

Unveiling the Phytochemistry and Pharmacological Potential of *Aerva lanata* and *Ficus carica*: A Comprehensive Review

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Received: 30th May, 2026; Revised: 10th June, 2026; Accepted: 15th June, 2026; Available Online: 18th June, 2026

ABSTRACT

Background

Medicinal plants remain an important source of bio-active compounds with therapeutic potential. This comprehensive narrative review summarizes current evidence on the phytochemistry, pharmacological activities and safety of *Aerva lanata* and *Ficus carica*.

Methods

Literature was retrieved from PubMed, Scopus and Google Scholar using combinations of the terms "*Aerva lanata*", "*Ficus carica*", "phytochemistry", "pharmacology" and "toxicity", including experimental, clinical and review articles.

Results

Aerva lanata, a widely distributed herb, shows antioxidant, anti-inflammatory, antimicrobial, antifungal, antidiabetic and antiurolithiatic effects mainly in preclinical in vitro and in vivo models, supporting its traditional use in urinary tract disorders, urolithiasis and selected skin conditions. *Ficus carica* (fig), a fruit tree with a long history of use, is valued for its nutritional profile and experimental evidence of antioxidant, anti-inflammatory, chemo preventive, hepatoprotective, antispasmodic and antiplatelet activities, consistent with traditional applications in gastrointestinal, respiratory and cardiovascular complaints.

Conclusion

This review collates data on botanical characteristics, ethnomedicinal uses, phytochemical composition, pharmacological properties and available safety information for both species, including reported adverse effects, possible drug-herb interactions and traditional dosage ranges. Overall, most findings are derived from preclinical studies, and robust clinical data remain limited, particularly for *A. lanata*. The review highlights key knowledge gaps and the need for well-designed clinical and safety studies before broader evidence-based application.

Keywords: *Aerva lanata*; *Ficus carica*; medicinal plants; phytochemistry; pharmacological properties; antioxidant activity; antidiabetic; traditional uses.

How to cite this article: Sivasubramanian P, Anna Poorani M, Baby Dharshini A, Iniya Dharshini SD, Nithya Jeeva Andrew S, Poovarasam M. Unveiling the Phytochemistry and Pharmacological Potential of *Aerva lanata* and *Ficus carica*: A Comprehensive Review. *Int J Drug Deliv Technol.* 2026;16(61s):795-806. DOI: 10.25258/ijddt.16.61s.88

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Medical practices and medicines are largely dependent on medicinal plants for their bio-active compounds. The secondary metabolites of the plants, especially those with antioxidant activity, anti-inflammatory activity, antibacterial activity, and antiproliferative activity are responsible for the development of modern medicines to a greater extent¹. Especially in the context of chronic and complex diseases, the chemical diversity of medicinal plants offers a fascinating area for continuous research in pharmacognosy and pharmacology². In the context of the actual

knowledge of several generations of the population of Africa, Asia, and the Middle East, traditional systems of medicine have long depended on medicinal plants as a form of primary medicine³. The issues of medication resistance, toxicity, and the high cost of traditional medicines have created a resurgence of interest in medicinal plants in recent decades⁴. The significance of medicinal plants with antioxidant activity comes into focus in the context of the recognition of oxidative stress as a major pathogenic factor for several metabolic, inflammatory, neurological, and proliferative diseases⁵⁻⁶. Among medicinal

plants widely documented in ethnomedicine, *Ficus carica* L. has received considerable attention because of its nutritional value and diverse pharmacological properties, including antioxidant, anti-inflammatory, hepatoprotective, and chemopreventive effects⁷. The therapeutic relevance of such plants is further supported by ethno pharmacological frameworks linking dietary practices, plant chemistry, and human health⁸⁻⁹.

In this regard, the present review article aims at collecting and evaluating the literature which is available on *Aerva lanata* (L.) Juss. ex Schult. and *Ficus carica* L., with respect to its botanical features, phytochemical constituents, pharmacological activities which have been scientifically validated, traditional uses, and safety profile. This review intends to provide a fair summary by integrating pharmacological and toxicological information with ethnobotanical expertise, identifying existing gaps and areas for further research. This narrative review was based on an organized literature assessment, which was carried out through electronic sources such as PubMed, Scopus, Google Scholar, etc. Human observations and preclinical investigations, such as in vitro and in vivo, were the major focus of the peer-reviewed. Includes ethnobotanical narratives, reviews, and original research articles published in English language journals/magazines.

BOTANICAL DESCRIPTION AND DISTRIBUTION

Aerva lanata (L.) Juss. ex Schult.

Morphology

Aerva lanata is known to belong to the Amaranthaceae family of perennials and sometimes annuals. It can grow to 30 to 60 cm in height. It often has an erect to prostrate growth habit. The stem is cylindrical, branched, and slightly pubescent. The leaves are simple, alternate, ovate to elliptic, with entire margins, and a characteristic tomentose, silvery white indumentum. The inflorescence has a fluffy aspect because of the small, sessile, greenish white flowers which are densely arranged in axillary or terminal spikes. The fruits are minute utricles containing minute seeds¹⁰. The general morphological features of the plant are illustrated in figure 1 below.



Figure 1. *Aerva lanata* (L.) Juss. ex Schult. – whole plant morphology Habitat and geographical distribution

Aerva lanata is generally distributed in grasslands, wastelands, road sides, crop fields, and so on. It is largely distributed in tropical to subtropical areas. It has an enormous range of adaptability in terms of ecological conditions. It can thrive in high temperatures, arid environments, and poor soil. Owing to this adaptability to grow in diverse agroclimatic conditions, it has been widely distributed in the Indian subcontinent, Sri Lanka, Southeast Asia, parts of Africa, and the Malay Peninsular region¹¹⁻¹³.

Taxonomical classification

The systematic position of *Aerva lanata* within the plant kingdom is summarized in Table 1, which presents its accepted taxonomical hierarchy from kingdom to species level.

Table 1. Taxonomical classification of *Aerva lanata*

Taxonomic Rank	Classification
Kingdom	Plantae
Family	Amaranthaceae
Genus	<i>Aerva</i>
Species	<i>Aerva lanata</i> (L.) Juss. ex Schult.

Ficus carica L.

Morphology

Ficus carica L., commonly known as the fig, is a small tree or a deciduous shrub in the Moraceae family. This plant usually grows to a

height of 3 to 10 meters. It has a wide crown and smooth gray bark. Its leaves are large, arranged alternately, palmately lobed, and rough on the upper side. When they get damaged, they release a milky latex. The inflorescence is a syconium that can be pear-shaped or globular and contains many tiny flowers. The size, color, and texture of the fruits vary based on the cultivar and the stage of ripeness. The figure shows the general morphological features of the plant. The general morphological features of the plant are illustrated in figure 2 below^{14 15}.



Figure 2. *Ficus carica* L. – whole plant and leaf morphology

Habitat and geographical distribution

Ficus carica grows in warm temperate and subtropical climes. It is frequently grown in locations with dry summers and warm winters. This species prefers well-draining soil and is frequently found in orchards, residential gardens, and farms. It most likely originated in the Mediterranean and western Asia. It is currently found throughout Southern Europe, the

Middle East, North Africa, and some regions of Asia after successfully spreading to tropical and subtropical regions.¹⁶⁻²¹.

Taxonomical classification

The taxonomical position of *Ficus carica* within the genus *Ficus* and the family *Moraceae* is presented in Table 2, outlining its systematic hierarchy.

Table 2. Taxonomical classification of *Ficus carica*

Taxonomic Rank	Classification
Kingdom	Plantae
Family	Moraceae
Genus	<i>Ficus</i>
Species	<i>Ficus carica</i> L.

Phytochemical composition

Medicinal efficiency of plants have many secondary metabolites such as alkaloids,

flavonoids, phenolic acids, terpenoids, and glycosides. Both *Aerva lanata* and *Ficus carica* have been extensively investigated for their phytochemical profiles, revealing a wide spectrum of bioactive constituents that may underlie their reported pharmacological activities.

Phytochemical composition of *Aerva lanata*

Many types of secondary metabolites have been reported to occur in *Aerva lanata* based on phytochemical analysis, with alkaloids being one of those that have been examined in some detail. Alkaloids were detected and isolated from the aerial part of *Aerva lanata* in some of the early chemical analyses²². The molecular structure of these alkaloids was later confirmed in structural elucidation studies, which improved our understanding of the biological significance of these alkaloids²³. In addition to alkaloids, numerous parts of plants like roots and aerial parts have been found to contain flavonoids, phenolics, saponins, tannins, steroids, and glycosides among others, through qualitative studies²⁴. Comparative phytochemical screenings across multiple medicinal plants have consistently reported *Aerva lanata* as a rich source of phenolic and flavonoid constituents²⁵. Moreover, the known chemical repertoire of the species has been expanded further by the identification and synthesis of specific compounds, for example, compounds of the kind related to oxirane²⁶.

Phytochemical composition of *Ficus carica*

The phytochemical content of *Ficus carica* varies with different factors such as part of the plant, variety, stage of maturity, and processing conditions. Research on the dried fig fruits has shown that they contain considerable amounts of phenolic compounds, flavonoids, sugars, organic acids, and minerals, which are of nutritional importance²⁷. Phytochemical screening and thin layer chromatography have also shown that flavonoids, phenolic compounds, tannins, and terpenoids are present in the leaves of the fig tree²⁸. Research has also shown that the post-harvest processing of the fig fruits, especially drying, significantly influences the content of sugars, organic acids, and phenolic compounds in the dried fig fruits²⁹. Further research on the analytical profile of the phytochemicals present in the fig fruits has shown that phenolic acids and flavonoids are the major components of the fig fruits²⁹, while their content varies with the stage of development of the fruit³⁰. Biotechnological research on the improvement of the extraction of phenolic compounds with antioxidant properties, such as those present in the fig tree³¹ has also shown that solid state fermentation of the byproducts of the fig tree improves the extraction of phenolic compounds

with antioxidant properties³². The results of the qualitative phytochemical analysis of the ethanol, methanol, and chloroform extracts of the leaves of *Aerva lanata* and *Ficus carica* ³³.

Table 3. Phytochemical constituents reported in *Aerva lanata* and *Ficus carica*

S. No.	Phytoconstituents	Chloroform extract		Ethanol extract		Methanol extract	
		A. L.	F. C.	A. L.	F. C.	A. L.	F. C.
1	Phenolic compounds	-	+	-	+	+	+
2	Proteins	-	-	+	-	+	+
3	Alkaloids	+	+	-	-	+	-
4	Glycosides	-	-	-	+	+	+
5	Flavonoids	+	+	+	+	+	+
6	Carbohydrates	+	-	+	+	+	+
7	Tannins	+	+	-	+	+	+

Legend: (+) Present (-) Absent A. L. – *Aerva lanata* F. C. – *Ficus carica*. The results of the research indicate that the distribution of phytoconstituents varies according to the plant species used in the research and the solvent system employed in the research. The methanolic extract of the leaves of *Aerva lanata* and the ethanol and methanolic extracts of the leaves of *Ficus carica* contained significant amounts of phenolic compounds. Glycosides were present in large amounts in the methanolic extracts of the leaves of both plants, while alkaloids were present in the chloroform extracts of the leaves of both plants and in the methanol extract of the leaves of *Aerva lanata*.

MEDICINAL PROPERTIES Pharmacological Properties of *Aerva lanata* Antioxidant activity

The antioxidant properties of *Aerva lanata* have been well evaluated using both in vitro and experimental studies. The substantial chelating, reducing, and free radical scavenging abilities have been observed to be present in the fractions containing phenolic acid derived from *A. lanata*, suggesting that phenolic compounds are major contributors to its antioxidant properties³⁴. The substantial antioxidant activity has been further confirmed through in vitro studies using different plant extracts, which have been attributed to their respective contents of total phenolics and flavonoids³⁵. Conventional lab studies using water-based

stem extracts have shown more evidence of how water-soluble bioactive compounds help reduce oxidative stress³⁶.

Anti-inflammatory activity

Aerva lanata showed anti-inflammatory properties in animal tests. Rats exhibited strong anti-inflammatory and diuretic effects in an early study, suggesting that their inflammatory responses changed³⁷. A review of medicinal plants that people have traditionally used for asthma revealed *Aerva lanata*'s potential anti-inflammatory effect in asthma-related issues³⁸. In vivo studies using allergic asthmatic mouse models also showed its ability to modify the immune response and reduce inflammation, as seen in improved airway responses and lower inflammatory markers^{39 40}.

Antifungal activity

In early experiments, *Aerva lanata* has shown antifungal qualities. Plant extracts have effects that inhibit specific fungus strains. These findings suggest that there are active compounds that can stop fungal growth. However, the full extent of antifungal action has not yet been established⁴¹.

Antimicrobial activity

The antimicrobial properties of *Aerva lanata* have been proven to be effective in combating various bacterial infections. In fact, initial studies have proven that *Aerva lanata* possesses toxic and antibacterial properties in its crude extracts, thus displaying antimicrobial properties. Further studies on Indian medicinal plants have proven that *Aerva lanata* possesses effective antibacterial properties against Gram-positive and Gram-negative bacteria⁴². Recent studies have also proven that *Aerva lanata* possesses protective, antioxidant, and antibacterial properties in its methanolic extracts⁴³.

Antidiabetic activity

Aerva lanata's antidiabetic properties have mainly been studied in animal models. In rats induced with diabetes by alloxan, alcoholic leaf extracts showed strong antihyperglycemic effects, indicating better glucose control⁴⁴. While we still know little about the specific processes of *Aerva lanata*, earlier research on other medicinal plants suggests that restoring pancreatic β -cells might be one way these plants aid in managing diabetes⁴⁵.

Antiuro lithiatic activity

The anti-uro lithiatic potential of *Aerva lanata* has been supported by studies that focus on kidney stone formation. A phenolic-rich ethyl acetate fraction from the aerial parts significantly reduced stone formation and improved kidney health in rat models with ethylene glycol-induced urolithiasis⁴⁶. Isolating natural compounds from the plant showed they also

inhibit crystal aggregation and growth. This backs up its traditional use for urinary stone issues⁴⁷. Previous reports on herbal treatments for kidney stones frequently mention *Aerva lanata* in traditional remedies⁴⁸.

Traditional uses of *Aerva lanata*

According to ethnobotanical records, *Aerva lanata* has long been used in many parts of India to treat gastrointestinal, respiratory, inflammatory, and urinary disorders. Its frequent inclusion in folk remedies for renal and urinary disorders aligns with its experimentally reported antiurolithiatic and nephroprotective potential. However, most traditional claims are supported primarily by observational and

ethnomedical evidence, with limited clinical validation as given in Table 4.

Table 4. Traditional uses of *Aerva lanata* reported in ethnobotanical studies

Inflammatory conditions	Management of inflammation, fever, and pain	49, 53
Respiratory system	Relief of cough, asthma-like symptoms	50, 52
Gastrointestinal system	Treatment of diarrhea, dysentery, and stomach ailments	51, 54

System / condition	Traditional use	Reference
Urinary system	Treatment of urinary stones, dysuria, renal disorders	49, 50
Dermatological uses	Application for skin diseases, wounds, and ulcers	51–53
General health	Tonic, treatment of general weakness and common ailments	55–57

Pharmacological Properties of *Ficus carica*
Antioxidant activity

Ficus carica has been extensively investigated for its antioxidant potential across different plant parts, particularly leaves and fruits. Quantitative analyses of fig leaves have demonstrated appreciable levels of α -tocopherol, flavonoids, and phenolic compounds, which correlate with significant antioxidant activity *in vitro*⁵⁸. Fresh fig fruits have also been reported to exhibit strong antioxidant capacity, attributed in part to their anthocyanin content⁵⁹. Recent phytochemical screening of fig leaves further confirmed the presence of antioxidant constituents using qualitative and quantitative assays⁶⁰. At the molecular level, antioxidant and enzyme-inhibitory activities have been attributed to specific phenolic constituents of *Ficus carica*, including stilbene related compounds, supporting mechanistic links between fig phytochemistry and biological effects⁶¹. Experimental animal studies have further suggested that antioxidant properties of *Ficus carica* contribute to improved glucose and lipid metabolism, indicating a close association between antioxidant activity and metabolic regulation⁶².

Limited clinical evidence also indicates that oral administration of fig leaf preparations may exert hypoglycaemic effects in patients with type I diabetes, although such findings remain preliminary and require further confirmation⁶³. *Ficus carica* is cited in some literature as a plant with antioxidant-related abilities to modulate glucose in connection with antidiabetic plants⁶⁴. Protective effects of *Ficus carica* leaves on glucose and lipid profiles have been demonstrated in type 2 diabetic rat models, with improvements observed in carbohydrate metabolism enzymes and pancreatic β -cell function⁶⁵. Equally, it has been shown that *Ficus carica* in combination with other herbal remedies can regulate cholesterol and glucose in the body. parameters in diabetes animals induced by streptozotocin and diet⁶⁶. Comprehensive reviews further highlight the role of fig constituents in the management of metabolic and oxidative stress-related disorders, reinforcing its antioxidant-linked therapeutic relevance⁶⁷. Despite these findings, most evidence supporting the antioxidant potential of *Ficus carica* is derived from experimental models, and further well-designed clinical studies are required to confirm its therapeutic relevance.

Anti-inflammatory activity

Numerous chronic diseases are caused by inflammation, which is frequently controlled by signaling pathways like nuclear factor kappa B (NF- κ B)⁶⁸. Research has shown that *Ficus carica* leaf extracts have anti-inflammatory properties, with notable decreases in inflammation-related parameters in animal models⁶⁹. Combined antioxidant and anti-inflammatory effects have been documented in several studies, indicating synergistic regulation of oxidative and inflammatory pathways⁷⁰. Moreover, fig leaf preparations have been shown to influence immune-mediated responses, including suppression of allergic reactions, supporting their potential role in inflammatory and hypersensitivity related conditions⁷¹.

Chemo-preventive effect

The potential of *Ficus carica* as a substance to prevent cancer has mainly been studied through lab tests and animal research. Metabolic analyses have shown that fig extracts can harm and slow the growth of certain cancer cell lines⁷². Studies on nutrition emphasize the importance of foods high in fiber, like figs⁷³. Other lab studies have demonstrated that fig extracts can fight colorectal cancer cells⁷⁴. Components from fig resin have been found to stop cancer cells from growing through known structural mechanisms⁷⁵. Research using raw plant extracts in living organisms has also suggested some properties that may prevent tumors, but the importance of these findings in clinical settings is still unclear⁷⁶. Reviews suggest that *Ficus carica* might play a supportive role in managing diseases, including those related to cancer and bone health⁷⁷.

Hepatoprotective potential

Experiments conducted on animal models proved the hepatoprotective effects of *Ficus carica*. The leaf extracts of the plant significantly lowered the liver damage caused by carbon tetrachloride⁷⁸. The protective capacity of fig leaf extracts against drug-induced liver damage was proved when similar effects were observed against rifampicin-induced hepatotoxicity models⁷⁹.

Antispasmodic and antiplatelet activities

Antispasmodic effects have been found for *Ficus carica* in ethnopharmacological studies, especially for the preparation of gastrointestinal smooth muscle. These effects are thought to be mediated through calcium channel modulation and related mechanisms. The same studies also

documented antiplatelet activity, suggesting potential cardiovascular relevance; however, these findings are largely preclinical and require further clinical validation⁸⁰.

Traditional uses of *Ficus carica*

Widely used in the systems across Asia, the Middle East, and parts of Latin America. Ethnomedicinal records describe its application in digestive, metabolic, respiratory, and inflammatory conditions, as well as for general health maintenance. In many traditional systems, different plant parts, including fruits, leaves, and latex, are employed depending on the intended therapeutic purpose. While several traditional uses align with experimentally observed pharmacological activities, most claims remain supported primarily by ethnomedicinal evidence rather than controlled clinical studies as shown in Table 5.

Table 5. Traditional uses of *Ficus carica* reported in ethnobotanical and medicohistorical sources

System / condition	Traditional use	Reference
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Gastrointestinal system	Treatment of constipation, indigestion, and hemorrhoids	81, 82
Metabolic disorders	Management of diabetes and metabolic imbalance	81
Respiratory system	Relief of cough, bronchial complaints, and throat irritation	82
Inflammatory conditions	Use in inflammatory and febrile conditions	81
Dermatological uses	Treatment of skin conditions using leaf or latex preparations	83
General health & nutrition	Nutritive tonic and supportive food-based remedy	84

SAFETY AND TOXICITY

Safety profile of *Aerva lanata*

Traditional usage

Aerva lanata has been traditionally used in various indigenous and tribal healthcare systems, particularly for urinary disorders, inflammation, and renal ailments. Ethnobotanical surveys among tribal communities have documented its use without frequent reports of acute toxicity, suggesting a history of perceived safety in traditional contexts⁸⁵. However, such observations are largely anecdotal and based on empirical knowledge rather than controlled safety assessments.

Preclinical studies

Preclinical investigations have provided experimental evidence supporting the relative safety of *Aerva lanata*, particularly in renal models. In studies conducted to examine its efficacy in rat models of acute renal failure induced by gentamicin and cisplatin, it has been shown to be nephroprotective⁸⁶. While there is little data regarding its toxicology, an in-depth analysis of its phytochemistry and

Safety profile of *Ficus carica*

Traditional usage

Ficus carica is a food and medicinal plant that has been traditionally used in conventional medical systems worldwide for many years. Fig fruits and leaves have long been prepared and used traditionally For digestive, metabolic, and inflammatory diseases, in most cases without

pharmacology further emphasizes that there is little to no severe toxicology at experimental levels in animal studies.

Toxicological considerations and potential side effects- *Aerva lanata*

The literature that is currently available indicates that *Aerva lanata* has been used in experimental investigations at a variety of doses without obvious evidence of acute toxicity; nevertheless, the lack of thorough toxicokinetic studies has made it difficult to create uniform dosage guidelines. There are few reports on possible side effects, and preclinical studies have not consistently shown any serious negative consequences. There is currently inadequate information on drug- herb interactions involving *Aerva lanata*, thus using it along with conventional drugs should be done with caution. Additionally, there is a dearth of data about long-term safety, emphasizing the necessity of clinical safety and chronic toxicity studies before firm conclusions can be made⁸⁷.

severetoxic if taken in usual doses⁸⁸. Reviews of ethnopharmacological and phytochemical data further support its broad traditional acceptance as a safe medicinal and dietary plant⁸⁹.

Preclinical studies

The preclinical studies generally report a favorable safety profile at experimentally tested doses. Comprehensive reviews indicate that fig extracts exhibit pharmacological activities without inducing significant toxicity in animal models, although systematic dose–toxicity relationships remain under explored⁸⁹.

Human studies

Some human studies have suggested using fig leaf products in clinical settings. Certain observational studies have noted the use of fig leaf fumigation along with traditional treatments for people with hemorrhoids, with no significant side effects reported⁹⁰. Similarly, the external use of fig leaf products has been recorded in treating cases of herpes zoster. However, these findings are not based on thorough safety assessments⁹¹.

Toxicological considerations and potential side effects – *Ficus carica*

Ficus carica is perceived to be a non-toxic plant, there have been some reported adverse effects. Serious cases of phototoxicity have been reported when fig leaves are used topically as a lotion or when used as a topical application to expedite tanning⁹². There have been reports on photoallergic contact dermatitis due to furocoumarins present in fig leaves, which indicate potential harm from topical contact⁹³. Patients without any pre-existing gastrointestinal disorders have suffered from gastrointestinal symptoms, including rare cases of intestinal obstruction due to fig seeds⁹⁴. Additionally, since figs are rich in dietary fibers, consuming them may have an effect on gastrointestinal disorders. High dietary fiber intake, including from figs, may aggravate conditions among sensitive patients, as stated in some literature on dietary treatments among patients with gastrointestinal disorders⁹⁵.

CONCLUSION

The botanical properties, phytochemical constitution, pharmacologic properties, traditional uses, as well as safety issues of *Aerva lanata* and *Ficus carica* were all carefully reviewed. Various biological phytoconstituents including alkaloids, phenolics, flavonoids, as well as glycosides are found to exist in these plants, which are responsible for their demonstrated biological activities. *Aerva lanata* has exhibited antioxidant, anti-inflammatory, antibacterial, antidiabetic, as well as antiurolithiatic effects in vitro as well as animal models. Its preclinical nephroprotective as well as antiurolithiatic activity supports its traditional use for urinary as well as renal disorders; however, human evidence is still pending. Just like the former, *Ficus carica* has

also demonstrated antioxidant, anti-inflammatory, hepatoprotective, antispasmodic, as well as chemopreventive effects. Its few but important human observations are all linked to its topical as well as metabolic applications. Most of the available evidence for these plants

is based on preclinical trials, although they have promising pharmacological properties. At present, there is a lack of standardization of extracts, identification of active compounds, comprehensive toxicological studies, and clinical trials for these plants. The safety statistics reveal some risks in topical exposure and overdose, particularly in *Ficus carica*, although they have positive properties in their traditional and experimental use. On balance, *Ficus carica* and *Aerva lanata* have proven useful properties as medical herbs and have potential medical uses. Further comprehensive research is, therefore, necessary for their confirmation and standard use in medical practice.

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