AN OVERVIEW OF *LANTANA CAMARA*: CHEMISTRY AND PHARMACOLOGICAL PROFILE

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Summary

Lantana camara Linn. (Verbenaceae) has been widely used as medicine in Ayurvedic system. It is recommended as vulerary, diaphoretic, carminative and antispasmodic. The chemical constituents reported from this plant belongs to different classes such as tannins, resins, sesquiterpines, anthocyanins, flavonoids, fixed oils, enzymes like oxidase, amylase and invertase. Many of the uses of *L. camara* have been verified by scientific methods. This review article summarizes the chemistry and pharmacological profile of *L. camara*.

Keywords: *Lantana camara,* phytochemistry, pharmacological activity.

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Introduction

Lantana camara Linn. (Verbenaceae) is a large scrambling evergreen shrub, native to tropical America and cultivated as an ornamental or hedge plant. Seven or eight species of the plant occurs in India. It is commonly known as *Ghaneri* (Marathi) or *Raimunja* (Hindi). Twigs usually more or less prickly and pubescent. Leaves are opposite, 2.5-7.5 by 1.5-4.3 cm. ovate and subacute. Base is truncate or narrowed, crenate-cerrate and scabrid on both sides. Petiole is 5-13 mm long and hispid. Flowers are usually orange colored. Fruit is 5 mm in diameter, black and shining. Leaves contain enzymes like oxidase, catalase, amylase and lipase, glucosidase, secondary metabolites as tannins, sugar, resin, sesquiterpines, caryophylline, phelandrene, aldehydes, alcohols, lantadene-A, lantadene-B, triterpenoid, lancamarene, and lantadene. In Guiana and Reunion, the plant is considered, diaphoretic, carminative and antispasmodic. A decoction is given in tetanus, rheumatism and malaria. It is a powerful tonic and is used in atoxy of the abdominal viscera.[1, 2]

Chemistry

Various chemical constituents isolated from different part of *L. camara* have been given in table1 and structures of some of the constituents are given in figure1.
Table1: Phytoconstituents of *L. camara.* [1, 2]

Plant part investigated	Chemical constituents isolated
Leaves	N, P, K, and Ca elements various enzymes as, oxidase, catalase, amylase, invertase, lipase, tannase, and glucosidase tannin, sugar, resin, sesquiterpines, caryophylline, dl-α-pinene (25.4%), 3-carene (8.8%), p-cymol (6.35%), humulene (38%), d-cadinene (1.65%) aldehydes, alcohols, lantadene-A, (angeloyloxy-oleanonic acid), triterpenoid, lantadene-B (dimethyl acryloyloxy-oleanonic acid), lancamarone, lantadene, geranyl acetate, terpenyl acetate, 8-cineole, and limonene Essential oil of leaf contain 1,8-cineol (15.8%), sabinene (14.7%) and α-caryophylene (8.9%)
Seeds	Fixed oil (9%), Fatty acids like linolenic acid, linoleic acid, oleic acid, stearic acid, and palmitic acid
Flowers	Anthocyanine, flavone, and carotene
Stalks	Ferfuroids, Lignan, and α-cellulose

Pharmacological activity:

Insecticidal and Pesticidal property:

All the larvae of root-knot Nematode were killed up to s/2 concentration of leaf extract within 5 hrs. At s/10 the mortality was quite high (96.59%) which increase to 100% after 30 hr treatment.[6] Pesticidal property of aqueous suspension (1%) of acetone extract of stem of *L. camara* against 8th instar larvae of *Eupterote undata* and on second instar larvae of *Conogethes punctifolia* shows higher mortality rate by 20% in larvae and 22% in pupae.[7] Podophyllotoxin isolated from *L. camara* shows delayed insecticidal activity against the 5th instar larvae of pieris rapae.[8] Insecticidal and pesticidal activity of the plant extracts/essential oils of *L. camara* was found to be natural pesticide.[9]

Anti-inflammatory, analgesic and antihypertensive activity:

Lantana extract (100 and 200mg/kg) orally showed significant analgesic and anti-inflammatory effect but no anti-convulsant effect. It significantly reduced pentobarbital induced hypnosis and showed inhibitory effect on hepatic microsomal enzyme activity in mice. The extract produced a transient fall in dog blood pressure and negative inotropic and chronotropic effect on isolated frog heart. It had varied responses on isolated frog heart. It had varied responses on isolated guinea pig ileum, osteogenised rat uterus and frog skeletal muscle.[10]

Antimicrobial and cytotoxic activity:

The essential oil from *L. camara* leaves was found to be active against *Salmonella pullorum, Escherichia coli, Klebsiella pneumoniae, Vibrio cholera, Penicillium digitatum, P. notatum, Rhizophus stolonifer,* and *Microspernum gypsum*.[11] The essential oil from *L. camara* leaves exhibited considerable antibacterial activity at 5mg/ml concentration against gram- positive and gram- negative bacteria and antifungal activity against *C. albicans*.[12] Four fractions of petroleum ether extract of *L. camara* leaves in different solvents showed significant antibacterial activity against some human pathogens under in vitro conditions. The MIC of the methanol fraction, containing triterpenoids, active against these pathogens was found to be comparable with those of some therapeutically used antibiotics.[13] The essential oil was tested for antibacterial activity against 6 strains, using disc diffusion method, and for cytotoxicity using brine-shrimp lethality assay. The oil showed moderate activity against *Candida albican*, *Bacillus subtilis*, *Staphylococcus typhi*, *Pseudomonas aeruginosa* and *Bacillus aureus.* These activities support its potential use as a remedy for bacterial infectious diseases. The essential oil with LC50 value of 0.01 was found to be highly toxic.[14] The chemical composition of essential oil obtained from air-dried leaves of *Lantana camara* L. by hydrodistillation was analyzed by GC and GC-MS. The essential oil was tested for antibacterial activity against 6 strains, using disc diffusion method, and for cytotoxicity using brine-shrimp lethality assay. The oil showed moderate activity against *Candida albican*, *Bacillus subtilis*, *Staphylococcus typhi*, *Pseudomonas aeruginosa* and *Bacillus aureus.* These activities support its potential use as a remedy for bacterial infectious diseases. The essential oil with LC50 value of 0.01 was found to be highly toxic.[15]

Cytological effect:

The cytological effect of *L. camara* leaf extract on root-tip cell mitosis of *Vicia faba* was studied. The extract induced a variety of mutagenic chromosomal and nuclear aberration, among them chromosomal breakage was the predominant one followed by C- metaphase, chromosome extrusion, rings at metaphase and stickiness of chromosomes. Other abnormalities like binucleate cells and tripolar anaphase were also seen. In view of the induced aberrations it can be concluded here that *L. camara* leaf extract showed its effect on spindle, process of cytokines and DNA.[16]

Efficacy against Alianthus Web worm:

Extract of *L. camara* var. *aculeate* obtained by using ethanol, acetone, and ether as solvent were effective in killing Alianthus Web worms, *Atteva fabriciella*. Ethanol extract was more effective than the extract of remaining two solvents as 5% solution of ethanol extract 66.66% mortality was obtained.[17]

Fungitoxic properties:

Flower extract of *L. camara* is tested in vitro against conidial germination and germ tuber length of *Alternaria solani*, the causal organism of early blight of potato. Flower extract of *L. camara* showed maximum antifungal properties as it has shown maximum inhibition of conidial germination.[18] In vitro as well as pot studies were carried out to ascertain the antifungal activity of leaf extract of *L. camara* against *Fusarium oxysporum* f.sp.*lini* causing wilt of linseed. *L.* camara significantly inhibited the radial growth of the pathogene at 30% concentration.[19]

Larvicidal activity:

Flowers of *L. camara* were extracted in acetone and tested against larvae of rice moth. *L. camara* was the best in killing the larvae resulting in reduction of emergence.[20]

Hypoglycemic and wound healing activity:

Antihyperglycaemic activity of the aqueous extract of leaves of *L. camara* was evaluated by using both normoglycemic and alloxan induced hyperglycemic rats. The wound healing activity was assessed for both leaf juice and hydroalcoholic (ethanol 50 percent w/w) extract of the leaves on excised rats. The aqueous extract found to produce significant reduction of blood glucose concentration between 2-4 hrs of administration in alloxan induced hyperglycemic rats at tested dose levels. However in normoglycaemic animals, the extract at 400mg/kg produced significant reduction of blood glucose between 2-4 hrs of administration. In the wound healing studies, the leaf juice was found to be more active than the extract.[21]

Effect against Beetle infestation:

Petroleum ether extract of leaves of *L. camara* mixed with green gram seeds at 0.5, 1.0, and 1.5 parts for 100 parts of seeds (w/w) proved very repulsive, a potent oviposition-inhibitor and a safe protectant against the beetle infestation.[22]

Efficacy of plant extract on major pests of cabbage :

L. camara plant extract was tried against diamond black moth and aphids attacking cabbage crop *L. camara* recorded minimum pest incidence.[23]

Effect on isolated Guinea pig ileum :

The total aqueous, ethanol, and aqueous extracts, of *L. camara* leaves induced contractions in isolated guinea pig ileum and the effect was always greater with the aqueous extract. Effects was concentration dependent.[24]

Insecticidal activity:

Evaluation of the insecticidal activity of *L.camara* in the field experiment has shown its activity is comparable to that of phosphamidon (0.1%). It is one of the insect growth regulator from plant origin.[25]

Toxicity study of *L. camara*:

A study was undertaken to explore the toxicological and pharmacodynamic effect of *L. camara* leaves. Methanolic extract of the dried leaves of *L. camara* failed to produce acute toxicity in Albino mice and Rats. But Albino Rabbits were susceptible to *L. camara* toxicity and showed delayed toxic effects. The approximate oral LD 50 (12 days) of the extract in Rabbits was 10gm/kg. The serum bilirubin level, SAP and SGOT were significantly increased but the SGPT activity remained unaffected in lantana treated Rabbits.[26] Bentonite was compared with activated charcoal as therapy for *L. camara* poisoning in calves dosed 5 days previously with leaf material of the common pink-aged red taxon of L. camara. Both therapies were given by stomach tube as a single dose at 5 gm/kg. Five of 6 calves in each of the groups given bentonite and activated charcoal recovered while 5 of 6 calves in the control group died. Calves given bentonite took 3 days longer on average to recover fully than those given activated charcoal but the effect of the two therapies on plasma total bilirubin concentration were statistically indistinguishable. Bentonite was judged to have promise as a cheap alternative to activated charcoal for therapy of lantana poisoning of cattle.[27] Ingestion of *L. camara* foliage by grazing animals causes hepatotoxicity and photosensitization. The active principles in *L. camara* leaves have been characterized. Chemical entities responsible for causing hepatotoxicity are lantadene A and C, which are pentacyclic triterpens, and have been prepared in crystalline (form-I) and amorphous (form-II). Form-II of lanatadine A and form-I and II of lanatadine celucited hepatotoxicity: while lanatadene B, which is an isomer of A and is abundant in *L. camara* leaves has been found to be nontoxic. Another compound lanatadene D has been identified in *L.camara* leaves

(red variety).[28] Ruminal movements decreased in all the with feeding leaves and small shoots of *L. camara* at 10 gm/kg b.wt. High alkalinity for rumen fluid was recorded it might be due to decrease microbial population. Rumen protozoal motility was also decreased by the 2nd day. By the 4th day it was sluggish.[29] *Lantana camara* poisoning of grazing animals caused substantial economic losses to farming. The symptoms are anorexia, constipation, jaundice. The largest organ of Lantana toxins is liver and they cause cholestasis and hepatotoxicity.[30] Data of Lantana poisoning during the period 1995-2000 at this station was analyzed based on the clinical signs and postmortem findings. The age wise morbidity and mortality were high in six to twelve months aged groups followed by one to two years groups. Post mortem examination revealed yellowish discoloration of carcass, swollen yellowish discoloration of liver, yellowish contents of gallbladder, and thickened in consistency.[31]Clinical observations on four male cow calves and three other lantana poisoned animals under field conditions have been made along with hematological studies, including observations on plasma bilirubin content and osmotic fragility of erythrocytes. Four healthy male cow calves served as control. Five clinically advanced cases succumbed within 1 to 10 days of observation. Hematocrit values in four of the seven affected animals were abnormally high. The total plasma bilirubin content in the fatal cases was of the order of 5 to 50 times the normal value while, in calves that recovered, it was not more than 3 times. The osmotic fragility of erythrocytes was measured by the rate of hemolysis in decreasing concentrations of saline. The erythrocyte of normal animal resisted hemolysis till the saline concentration was lowered to 0.60%, and it was complete at the low saline concentration of 0.30%. However, in lantana poisoned animals, hemolysis started even in 0.72% saline and was complete at a saline concentration of 0.44%. The hemolysis curves of animals that died were far removed from the normal, but those of the calves that recovered and the one that died but had the lowest bilirubin content closely approached the normal curve.[32] This plant is considered to be one of the chief causes of poisoning in Florida. The green, unripe fruits are the most dangerous. The ripe fruits are apparently not harmful, but the leaves are known to be fatally poisonous to animals, even in relatively small quantities. Caterpillars can destroy foliage and reduce flowering. Control with any recommended insecticide.[33]

Study of antidotes in experimental *Lantana camara* albino rats:

Dried alcoholic extract of fresh leaves of *L. camara* was given orally (3gm/kg) to albino rats. After 4 to 14 hr exposed to sunlight induced maximal photodermatitis.[34]

In vitro effect of *L. camara* on the morphology and cultural characters of *Phoma medicaginis* var. *pinodella*:

In vitro efficacy of *L. camara* was evaluated against *P .medicaginis* var. pinodella, a causal organism of *Phoseolus radiatus* Linn. The maximum percentage of inhibition of the growth was exhibited by *Azadiracta indica* and *Catharanthus roseus* and minimum inhibition was shown by extracts of *L. camara*.[35]

Effect of *L. camara* extract on *Xanthomonas compestris citri* in vitro:

Extract of *L. camara* plant was tested for inhibitory effect on *X. compestris citri* in vitro, the incitant of citrus canker. There was no difference in the crude and centrifuged extract. *L. camara* found significant inhibition area ranging from 42 mm^2 to 62 mm^2. The active principle was extracted in ether which was found more inhibitory than the water extract.[36]

Evaluation of pesticide:

Studies on the pesticidal properties of the aqueous suspension (1%) of the acetone extract of the stem of *L.camara* against the 8th instar larvae of *Eupterote undata* the hairy caterpillar and on the second instar larvae of *Conogethes puncifolia*, the shoot borer, on cardamom were carried out. *E.undata* was allowed to feed on the spread leaves and the rate of mortality was found higher by 20% in larvae and 22% in pupae. All the adults from the treated group of larvae were deformed. Topical application of aqueous suspension of the extract on second instar larvae of *C. punctiferalis* resulted in 80 percent larval mortality.[37]

Vaccination as a possible means of preventing *Lantana* poisoning:

The toxic triterpene acids lantadene A and lantadene B were isolated from *L. camara* and conjugated to bovine serum albumen or haemocyanin. The conjugates were emulsified with complete Freud's adjuvant and injected into sheep and cattle. Vaccinated animals produced antibodies against the toxic compounds. Cholestasis was less severe in vaccinated than in non-vaccinated sheep challenged with a toxic dose of *L. camara*.[38]

Antimalarial activity:

Extract of root bark of *L. camara* was found to have an IC50 between 5-10 µg/ml and was found to be active as an antimalarial.[39]

Nematicidal properties of leaf extract of *L. camara*:

All the larvae of root-knot nematode were killed up to S/2 concentrations of leaf extract within 5 hr. At S/10 the mortality was quite high (96.59%), which increased to 100% after 30 hr treatment.[40]

Seed protectant effect:

L. camara leaf powder was mixed with seeds of greengram variety PS 16 at the rate of 0.5, 1.0, 1.5 and 2.0 parts per 100 parts of seeds (w/w). Into this sample freshly emerged beetle was released. The developmental period of beetle was longer in treatment over control. This result indicates that their plant materials can be used as seed protectants.[41]

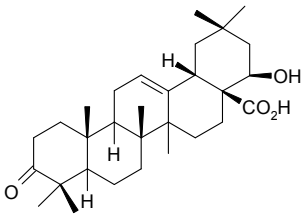
Allelopathic and antifungal potential of *L. camara* root Leachates in soil:

Soil amended with the full strength of root Leachate significantly ($p<0.05$) suppressed the root infection caused by *Fusarium sofani.and Rhizoctonia solani*. The suppressive effect was 44% and 51% respectively against *F. solani* and *R. solani* over the untreated controls The germination percentage of mungbean was significantly ($p<0.005$) reduced compared with controls by the root Leachates and greater reduction occurred at higher concentration. Both plant height and fresh weight of shoot were significantly ($p<0.05$) retarded over the controls in soils receiving full strength of leachates and its 1:2 dilution but were markedly enhanced when treated with 1:4 dilution. To investigate if allelopathic activity of *L. camara* root leachate is modified after the addition of N- fertilization, soils were amended with different dilutions of *L. camara* root leachate (FS, 1:2 or 1:4) plus N- fertilization (0.18 gm/kg of urea). In general soils treated with urea significantly suppressed *F. solani* and *R. solani* over the controls. The inhibitory effect was even more pronounced when soil was treated with both full strength of root leachates and urea (69% and 59% reduction respectively, against *F. solani and R. solani*). Similarly addition of urea significantly increased.[42]

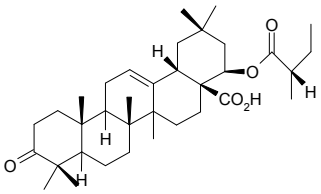
Conclusion

L. camara is traditionally very important plant having many important pharmacological activities like anti-inflammatory, analgesic, antihypertensive, antimicrobial, fungitoxic, cytotoxic, and hypoglycemic properties. Many important phytoconstituents responsible for the activity were isolated. This proves therapeutic importance of the plant. Such type of systematic information about the plant is useful for the researchers.

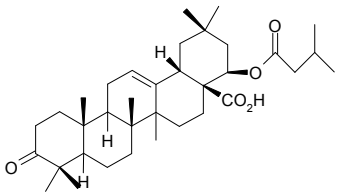
Figure 1. Chemical structures of *L. Camara* plant.[3,4,5]



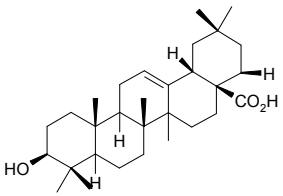
Lantadene-C



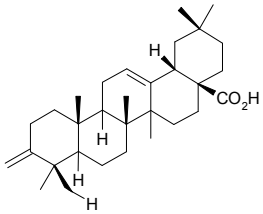
Lantadene-A



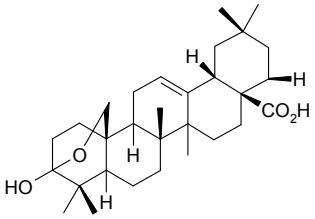
Lantadene-B



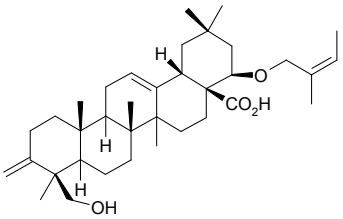
Oleanolic acid



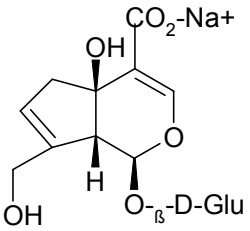
Lantanolic acid



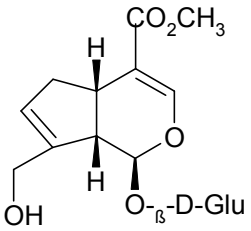
Lantic acid



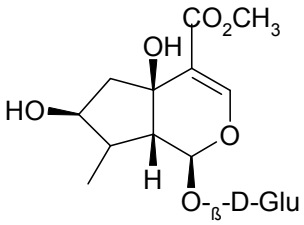
Icterogenin



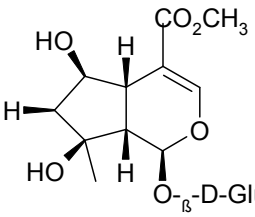
Theveside



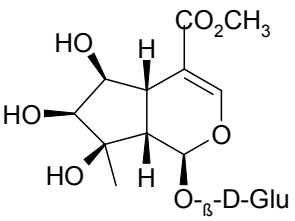
Geniposide



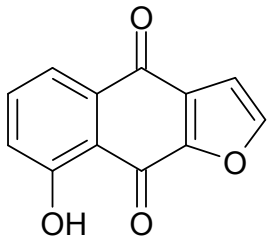
8-epiloganin



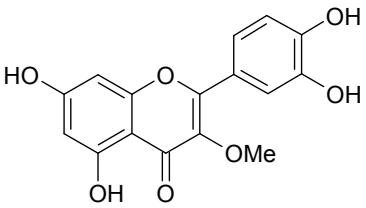
Shanzhside methyl ester



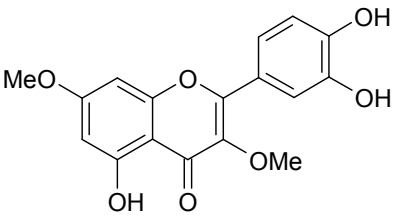
Lamiridoside



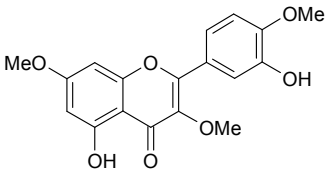
Quinonediodantunizone



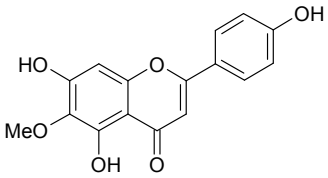
3-methoxyquercetin



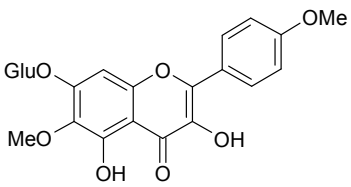
3-3-dimethoxyquercetin



3-7-4'-trimethoxyquercetin



Hispidulin



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