

Phytochemical Composition and Pharmaceutical Potential of *Lantana* sp: A Review

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Abstract

Lantana is a common plant found in around 60 tropical and subtropical countries worldwide. It is a highly invasive species that has tremendously dominated over other species of plants and threaten biodiversity. At present, physical, chemical, and biological agents are in consideration to eradicate this plant to prevent the threat to biodiversity and soil fertility. *Lantana* is considered as an unwanted plant and its biomass is disposed off. In this review, the pharmaceutical potential of this plant and its phytochemical constituents are discussed. Being source for wide variety of bioactive phytochemicals, *Lantana* is a valuable pharmaceutical raw material. Hence, instead of eradicating the plant as waste material, its pharmaceutical potentials such as antioxidant, antidiabetic, antimicrobial, anti-inflammatory, and anticancer activities can be exploited for the possible application as therapeutic agent. The modern medicine can take advantage of the fast-growing nature of this plant and use this plant as a tool for biopharming. In traditional medicine, *Lantana* has been used in formulation along with other plants as a treatment for several ailments. This review concludes that *Lantana* is a medicinally valuable plant, with huge potential in the pharmaceutical industry.

Key words: Biological activities, invasive plant, *Lantana camara*, pharmacological significance, phytochemical constituents

INTRODUCTION

The genus *Lantana* is from the Verbenaceae family, *Lantana camara* was introduced in India, for its ornamental and attractive nature.^[1] It is called a wild sage because of its toxicity, and it outcompetes with other most desirable species of flora and fauna. It is considered one of the important medicinal plants in the world. *Lantana* is widely used as folk medicine in many states and in and around India and Bangladesh. Phytochemical investigation has resulted in the isolation of various bioactive phytochemicals from different parts of the plant.^[2] Therefore, the aim of the present review is to provide a complete compilation of the phytochemical components of *Lantana* recorded in the literature.^[3] The biological activities of *L. camara* were reviewed based on their scientific reports in recent years.^[4,5] All reported phytochemical constituents of *Lantana* plant are summarized in Table 1 with their molecular weight and chemical structure for further discussion. The appearance of *L. camara* with its flower and leaf is shown in Figure 1.

CHEMICAL CONSTITUENTS OF LANTANA

There are around six iridoid glycosides and six oligosaccharides isolated from the ethanolic roots of *L. camara* that includes stachyose, verbascose, ajugose, verbascotetracoside, theveside, theviridoside, lamiridoside, geniposide, Lantanose A, and Lantanose B.^[6] Stem oil extract of *Lantana* is identified to contain about 66 phytochemical constituents. The major constituents of fruit oil of *Lantana* were identified as stearic acid, palmitic acid, and germacrene D, while major constituents of stem oil were identified as palmitic acid and stearic acid.^[7] Chemical constituents such as linalool, phytol, 1-octen-3-ol, alpha-muurool, beta-bisabolol, trans-beta-farnesene, alpha-curcumene, alpha-cardinol, beta-caryophyllene, beta-bisabolene, tetradecanoic acid,

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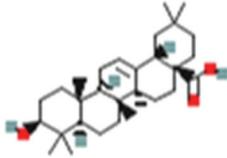
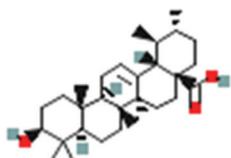
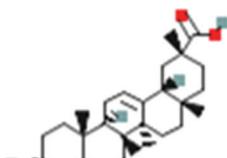
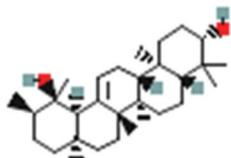
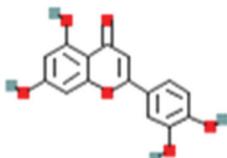
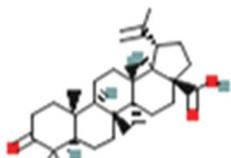
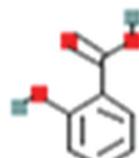
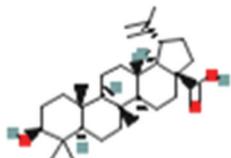
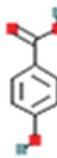
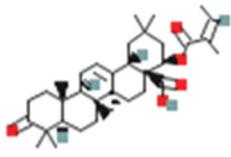
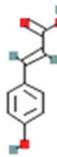
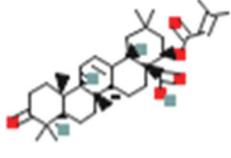
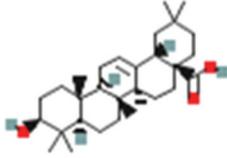
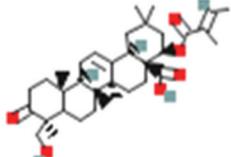
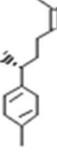
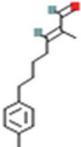
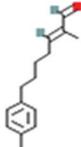
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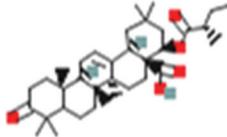
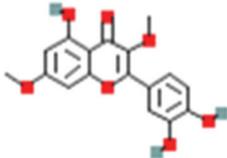
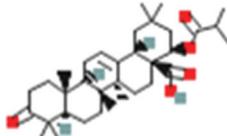
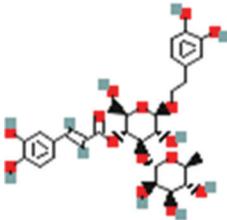
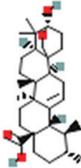
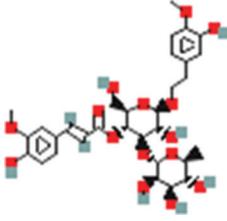
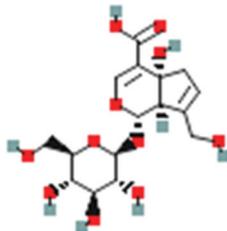
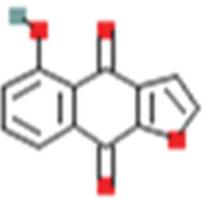
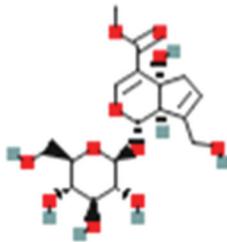
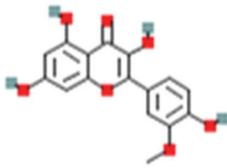
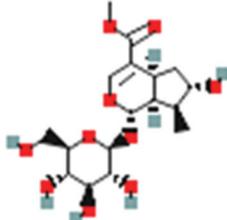
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Table 1: List of phytochemicals reported from *Lantana* plant

Chemical name	Mol. wt. (g/mol)	Molecular structure	Chemical name	Mol. wt. (g/mol)	Molecular structure
Camaric acid	568.8		Oleanolic acid	456.7	
Ursolic acid	456.7		Katonic acid	456.7	
Pomolic acid	472.7		Luteolin	286.24	
Betulonic acid	454.7		Salicylic acid	138.12	
Betulinic acid	456.7		p-Hydroxybenzoic acid	138.12	
Lantadene A	552.8		p-Coumaric acid	164.16	
Lantadene B	552.8		Oleanolic acid	456.7	
Icterogenin	568.8		Beta-curcumene	204.35	
(+)-Nuciferol	218.33		(E)-Nuciferal	216.32	

(Contd...)

Table 1: (Continued)

Chemical name	Mol. wt. (g/mol)	Molecular structure	Chemical name	Mol. wt. (g/mol)	Molecular structure
Lantadene C	554.8		3,7-dimethoxy quercetin	330.29	
Lantadene D	540.8		Verbascoside	624.6	
Lantic acid	470.7		Martynoside	652.6	
Theveside	390.34		Diodantunezone	214.17	
Theviridoside	404.4		3-O-Methyl quercetin	316.26	
8-epiloganin	390.4				

epi-cubebol, cis-3-hexen-1-ol, and 1-hexanol are the major compounds found in *Lantana*.^[8]

list of known activities of reported phytochemicals from *Lantana*.

APPLICATIONS OF KNOWN PHYTOCHEMICALS

All reported molecules from *Lantana* have been known to have many pharmaceutical activities. The following is

Betulinic acid

It exhibits therapeutical activities against breast cancer cells and normal fibroblast cells.^[9] It also acts as an antimelanoma agent.^[10]



Figure 1: Morphology of *Lantana camara* flower and leaf

Beta-curcumene

It is a type of sesquiterpene.^[11]

Betulonic acid

Ionic derivatives of betulonic acid show better biological activities and are more soluble in water. It exhibits antiviral activity and works against the herpes simplex virus type-2.^[12]

Camaric acid

It is isolated from the methanolic extract of *Lantana* involved in the nematicidal activity.^[13]

Icterogenin

It is involved in changing the rate of bile flow in mice.^[14]

Katonic acid

It is a cytotoxic triterpene which acts as a plant anticancer agent.^[15]

Lantadene A

It is also called as rehmannic acid. It is the active principle of *L. camara* L. which has certain oxygen functions.^[16]

Lantoic acid

It is a pentacyclic triterpenoid involved in nematicidal activity found from the aerial parts of *Lantana*.^[17]

Luteolin

It suppresses the growth and metastasis of human lung cancer cells. It possesses antitumor, anti-inflammation, anticancer, and antioxidant activities.^[18] It is a type of flavonoid which induces the immunomodulatory response in peripheral blood mononuclear cells.^[19] It is a type of polyphenolic flavone that stimulates the antitumor effect of cisplatin in drug-resistant ovarian cancer through inhibition of cell metastasis and programmed cell death.^[20] It has chemo stimulating and antiproliferative on human gastric cancer cell lines.^[21] It also reduces obesity-associated insulin resistance in mice by certain signaling in adipose tissue macrophages and is also involved in insulin resistance.^[22]

Martynoside

These plant phenylpropanoid glycosides consist of antimetastatic, anticancer, and cytotoxic activities. It can also be considered as natural selective estrogen receptor modulator.^[23] It also helps in retarding the skeletal muscle fatigue depending on their antioxidant activities.^[24]

Oleanolic acid

It possesses diverse pharmacological activities and a naturally occurring pentacyclic triterpene, it inhibits the cell proliferation and cell survival of prostate cancer cells.^[25] It also suppresses the proliferation of lung carcinoma cells, which indicates its antitumor activity.^[26] Its combination with metals such as iron or zinc possesses significant anti-inflammatory, immunomodulatory, and antiasthma activity.^[27]

p-Coumaric acid

It is a type of cinnamic acid which has antioxidant activity. It can also prevent bone loss, thereby promotes osteoblastogenesis.^[28] It also possesses antiproliferative effect on colon cancer both *in vitro* and *in vivo*.^[29]

p-Hydroxybenzoic acid

It is used as a fungicide, it has potential biotechnological application in food, pharmacy, cosmetics, etc.^[30]

Pomolic acid

Competitive antagonist of norepinephrine and adenosine triphosphate induced aggregation of human platelets.^[31]

Salicylic acid

It is a key plant hormone that is involved in hosting response against microbial infections.^[32]

Theviridoside

It is found in the roots of the *L. camara*.^[6] It also shows cytotoxicity towards human cancer cell lines.^[33]

Ursolic acid

It is a plant-based pentacyclic triterpenoid carboxyl acid, against vascular endothelial damage, and liver oxidative injury in the mice.^[34] It also acts as an effective neuroprotective drug against the inflammatory responses on the cerebral region of the brain. It can act as an inflammatory agent.^[35]

PHARMACOLOGICAL ACTIVITIES OF LANTANA

Anti-inflammatory activity

Leaf extract of *Lantana* possesses phytochemicals like terpenoids (mainly triterpenes and sesquiterpenes) that are cytotoxic on tumor cells and exhibited anticancer potential in

animal models. Therefore, the extraction of triterpenoids for drug development is useful because of its many biological activities.^[36] There are around 70 triterpenes isolated from this genus. The methanolic extract of this plant has been reported to reduce the carrageenan-induced paw edema. Anti-inflammatory agents can suppress seizures in humans and involve in the process of epileptogenesis. It can also induce the cytokine encoding genes, which suppresses inflammation. Based on these attributes, *Lantana* plant is considered to be significantly anti-inflammatory in nature.

Antioxidant activity

Antioxidant property is a fundamental factor of all food substances. It is estimated in terms of reducing potential and free radical scavenging exercises.^[37] It benefits by counteracting the degenerative ailments through oxidative mechanisms. Extracts of *Lantana* leaves are proven to be rich in flavonoid content. There are around 30 flavones isolated from *Lantana* species. These flavones are also believed to activate certain antioxidant response systems in the cell system which helps in scavenging reactive oxygen molecules from the cell. Phenolic compounds such as caffeic acid and rosmarinic acid are reported to be teeming compounds in the methanolic extract of *Lantana*, which contributes to the antioxidant nature of the plant. There are many varieties of *Lantana* leaf extract which shows the free radical scavenging activity and *in vitro* lipid peroxidation. Thereby, it prevents certain human diseases such as myocardial infection, cancer, and rheumatoid arthritis.^[38] Verbascoside is the major phenolic compound present in the species of *Lantana* (*Lantana montevidensis*) which helps in preventing the disease named Konzo which is related to oxidative damage.^[39] These reports support the fact that *Lantana* is a potential source of antioxidant molecules.

Antimicrobial activity

Compounds like flavones isolated from the leaves of *Lantana* species possess antifungal and antibacterial properties.^[40,41] Known for its bioactive molecules, *Lantana* also readily kills off the bacteria, aiding to its antibacterial activity.^[3] Extracts of these plants are also proven to treat gastrointestinal infections.^[42] *Lantana* is also proven to exhibit antifungal activity against selected fungal strains.^[42] The main components of the essential oil of *Lantana* species consist of E-nerolidol, phytol, and E-caryophyllene which provide resistance to many fungal pathogens.^[42] This is a potential source for further exploitation, as there is only handful of research done in this aspect of the plant.

Anticancer activity

Anthraquinones are reported to be present in *Lantana*. Anthraquinones are commercially used in many pharmaceutical industries as an anticancer agent. This suggests a potential anticancerous application of *Lantana*.

The phenolic compounds of this plant have been reported to help in cancer prevention. It is also proven to inhibit the proliferation of cancer cells.^[43] *L. camara* has shown cytotoxic effects on cancer cell lines at low concentrations. It shows the potential of the plant to be used in treatment.^[42]

Antidiabetic activity

Saponins present in the extract of *Lantana* are proven to help in reducing the blood glucose level. It is also proven to decrease the blood cholesterol level. It further helps in promoting general health.^[44]

Cardiac activity

The presence of cardiac glycosides inside *Lantana* is one of the important features proven to be involved in the treatment of cardiac rhythm disorder and congestive heart failure. There are around 16 phenylethanoid glycosides and eight iridoid glycosides isolated from the same species. These proved that the phytochemicals in *Lantana* plant can be used in treating heart ailments and disorders.

Anti-insecticidal activity

Besides the venture as a psychoactive medication, alkaloids deduced from *Lantana* are used as insecticides which have significant toxicity toward insects.^[45,46] Leaves and flower extracts of *Lantana* have been proven to have larvicidal activity. The essential of the leaves of *Lantana* was found to be repulsive for mosquitoes (*Aedes aegypti* L.). Combination of *L. camara* plant with other plants is reported to act as a mosquito repellent.^[18] Essential oils present in the blades of *Lantana* have been proven to have insecticidal effects on vectors of dengue, malaria, dengue hemorrhagic fever, Chikungunya, and yellow fever.^[17] These attributes of *Lantana* can potentially be exploited in developing insecticides for agricultural usage and developing topical mosquito repellents.

Anthelmintic activity

Leaves of *Lantana* species have been proved to be effective in anthelmintic property. Ethanolic extracts of *Lantana* species have been observed to be highly effective against certain worms like *Pheretima posthuma*.^[47] Extracts of *Lantana* have shown antihelminthic activity against *Fasciola hepatica* as well, which causes hepatic disease to many domestic animals leading to death and thereby severe economic loss.^[48]

Antipyretic activity

Ethanolic extract of *Lantana* plants has been observed to be antipyretic in nature. It lowers the temperature of the body

by inhibiting the synthesis of prostaglandins.^[49] Extracts of *Lantana montevidensis* have also demonstrated antipyretic activity.^[39]

Antispasmodic activity

Oleanolic acid has been isolated from *Lantana* which is used by folk medicine practitioners from Bangladesh as an antispasmodic agent.^[50]

Antidiarrheal activity

The stem of the *L. camara* has been used traditionally in the treatment of diarrhea. Scientific analysis proved that administration of *L. camara* causes a significant defect in the frequency and the weight of defecation. Ethnopharmacological studies have shown that it has biological activity (antibacterial) against bacteria, causing diarrhea.^[51] *Lantana* is also proven to have unique laxative and combustible properties.

CONCLUSION

L. camara is widely used in the conventional medicine system for the remedy of itchiness, wounds, boils, blisters, bilious fever, cataract, and inflammation, including rheumatism. Diverse parts of the flowers are used in the treatment of cold, neuralgia, chickenpox, eyesores, whooping cough, asthma, bronchitis, and arterial hypertension. *L. camara* has been reliably studied for numerous curative activities such as antioxidant, antibacterial, antipyretic, larvicidal, insecticidal, antimicrobial, wound healing, and antihyperglycemic potential. With many proven biological activities, *Lantana* is definitely a valuable medicinal plant, it can be used for drug development.

Lantana has been an invasive plant since many times, which affects biodiversity to a large extent every year. Due to the alarming rate of the spread of this invasive species, particularly in the tropical and the subtropical countries such as India and South Africa, these countries are currently focussing on eradication of this plant by pruning, burial, and burning. Instead, this plant can be used in therapeutic applications based on their phytochemical constituents and pharmaceutical value of the plant. This review suggests that rather eradicating the plant from its existence, it can be uprooted and used as raw materials to extract pharmaceutically valuable bioactive phytochemicals.

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