches and stems are robust, have stiff hairs covering them, and form acute angles. The leaves have short stems that appear long and thin with blunt points, or they almost completely lack stalks. They are hairy, measuring up to 8.0 cm in length and 1.25 cm in width, with smooth or slightly serrated edges(7). The small white flowers are densely packed in clusters at the ends of stems or in the leaf axils. Each flower is accompanied by linear bracts around 6 mm long, ending in pointed tips covered in fine

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hairs(3). The calyx, surrounding the flower base, varies in length from 8 to 13 mm, with a curved tube that narrows above the fruit Usually, the calyx has a ribbed, hairy top half and a smooth, membranous lower half. The corolla, which is about 1 centimeter long, has a tube that is about 5 mm long and has hairs on top that form a ring in the center of the tube(8). The corolla's lower lip is roughly twice as long as the upper lip and has a rounded shape. The upper lip is short and heavily covered in white hairs that resemble central lobe and two smaller, pointed side lobes. The fruit consists of nutlets, each around 2.5 mm long, oblong in shape, brown, and smooth, with angular edges on one side and a rounded surface on the other(4).

Stems: The stems are pale greenish-yellow in color, hairy, and coarse to the touch. They have four distinct furrows and can be as thick as 4 mm. Nodes and internodes taste rather bitter and may be identified from one another with ease (Fig 2)(4).

Leaves: The yellow-green leaves have a diameter of 1 to 2.5 cm and a length of 3 to 9 cm. They are ovate or lanceolate in shape, with a surface that is somewhat hairy and sharp ends. Strong flavor is imparted by either whole or slightly serrated borders (Fig 3)(9).

Calyx: The calyx varies in morphology, being tubular and extending between 8 to 13 mm in length. Above the nutlets, its tube narrows and bends. Usually, the calyx has a ribbed, hairy top half and a smooth, membranous lower half(3).

Flowers: Terminal or axillary clusters of petite, sessile white flowers are packed closely together. Bracts, which are about 6 mm long, linear in shape, and have pointy tips, are attached to each bloom and have long, thin hairs on them (Fig 1)(4).

Corolla: Dense, short white hairs covering the upper lip mimic the two smaller, pointed side lobes and the center lobe. Round surfaces on one side and sharp edges on the other define the fruit's smooth, black, rectangular nutlets. There are about 2.5 mm in length to each nutlet(9).

Root: The roots are cylindrical, smooth, and zigzag in shape, with numerous wiry, fine rootlets.

Fruit: The fruits are little, 2.5 mm-long schizocarpic carcerule nutlets. Their oblong, dark, smooth shape has rounded outer edges and sharp inner faces(10).

Figure 1 Flowers of *Leucas aspera*

Figure 2 Stems of *Leucas Aspera*

Figure 3 Leaves of *Leucas Aspera*

1.3. Observation

Root: The root structure shows the epidermis, which is composed of a single layer of rectangular cells with thin walls. Thinning walls and tangential elongation characterize the parenchymatous cells that comprise the secondary cortex(5).

Stem: The stem has four distinct ridges and furrows and is squarish in shape. Its single-layered epidermis is composed of several unicellular to tricellular trichomes and oblong to rectangular cells with thin walls(2).

Leaf: The trichomes on the leaf petiole, which can be unicellular or tricellular, have sharp edges, and the epidermis is composed of a single layer. the cortex, which is made up of one layer of collenchyma cells that range in shape from round to angular(4,11).

1.4. Pharmacological effects

Histopathological significance is believed to have been associated with the pharmacological properties of *Leucas aspera* plants, which include antifungal, antioxidant, anticancer, phytotoxic, antivenom, hepatoprotective, anti-inflammatory, antinociceptive, antiulcer, antimalarial, and antidiabetic action. The pharmacological qualities are present in all parts of the plant, including the stem, roots, leaves, and flowers. qualities that inhibit fungus *L. aspera* exhibited antifungal activity against *Microsporum gypseum* and Trichophyton in an in vitro study employing ether and chloroform extracts. 5 mg/mL was found to be the lowest inhibitory concentration(12). Together with fungistatic qualities, *Leucas aspera* displayed fungicidal ones. Inhibiting prostaglandins and acting as antioxidants Research was done on *Leucas aspera's* prostaglandin (PG) inhibitory and antioxidant qualities. The extract demonstrated both activities, namely a 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging effect and inhibition at 3–4 g/mL against PGE1– and PGE2-induced contractions in the ileum of guinea pigs. Antimicrobial properties of flowers from *Leucas aspera* expressed floral juice, the methanol extract, the methanol fraction with the highest activity for the alkaloidal residue, and the methanol extract of *L. aspera* flowers all demonstrated good antibacterial activity. Certain essential oils have antimicrobial properties. Bacteriostatic activity *against Salmonella typhi, Vibrio cholerae, Escherichia coli, Proteus vulgaris, Pseudomonas pyocyanea,* and *Dys* was demonstrated by the essential oils derived from *L. aspera*(13).

1.5. Mechanism of action

The pharmacological qualities of *Leucas aspera* plants, such as its antifungal, antioxidant, anticancer, phytotoxic, antivenom, hepatoprotective, anti-inflammatory, antinociceptive, antiulcer, antimalarial, and antidiabetic effects, have long been appreciated. All sections of the plant, including the leaves, flowers, stem, and roots, exhibit these advantageous qualities(2,14).

1.5.1. Antifungal Properties

In vitro studies on *L. aspera* extracts in ether and chloroform have shown antifungal efficacy against *Microsporum gypseum* and Trichophyton. It was discovered that 5 mg/mL was the minimal inhibitory concentration, demonstrating both fungicidal and fungistatic effects(15).

1.5.2. Antioxidant Activity and Prostaglandin Inhibition

According to studies, *L. aspera* possesses antioxidant and prostaglandin (PG) inhibitory properties. The extracts showed a radical scavenging effect against 1,1-diphenyl-2-picrylhydrazyl (DPPH) and inhibition at 3–4 g/mL against PGE1– and PGE2-induced contractions in the ileum of guinea pigs(16).

1.5.3. Antimicrobial Properties of Flowers of Leucas aspera

The *L. aspera* flower methanol extract, fractions, alkaloidal residue, and expressed floral juice all showed notable antibacterial activity. The methanol fraction and extract showed the strongest activity against various bacteria, highlighting its potential as an antibacterial agent(15).

1.5.4. The Antibacterial Properties of Essential Oils

Essential oils derived from L. aspera demonstrated bacteriostatic activity against a range of bacteria, including *Staphylococcus aureus, Vibrio cholerae, Salmonella typhi, Klebsiella aerogenes, Escherichia coli, Proteus vulgaris, Pseudomonas pyocyanea*, and *Dys*(15,17).

1.6. Extraction

The plant sample was collected, rinsed thoroughly with deionized water to get rid of any dirt, and then left to air dry in the shade to get rid of any moisture that remained. The *L. aspera* aqueous extract was made by heating ten grams of dried leaf material to seventy degrees Celsius in one hundred milliliters of distilled water. Next, Whatman No. 1 filter paper was used to filter the resultant crude extract. The leaf extracts were filtered, then carefully sealed and kept at 4°C for additional examination. Subsequently, 100 mL of a 1 mM aqueous silver nitrate solution was added gradually to 50 mL of the aqueous leaf extract in an Erlenmeyer flask while being continuously stirred at 500 rpm(18). The formation of silver nanoparticles, or AgNPs, was indicated by the color changing from green to dark brown. AgNPs were then purified using centrifugation at 15,000 rpm. The precipitate was dried in an oven at 70°C for three to four hours following three ethanol washes to eliminate contaminants. The generated AgNPs were stored in a brown bottle for characterization (Fig 4)(8).

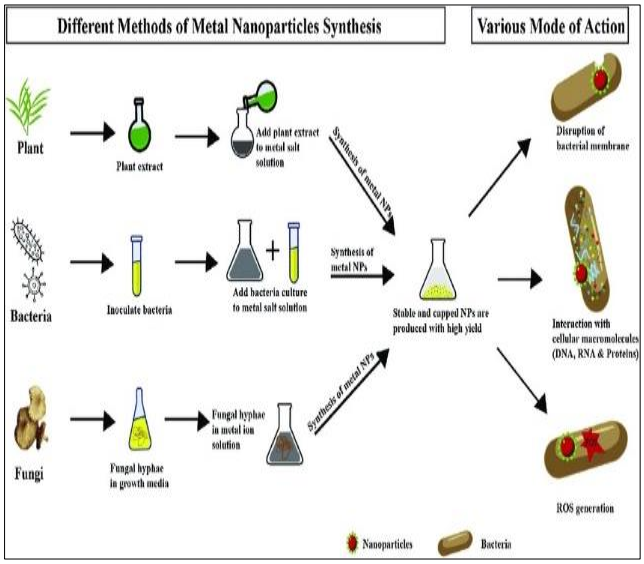

Figure 4 Process of extraction (fig4)

1.7. Nanoparticles

1.7.1. Silver Nanoparticles

X-Ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), High-resolution Transmission Electron Microscopy (HRTEM), and UV/Vis spectroscopy were used to evaluate the produced silver nanoparticles (AgNPs). Through the use of UV/Vis spectroscopy, the reduction of AgNO3 into AgNPs with the addition of aqueous plant extract was recognized by the creation of a surface Plasmon resonance peak (~ 400 nm). The several bioactive functional groups that are present in aqueous plant extract and coated over produced AgNPs throughout the reduction and stabilization process were identified using FTIR (at 4500–750 cm−1) analysis. The produced AgNPs' structure, phase purity, and lattice characteristics were ascertained using XRD examination. AgNPs' size, shape, and aggregation were assessed by HRTEM(6,17).

1.7.2. Copper Oxide Nanoparticles

Analytical-grade chemical reagents were all used without further purification. *Leucas aspera* and *Morinda tinctoria* leaf extracts were used as a bio-reducing agent to create CuO nanoparticles. Precursor CuSO4.5H2O was used; 0.37g of it was dissolved in 75 ml of deionized water and well mixed with a magnetic stirrer [10–12]. Next, 25 milliliters of recently made *Leucas aspera* leaf extract was added to the copper sulfate solution. After vigorous stirring, the solution turned from blue to a pale yellowish-green tint to a dark brownish-green color [13–17]. *Leucas aspera* and *Morinda tinctoria* plant material's aqueous leaf extracts were successfully used to create CuO nanoparticles, which acted as stabilizing and reducing agents. To determine the structure of the produced nanoparticles, XRD analysis was used. Using SEM technology, the specimen's morphology and shape were examined, displaying cubical and spherical features(4).

1.7.3. Bimetallic Ag Cu Nanoparticles (BNP)

Utilizing renewable *Leucas aspera* plant leaf extract, bimetallic Ag-Cu nanoparticles were efficiently synthesized via an enhanced green synthesis method employing the BBD statistical tool. The optimized bimetallic Ag-Cu nanoparticles, synthesized in a green manner, exhibit significant potential as in vitro antioxidants and alveolar anti-cancer agents. Further in vivo clinical testing of Ag-Cu nanoparticles derived from *Leucas aspera* is required to develop innovative alveolar anti-cancer medications with targeted drug delivery capabilities(19).

2. Conclusion

In synthesizing nanoparticles, plant extracts can act as both stabilizing and reducing agents. When plant extracts are used for nanoparticle synthesis, the reaction can be completed quickly—in just a few minutes—by simply combining the extract with a metal salt solution at room temperature. This process has been effectively used to create gold and silver nanoparticles, among other metals. Differently produced nanoparticles are used in a variety of in vitro diagnostic situations. Broad-spectrum antibacterial activities of silver and gold nanoparticles are demonstrated against infections that impact both people and animals. The production of nanoparticles usually follows a "top-down" or "bottom-up" approach. Although they introduce surface defects that may limit surface chemistry, nanoparticles are created via size reduction from a suitable starting material utilizing a variety of physical and chemical techniques. The manufacture of metallic nanoparticles using plant extracts has the benefits of being environmentally friendly, scalable, and affordable. This technique allows for control over the size and morphology of the nanoparticles and is especially useful for creating nanoparticles free of harmful impurities, which is essential for therapeutic applications.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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