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The medicinal heritage of *acalypha indica*: an integrated review

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Abstract
Medicinal plants are essential components of traditional healthcare systems worldwide, serving as vital therapeutic resources in many cultures. *Acalypha indica*, commonly known as Indian Acalypha, is a widely distributed herb with significant medicinal and ecological importance. This review highlights its ethnomedicinal uses, taxonomy, habitat, phytochemical composition, and pharmacological effects. Traditionally used in Ayurveda, Siddha, and Unani medicine, *Acalypha indica* is known for its antimicrobial, anti-inflammatory, antioxidant, anti-parasitic, and anti-venom properties. Phytochemical analysis reveals the presence of bioactive compounds such as alkaloids, flavonoids, tannins, and saponins, which contribute to its diverse therapeutic activities. The plant has been applied in treating respiratory issues, skin infections, gastrointestinal disorders, and oxidative stress. Additionally, it demonstrates potential in acaricidal, diuretic, and wound healing properties. Despite its traditional medicinal value, recent research on *Acalypha indica* indicates the need for further exploration in areas like toxicity, standardization, and clinical validation. This review emphasizes the importance of in-depth research on *Acalypha indica* as a natural therapeutic resource.

Keywords: *Acalypha indica*, phytochemistry and pharmacological properties, anti-venom properties and wound healing effect

Introduction

Traditional medicine, which involves reliance on natural plants, is accepted globally as an essential source of treatment for diverse medical conditions. The World Health Organization formally acknowledged medicinal plants as trustworthy and reliable sources for the pursuit of therapeutic activities to recognize their importance in healthcaresystems, particularly in areas lacking sufficient modernmedicalresources and their access (WHO, 2002) [42]. More recent studies also point to an increasing interest in herbal medicine around the world, indicating an increase in its integration into modern health practices (Sharma *et al*., 2019) [28, 29].

Medicinal plants are available abundantly around human settlements, being a mainstay of many traditional healing practices. These plants are easily accessible since they grow in many areas such as along road sides, in backyards, and within the compounds of homes, where they can be accessed by individuals who use them daily for medicinal purposes (Rao, 1996) [24].

Others grow them specifically for personal or family use, integrating these natural remedies into their lives (Nasir, 2012) [19]. Such plants have been recognized for their use in treating common ailments and preventing diseases (Gazzaneo *et al*., 2005) [15]. The significance of these plants is due to their widespread availability and versatility, providing a number of therapeutic benefits such as the treatment of common illnesses, relief from pain, and general wellness. In some cultures, the traditional knowledge of how to use these plants for medicinal purposes has been passed down through generations orally, though this practice is now at risk of being lost as older generations pass away without leaving detailed documentation for future generations (Martin, 1995) [18]. Researchers point out that this traditional knowledge needs to be documented to ensure its preservation and continued use (Pieroni *et al*., 2011) [20]. Therefore, documentation and preservation of medicinal plants' knowledge is a very important factor to preserve this valuable resource. Many traditional healers who have firsthand knowledge and experience with these plants continue to act as a bridge between the past and the future of conventional medicine. Without proper preservation, however, this knowledge may gradually be lost, leaving future generations with limited access to these natural remedies (Nasir, 2012) [19]. Efforts are now being made in harvesting and preserving this knowledge, especially through partnerships between ethnobotanists and local communities (Ladio & Lozano, 2009) [17].

Taxonomy of *Acalypha indica* (Indian Acalypha)

The scientific classification (taxonomy) of *Acalypha indica* is as follows:

Vernacular names

Tamil: Kuppaimeni.
Sanskrit: Arittamanjarie.
English: Indian acalypha.
Hindi: Kuppu; Khokali.
Telugu: Kuppichettu; Harita-manjiri; Kuppinta or Muripindi.

Habitat and ecology

Acalypha indica thrives in tropical and subtropical climates. It is commonly found in moist, disturbed soils, including

gardens, roadsides, and waste grounds. The plant can grow in both shaded and sunny areas, although it tends to prefer well-lit environments. It is tolerant of a wide range of soil types but flourishes best in loamy, well-drained soils (Kumar & Reddy, 2018).

The plant has a weedy nature and can some considered invasive, although it is highly valued in traditional medicine, which often prevents its classification as a harmful weed in certain regions. Due to its ability to grow in disturbed areas, *Acalypha indica* plays an ecological role in soil stabilization and can contribute to the rehabilitation of degraded lands (Ghorbani, 2005) [16].

Acalypha indica, commonly referred to as Indian Acalypha, is an annual herbaceous plant belonging to the Euphorbiaceae family (Frolov & Saraeva, 2022) [14]. Native to tropical regions, this plant is now widely distributed across the globe, particularly in tropical and subtropical regions. Its weedy nature and ability to thrive in disturbed environments have contributed to its widespread presence in various ecosystems. The geographical distribution of *Acalypha indica* spans several continents, with significant populations in Africa, Asia, and other tropical regions. This distribution highlights its ecological versatility and cultural importance, especially in traditional medicine across the regions where it thrives. This plant has been a staple in traditional medicinal systems for centuries due to its diverse therapeutic properties, including its use in Ayurveda, Siddha, and Unani (Bhat & Nigar, 2020) [5].

Global distribution

Acalypha indica is indigenous to tropical Africa and the Indian subcontinent. Over time, it has spread to many other parts of the world, particularly areas with warm, humid climates. Its global distribution is now evident in a variety of ecosystems, ranging from coastal lowlands to disturbed agricultural fields.

Africa

Africa is one of the primary native regions of *Acalypha indica*, and it is widely distributed across sub-Saharan countries. In West Africa, *Acalypha indica* is prevalent in countries like Nigeria, Ghana, and Sierra Leone. It is commonly found along roadsides, in open fields, and within village communities. In these areas, the plant grows vigorously in moist, disturbed soils and is often considered a weed due to its rapid spread and competitive nature with crops. The use of *Acalypha indica* in traditional African medicine is well-documented, particularly for treating skin diseases, respiratory conditions, and parasitic infections. Studies indicate that the plant has been used in Nigeria to treat ailments like pneumonia and scabies, reflecting its integration into local herbal practices

In East Africa, particularly in countries like Kenya, Uganda, and Tanzania, *Acalypha indica* grows in similar environments, thriving in disturbed lands such as abandoned fields, roadsides, and areas near human settlements. The humid tropical climate of East Africa supports its growth throughout the year, and its medicinal applications in traditional healing systems are well-known. It is often used for its anti-inflammatory and antimicrobial properties, especially in rural communities

South Africa also hosts substantial populations of *Acalypha indica*, particularly in subtropical regions like KwaZulu-Natal and the Eastern Cape. In these areas, it is found in moist, shaded environments, often growing along rivers and near forests. The plant's ability to grow in degraded or disturbed habitats makes it a colonizer species that plays a role in soil stabilization in some regions. The use of *Acalypha indica* in traditional South African medicine includes treatments for skin ailments and digestive issues, with local herbalists employing various parts of the plant for their therapeutic properties (Dutta, Nandy, & Dey, 2021) [13].

Asia

Asia, particularly the Indian subcontinent, represents one of the most significant regions for the distribution of *Acalypha indica*. In India, the plant is widespread and thrives across various ecological zones, from the tropical lowlands to the hilly regions. (Sivapalan & Rajesh, 2011) [32]. It is particularly abundant in the southern states of Tamil Nadu, Kerala, and Karnataka, where it grows in gardens, along roadsides, and in disturbed agricultural fields. The plant is well-adapted to the monsoonal climate of southern India, and its growth peaks during the rainy season (Das & Singh, 2018) [11]. It has been utilized in traditional Ayurvedic and Siddha medicine for treating respiratory conditions, skin infections, and digestive disorders. For instance, it is commonly used to treat asthma and bronchitis due to its bronchodilator and expectorant properties (Mathew & Kumaran, 2020; Gupta & Banerjee, 2016).

In northern India, *Acalypha indica* is found in regions such as Uttar Pradesh, Bihar, and West Bengal, where it grows in low-lying, moist environments, including along riverbanks and in open fields (Sharma & Prasad, 2019) [28, 29]. Its presence in agricultural areas sometimes categorizes it as a weed, yet its medicinal significance prevents it from being considered a harmful invasive species (Verma & Chauhan, 2017) [39]. The plant is also common in Bangladesh, Nepal, and Sri Lanka, where it thrives in tropical and subtropical climates. In Sri Lanka, *Acalypha indica* is often used in Ayurvedic practices, particularly for treating skin diseases like eczema and ringworm, owing to its antifungal and antibacterial properties (Jayasinghe & Fernando, 2015; Mendis & Silva, 2021).

Fig 1: Botanical and Morphological characteristics

Acalypha indica

Acalypha indica is an erect, annual herbaceous plant that typically grows between 60 and 75 cm in height (Nambiar & Varghese, 2023). It has a slightly pubescent, green stem that becomes more rigid as it matures, often displaying a reddish tint. This fibrous-rooted plant adapts well to various soils, thriving in disturbed environments such as waste grounds and gardens (Akman, 2020; Rahman & Candolin, 2022) [1].

The leaves of *Acalypha indica* are simple, alternate, and ovate with serrated edges, measuring approximately 4–8 cm in length and 2–5 cm in width. Their color ranges from light to dark green, with pronounced veins on the underside, which gives them a distinct texture and appearance. Each leaf blade broadens near the middle and tapers toward the base and tip. The petioles, measuring 2–5 cm, contribute to a drooping leaf appearance (Chen *et al*., 2023; Amar *et al*., 2023) [2, 9].

The plant bears small, greenish, unisexual flowers in axillary or terminal spikes, with male flowers usually positioned at the top and female flowers at the base of each spike. Male flowers contain multiple stamens, while female flowers feature a trilobed ovary with a prominent style. These spikes measure around 2–7 cm in length and are generally pollinated by wind (Mabberley, 2017).

The fruit is a small, dry capsule about 3 mm in diameter, which bursts open when mature, dispersing smooth, light brown seeds. Due to its adaptable nature, *Acalypha indica* grows well in both shaded and sunny areas, making it highly resilient. Although regarded as a weed in some regions, its medicinal properties often overshadow its invasive potential (Prime, Wade, & Browne, 2020; Dongre *et al*., 2023) [12].

Traditional medicinal uses

Indigenous practitioners have utilized *Acalypha indica* in the treatment of various ailments, from skin disorders and respiratory conditions to gastrointestinal disturbances and parasitic infections (Ssenku*et al*., 2022). Scientific studies have validated the traditional uses of *Acalypha indica*, particularly highlighting its anti-inflammatory, antimicrobial, and antiparasitic properties (Qaemifar, Borji, & Adhami, 2023). The presence of bioactive compounds such as alkaloids, flavonoids, tannins, and saponins enhances its effectiveness in medicinal applications (Sorrenti *et al*., 2023). In recent years, research has aimed to explore its full pharmacological potential, increasing interest in its biotechnological applications and safety profiles.

In Ayurveda, *Acalypha indica* is traditionally used for treating respiratory issues such as asthma, bronchitis, and pneumonia (Haile *et al*., 2022). The leaves are often boiled to create herbal infusions that provide respiratory relief, and the plant's juice or decoction is applied topically to treat skin ailments like scabies, eczema, and ringworm infections. The plant is also known for its vermicidal activity, commonly used in traditional medicine to expel intestinal worms and parasites.

The roots of *Acalypha indica*serve as a purgative to aid digestion and detoxify the body. Its leaves also promote wound healing and are often used for ulcers and cuts. Additionally, the plant has long been a popular remedy in traditional healing for addressing snakebites and insect stings.

Phytochemistry and pharmacological properties

The medicinal properties of *Acalypha indica* can be attributed to its rich phytochemical profile (Sánchez-Hernández *et al*., 2023) [27]. It contains a variety of bioactive compounds, including alkaloids (such as acalyphine), flavonoids, tannins, and saponins. These compounds are responsible for the plant's broad spectrum of pharmacological activities. For instance, acalyphine, a key alkaloid, has shown potent vermicidal and antimicrobial properties, which support its traditional use in treating intestinal parasites. The plant material's constituents include the alkaloid acalyphine, the base triacetoneamine, the cyanogenetic glucoside, and kaempferol. Acalyphamide, amide, and a few additional 2-methylanthraquinone, amides, y-sitosterol, and beta sitosterol, n-octacosanol, tri-O-methyl ellagic acid and stigmasterol, quinine, tannin, resin, betasitosterol glucoside, and essential oil (Nag *et al*., 2018). Numerous nutrients, including lipids, proteins, carbohydrates, and vitamins, are present in fresh A. indica plants. Patients with mineral deficiencies can benefit from its high iron content, which is followed by copper, nickel, zinc, and chromium. This plant is good for body hydration because it has a high moisture content of up to 90% and a total ash value of 18% (Takle *et al*., 2011) [35]. This plant contained phenolic compounds that were effective antioxidants, including geraniin, glucogallin, corilagin, and chebulagic acid. This plant contains gallic acid, ellagic acid, 16 α, 17-dihyroxy-entkauran 19-oic acid, 4,4′,5,5′,6,6′ hexahydroxydiphenic acid, and kauren-18-oic acid. Sanseera *et al*., (2012) found that the quebrachitol compound in the leaves actively inhibited anti-cancer activity against small cell lung and breast cancer (Chekuri *et al*., 2020) [8].

Research studies have confirmed the antimicrobial properties of *Acalypha indica*, demonstrating its ability to inhibit the growth of pathogenic bacteria and fungi (Guarnieri *et al*., 2022). It has been found effective against common bacterial strains like Escherichia coli and Staphylococcus aureus, as well as fungi such as Candida albicans. Additionally, the plant exhibits significant anti-inflammatory and analgesic effects, which make it suitable for treating conditions like arthritis, wounds, and infections.

Moreover, *Acalypha indica* has shown antioxidant activity, suggesting its potential in preventing oxidative-related diseases (Chakraborty *et al*., 2023) [7]. Its role in traditional medicine as an anti-inflammatory agent is supported by studies showing its ability to reduce inflammation in laboratory models (Morrison *et al*., 2022).

Toxicity and safety

While *Acalypha indica* is widely used in traditional medicine, recent research into its safety profile suggests that it is generally safe when used at appropriate doses (Burmester *et al*., 2023) [6]. However, like many medicinal plants, high doses of *Acalypha indica* extracts can lead to toxicity. Toxicological studies have indicated potential side effects such as gastrointestinal irritation and central nervous system depression if consumed in large quantities. Therefore, caution is recommended, and further clinical trials are needed to establish a definitive safety profile for its use in modern medicine.

Post-coital anti-fertility activity

The study examined the post-coital antifertility effects of four solvent extracts of *Acalypha indica* in female albino rats: ethanol, petroleum ether, aqueous, and chloroform. Chloroform and water extracts did not exhibit oestrogenic action, although petroleum ether and ethanol extracts did (Shivayogi *et al*, 1999) [30].

Four solvents were used in the investigation to investigate the action of post-coital infertility in female albino rats. It was discovered that the extracts of petroleum ether and ethanol had the strongest anti-implantation effects. Histological investigations verified the plant's oestrogenic potential, and both extracts of *Acalypha indica*at exhibited oestrogenic activity (Tanmoy Sinha *et al*., 2012) [36].

Anti-venom properties

In rats and isolated frog tissue, it was discovered that the ethanol leaf extract of *Acalypha indica*neutralised the venom of Viper russelli. In isolated frog tissue, the extract had cardiotoxic and neurotoxic effects, whereas in rats, it reduced mortality, haemorrhage, necrotising, and mast cell degranulation at dosages of 500 and 750 mg/kg. Additionally, it decreased GSH and catalase levels in kidney tissue and lipid peroxidation in red blood cells. (Annie *et al*., 2004) [3]

At a dosage of 500 mg/kg, the anti-venomic extract of Acalypha indica can extend the lifespan of Daboia russellivenom by up to 100%. Other extracts with antioxidant activity, such as acetone, petroleum ether, benzene, and chloroform, also have antivenom effectiveness. (Rajendran *et al*., 2010) [22]

Wound healing effect

The research examined the wound healing potential of extracts from Heliotropium indicum, Plumbago zeylanicum, and *Acalypha indica* in rats through excision and incision wound models. The findings indicated that *Acalypha indica* extracts combined with saline exhibited decreased tensile strength and collagen maturation rate when contrasted with Heliotropium indicum. (Suresh Reddy *et al*., 2002) [34]

The healing properties of *Acalypha indica* leaf extract for skin issues were not as effective in rat wound models when using its ethanolic form. (Vinoth Raja *et al*., 2009) [40]

Malarial vector

The research examined different leaf extracts of *Acalypha indica* for their effects on killing larvae, eggs, and attracting egg-laying behavior in the Anopheles stephensi mosquito, which spreads malaria. The results indicated encouraging findings with LC50 values of 19.25, 27.76, 23.26, and 15.03 ppm, in that order. The effectiveness in killing eggs directly correlated with the number of eggs, showing the most attraction at 90.09%, 94.20%, 85.43%, and 95.75% with benzene, chloroform, ethyl acetate, and methanol extracts respectively. (Govindarajan *et al*., 2008)

Antioxidant capacity

The DPPH assay method was used in the study to evaluate the antioxidant activity of aqueous ethanolic leaf extracts from different plants. After 15 minutes of incubation at a test concentration of 50µg/ml, the results indicated that all extracts had antioxidant activities ranging from 89 to 93%. (Ruchi *et al*., 2007) [25]

Anti-inflammatory activity

Four groups of albino rats were used in the study to test the anti-inflammatory properties of *Acalypha indica* leaves. An hour prior to the injection of carrageenan, the rats received pretreatments consisting of control, standard (Indomethacin), *Acalypha indica*, and a combination of both. 0.1 ml of 1% carrageenan solution was injected into the rats' right paw to cause acute oedema. The findings demonstrated that *Acalypha indica* leaves successfully reduced oedema and paw volume. (Mohana Vamsi *et al*. 2008)

The ethanolic extract of *Acalypha indica* was used in the study to test its anti-inflammatory effects in rats, with phenylbutazone serving as the standard medication. With no protein denaturation, the extract demonstrated 85% inhibition in carageen-induced paw edema and albumin proteinase and denaturation tests. Similar to a lysosomal membrane, the extract prevented hypotonicity-induced lysis, stabilizing the erythrocyte membrane. (Rahman *et al*., 2010; Soruba *et al*., 2015) [33]

Acaricidal activity

The research examined the acaricidal effects of paste made from *Acalypha indica* leaves both *in vitro* and *in vivo*. On naturally infested broiler rabbits, the *in vivo* study demonstrated a lethal effect on live mites after 4 hours of treatment, whereas the *in vitro* study demonstrated maximum inhibition after 48 hours. (Singh *et al*., 2004) [31]

Diuretic activity

When the methanolic extract of *Acalypha indica* was administered to albino mice for five hours, the study found that its diuretic effect peaked at a dose of 400 mg/kg body weight. (Das *et al*., 2005) [10]

Antibacterial and antifungal activities

Several extracts from *Acalypha indica*, such as ethyl acetate, hexane, and methanol, were tested for their antibacterial properties against Klebsiella pneumoniae, Staphylococcus aureus, and Bacillus subtilis. Hexane extracts demonstrated moderate activities, whereas ethyl acetate extracts successfully suppressed the growth of all three bacterial species, according to the results. The highest levels of inhibition against Aeromonas hydrophilla and Bacillus cerues were demonstrated by the aqueous extracts of Tridax procumbens, Cleome viscosa, *Acalypha indica*, and Boerhaaviaerecta. A soxhlet apparatus was used to prepare the hexane, chloroform, acetone, and methanol extracts of fresh, dried, and powdered *Acalypha indica* samples. Through TLC and HPLC analyses, the Rf values of the plant extract and a synthetic antifungal substance called Clotrimazole were confirmed. *Salmonella typhi*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Shigella flexneri*, and *Klebsiella pneumonia* were tested for their antibacterial qualities against extracts of *Acalypha indica*, *Solanum trilobatum*, *Aegle marmelos*, *Adhatodavasica*, *Aristolochialatas*, *Datura metel*, *Glycyrrhiza glabra*, *Solanum incanum*, *Eucalyptus globulus*, *Azadirachta indica*, and *Vitex negundo*. Several extracts from *Acalypha indica* leaves, such as ethanol, hexane, chloroform, ethyl acetate, and methanol, were tested for their antibacterial properties against both gram-positive and gram-negative bacteria. With inhibitory concentrations ranging from 0.156 to 2.5 mg/ml, the results demonstrated that all extracts exhibited

antibacterial activity against gram-positive organisms. (Govindarajan *et al*., 2008)

The study assessed the antifungal activity of several *Acalypha indica* extracts against a range of fungi, identifying flavonoidal derivatives and phenolic compounds as the main sources of antifungal activity. (Sakthi *et al*., 2011) [26]

Haemolysis

Acalypha indica's hemolytic potential was assessed in patients who drank the plant's broth; the results showed that the patients lacked glucose 6-phosphate dehydrogenase. (Venkata Narasimha Kadali *et al*., 2016) [38]

Hepatoprotective activity

Wistar albino rats were given 300 mg/kg of the methanolic extract of *Acalypha indica* aerial parts, and after 48 hours of hepatotoxic administration, the extract demonstrated hepatoprotective activity by reducing GOT, GPT, and ALKP levels, which was similar to the usual medication silymarin.

Anti-ulcer activity

Phytoconstituents found in *Acalypha indica's* methanolic extract prevent ulcers. Swiss albino rats, as well as swim stress and pylorus ligation models, were used to test the anti-ulcer activity. At 100 mg/kg, the extract decreased the volume of gastric juice by 67.14%, complete acidity by 59.29%, free acidity by 53.24%, and ulcer index by 37.18%. Results were similar to those of the standard medication. (Kalimuthu *et al*., 2010)

Analgesic activity

Acalypha indica's methanolic extract contains phytoconstituents that help prevent ulcers. Swiss albino rats were used to test the anti-ulcer activity, along with swim stress and pylorus ligation models. At 100 milligrams per kilogram, the extract reduced the ulcer index by 37.18%, the volume of gastric juice by 67.14%, the complete acidity by 59.29%, and the free acidity by 53.24%. The outcomes resembled those of the usual drug. (Mohuya Mojumdar *et al*., 2016)

Psoriasis

The study shows that *Acalypha indica* leaf extract has anti-psoriatic effects on the chronic inflammatory skin condition A431 and B16-F10 cell lines. It was discovered that the extract worked well for psoriasis, a skin disorder marked by fast keratinocyte growth. (Rajkiran Reddy Banala, *et al*., 2017) [23].

Future study and applications

Acalypha indica is a plant which has significant potential as a medicinal drug for a wide variety of applications, which are easily available and at relatively inexpensive costs. Bioactive phytochemicals in this plant can be extracted, isolated, and purified to fulfill specific medicinal requirements for the development of the alternative secondary medicinal product. Several therapeutic areas where it demonstrated greater efficacy over standard drugs were anthelmintic, anti-inflammatory, antibacterial, anticancer, antidiabetic, antihyperlipidemic, anti-obesity, antivenom, diuretic, hepatoprotective, and wound healing activities.

Among its pharmacological properties, its antioxidant potential is notable. This property contributes to the drug's analgesic, anti-urolithiasis, antivenom, hepatoprotective, and wound healing effects. The key antioxidant agents include eight flavonoids, ellagic acid, gallic acid, and ascorbic acid that could act synergistically for greater therapeutic effects.

Recent studies have also tried to synthesize plant extracts with nanoparticles, namely silver, copper, and gold, for advanced applications in cancer treatment and as an antibacterial agent. Despite this, there are minimal studies on the volatile phytochemicals and essential oils of *Acalypha indica*. These substances will be of potential use for relief from headaches and epilepsy as an inhalation but need more extensive research.

Acalypha indica has also been found to have potential as a bio-exterminator against pests, mollusks, and mosquito larvae with low toxicity to non-target organisms, providing an environmentally friendly alternative to synthetic chemicals. Future studies should determine the specific bioactive compounds present in the plant and their applications to maximize its therapeutic and environmental potential.

Conclusion

This review highlights the diverse potential of *Acalypha indica*, concentrating on its phytochemical content, pharmacological activities, and ethnomedicinal practices. The plant, particularly its leaves, has been used for therapeutic purposes through anthelmintic, anti-inflammatory, antibacterial, anticancer, antidiabetic, hepatoprotective, and wound healing treatments. Despite the positive outcome of pharmacological studies, there are still challenges associated with the lack of a recommended human dosage and less clinical trials. Future research should isolate and purify active compounds, explore unstudied ethnomedicinal uses, and focus on essential oils and volatile compounds to understand their therapeutic potential, especially through inhalation. Since *Acalypha indica* is readily available and not expensive, it is a good opportunity for the discovery of new natural drugs to replace existing treatments. There is a strong recommendation to further explore its under-researched therapeutic activities and clinical applications.

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