National Journal of Pharmaceutical Sciences

E-ISSN: 2788-9270
P-ISSN: 2788-9262
www.pharmajournal.net
NJPS 2023; 3(1): 10-15
Received: 07-10-2022
Accepted: 08-11-2022

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A Review paper on pharmaceutical potential of *Lantana camara* Plant

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Abstract
Lantana plant, in general, is known to be harmful, alien, invasive and dangerous in nature. It causes much ecological and economic loss to farmers due to its toxicity to livestock such as cattle, sheep, horses, dogs, etc. It also affects the cultivation of crops and considered to be a threat to primary production of crops and biodiversity as well. This plant is widely known for its salt tolerance. *Lantana camara* a species of ornamental flowering plant belonging to the *Verbenaceae*, it is an erect sprawling or scandent shrub with a short life span and is known for its mass growth along sides of abandoned places, roadsides, and uncultivated lands. This weed is in tropical and wide variety of ecosystems around the globe. This invasive species is known with different names in different countries such as red sage, shrub verbena, yellow sage. The spread of *L. camara* has been found to cause enormous loss to biodiversity by replacing natural ecosystems and sometimes known to cause total habit alternation. In this review article, we discuss *L. camara* as a weed, its origin, reproductive bionics, chemical composition, and its pharmaceutical potential as antibacterial, anti-inflammatory, anti-hyperglycemic, anti-oxidant activity, anti-cancer activity and wound healing activity in detail.

Keywords: *Lantana camara*, red sage, antibacterial, anti-fungal, pharmaceutical activities

Introduction
Lantana species is a highly toxic and threateningly invasive weed naturalised in more than 60 tropical and subtropical countries [1]. The weed is noted to be present in the Galapagos Islands of Ecuador [2]. This plant causes a lot of threat to crops, livestock, and mankind. This weed is a perennial weed that invades isolated land, disintegrates biodiversity, ecosystems and can cause rigorous allergic reactions to animals, and it triggers significant problems in forestry, crops and grazing fields. This invasiveness is caused due to the several biological and ecological conditions of the weed plant. In the field of agriculture, it can devastate the production rigorously, which can lead to the series of crop failures, loss in farming, live stocks and in the end cause a huge economic loss to humans[3]. There were a lot of approaches that have been made for destruction, management and to control the outbreak of plant, such as burning, chemical herbicides, and other biological control methods like feeding plant leaves to beetles. *Lantana camara* species has also been proved to have many health benefits such as remedy for skin issues, chickenpox, measles, diarrhoea, malaria, leprosy and high blood pressure [4] and also commercial value and industrial usage such as cattle manure for biodiesel production, and biopesticide production [5]. This herb is known for its vigorous growth and high fertility in all climatic conditions, especially warmer climates. It causes ecological and agricultural losses every year on a large scale and is considered as one of the worst weeds for its invasiveness and environmental aspects. It has a negative impact on the biodiversity, as it rip off the native population of plants and animals, and because of its toxic nature, it also cause the threat to livestock and humans as well. Many people, when exposed to the plant and its pollen, get severe allergic reactions [6]. Lantana camara, an introduced species by the British has turned itself in to a noxious weed, which has expanded itself in almost all the possible habitats of India. It is a major threat to the ecosystem, including plants and animals.

Origins and spread
Lantana weed is native to the Central and South America but its original distribution is unclear due to the introduction of a number of ornamental varieties. *Lantana* was initially brought to India in 1807 as an ornamental plant at the National Botanical Garden [7] and as an ornamental hedge plant in Calcutta in the early nineteenth century [8]. But later this plant has spread out across all open areas along road sides, railway tracks, edges of crop fields and open forests all over the country.

The species does not got the chance to of a proper investigation in its native ranges as it was not considered as a serious pest. In West Indies it is found in dry thickets [9]. The weed is noted to be present in the Galapagos Islands of Ecuador [10]. This species has been widely promoted as an ornamental since the early 1800s and it is widely naturalized throughout the Neotropics. It is present on all continents expect Antarctica. It has become very widespread in Australia, India and South Africa, infesting millions of hectares of land [11].

Ecology, Anatomy and reproductive bionics

Lantana camara is an annual, perennial with an erect and much-branched growth habit. Fully grown plants can reach 2-3 metres in height, though most of them do not exceed 1.5 metre. The leaves are simple, opposite or whorled, toothed, ovate [12]. The multi-coloured cluster of flower which are spherical clusters of tubular white, red, pink, or yellow flowers, with five lobes in a flat-topped cluster on a long stalk. The flowers typically change colour as they mature, resulting in inflorescence that are two-three coloured. *L. camara* flowers are small, 5 lobed, in flat rounded heads about 5 cm across, in dense umbel- like aggregations that are brightly bicoloured, tubular and sweet smelling. In the Tamil Nadu region of India there are differences in toxicity of *L. camara*, with the red flowered variety being more toxic than the pink flowered form [13]. Flowers usually occur all year round, but are most prolific during wet summer months with one more flowering episode in mid-October. It takes about two weeks for fruiting after flowering, and ripened fruits can be found in the bushes till mid-December. The rapid germination and fast growth rate and allelopathic nature of this plant help it to suppress nearby vegetation and allow it to grow vigorously and, as a result, produced a large number of seeds that increase the size of its soil utilization/occupancy. *L. camara* also reproduces and disperses vegetatively very easily. Germination rate of fresh seed is generally low, but the germinability gets improved when the seed passes through the digestive system of birds and animals [14]. It starts flowering when the plant is just 1 year old and will flower up to 6–8 months, respectively. This weed can germinate, flower, and grow in hot temperate conditions; hence, it can be seen developing at any time of the year. Projections of seed survival indicate that *L. camara* seeds could survive for up to 11 years under natural rainfall conditions in Australia However, the primary season for growth is summer, when there is a plentiful amount of rain and the aerial parts of the plant do not tolerate extreme cold conditions [15]. This weed is mostly found in areas that are not farmed and are of low fertile properties such as wastelands and roadsides, river beds, and plant nurseries. *L. camara* has a marked ability to compensate for herbivory as plants survived experimental defoliation for two years [16].

Seed developments and impact on humankind

Under appropriate conditions, these plants produce flowers just after 22–48 days of germination. The best alternating temperature period for seed germination was 22–27 °C. While and also analyzed that, under farm conditions, this particular seed must be buried 5 cm below ground and the plants would survive for about a period of 2 years, with partial life expectancy of 5 years [13].

Considered as one of the most invasive weed. *Lantana camara* is distributed as an ornamental plant throughout the world since the 17th century, the lantana is one of 100 species of the most invasive of the IUCN list. In Australia, It covers the massive 4 million hectare of land by forming dense thickets. In Africa, on East coast and Eastern interior of South Africa. Declared category 1 weed. It is an invasive weed, forms dense impenetrable thickets, replaces indigenous vegetation, and increases erosion. A weed very common, particularly in sugarcane fields, pineapple or orchards. It is present in 50% of the fields, but its abundance is always maintain low in crops. This presence quite everywhere allows it to quickly colonize the land as soon as it is abandoned. In the dry area, it colonizes savanna and forest lands, forming dense thickets that greatly disturb the development of indigenous vegetation [16]. In addition, the presence of essential oil glands in the leaves makes it a very flammable species, facilitating bush fires. Occasional weed in sugarcane fields and other crops where it can become invasive and very harmful if it is not controlled. *Lantana camara* plant parts are toxic to animals. About 73% of people living along the weed are said to be affected.

Control of *lantana camara*

The control of Lantana weed is a great challenge due to its rapid spreading nature. Measures have to be improvised to eradicate this plant since it has more impact on biodiversity and mankind. India has a great risk of rapid spread in agricultural fields. Active research is going on to find a cost effective method and effective way to control this weed. The followings are some of the control measures followed and its effectiveness toward Lamana eradication.

Overgrazing control

In many cases to control plant growth grazing and overgrazing are allowed. However, in the case of Lantana, on overgrazing in certain places increase relatively. Overgrazing, due to the high increase in live stocks decreases the vigour and diversity of grassland that makes the spread of the weed even more lavishly. In fact, intense grazing by goats and donkeys will favour *L. camara* infestations by suppressing competition from palatable species [17]. Hence, maintenance of correct livestock numbers may prevent the spread of Lantana.

Control by burning

Fire can reduce the height and density of lantana. Fire rarely kills lantana, and plants soon recover. Risks of using fire include:

- By destroying desirable vegetation
- By exposing soil and causing erosion [18].

Herbicide control

Herbicidal control is the most effective and widely used method to control *Lantana camara* weed. However, the current efficacy of bioherbicides is not as effective as chemical herbicides till date. Chemical herbicides are commonly called Hot Shot™; Triclopyr + picloram; 2, 4-D + picloram; Metsulfuron methyl. The above herbicides are effective in the control of *Lantana camara.* This weed can be controlled using chemical herbicides in non-cropping areas as well as cropping areas. Cropping areas are a bit risky to practice these herbicides as they damage primary crops. Chemical fertilizer used in agricultural farms needs certain precautions to choose the herbicides so that it cannot harm crops. On the other hand, biological and natural

herbicides such as oils from medicinal plants in low concentrations are effective and helpful in the control of *Lantana camara*. These oils have no or little effect on the current crops as much as on *Lantana camara*. In India, eradication of *L. camara* from sub-watersheds in the Markanda catchment, Himachal Pradesh, was effective and economical using glyphosate sprayed on to regenerated growth, cut four months previously [19].

Biological control

Biological control has been proven to be the best method to control the spread of *Lantana camara*. This can be done by feeding the plants to insects, and we can also use fungi, bacteria, and other plants that have adverse effects on this weed. The larvae of moth and butterflies is predominant in *Lantana camara* existing places. The larvae of the moth feed on the stem of *Lantana camara* and inhibit plant growth considerably, acting as a biological control agent. In Hawaii, *Neogalea sunia* and *Epinotia lantanae* contribute to the control of *L. camara* across the islands. In addition, a combination of *Hypena strigata*, *Octotoma scabripennis*, *Salbia haemorrhoidalis*, *Teleonemia scrupulosa* and *Uroplata girardi* provide partial to substantial control in drier areas <1270 mm rainfall), and in wetter areas *Plagiohammus spinipennis* provides partial control [20].

Phytochemical composition of *lantana camara*

Battase *et al*. (2021) [21] have found out that all parts of the invasive weed *Lantana camara* including trichomes show characteristic compounds and toxins, as mentioned in Figure 1. Parts of *L. camara* such as leaf, stem, and roots contained flavonoids, alkaloids, tannin, protein, catechin, phenol, saponin, steroids, anthraquinone, reducing sugar, and several tri-terpenoids which contain various important phyto molecules such as verbascoside, linaroside, lanatoside, umuhengerin, ursolic acid, carminic acid, caprylic acid, and phytol. These are mostly responsible for using various biological activities [29-32]. The elements of essential oil of Lantana are sabiene, β-caryophyllene, α-humulene, 1, 8-cineole and 8-hydroxy bicycle germacrene, caryophyllene, 1, 8-cineol, two rare sesqui-terpenoid humulene epoxide-III, and sabinene [33]. Chemical investigation of the flower and leaves extract to give knowledge of similar lipid and carbohydrate compositions. The flowers carried out carbohydrates more than leaves; although the lipids were more in the leaves extract [34]. Pentacyclic triterpenoids (camangeloyl acid, methyl camaralate, and camaryolic acid), octadecanoic acid, palmitic acid, camaric acid, β-sitosterol 3-o-beta-D- glycopyranoside, docosanoic acid, lantanolic acid, oleanolic acid, icterogenin, lantadene

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Flavonoid content

Anwar *et al*. (2013) studied that the determination of TFC from leaves and flowers of *L. camara* with different concentrations of ethanol and methanol extracts was done by AlCl3 method. The amount of TFC present in leaves and flowers extracts of it was compared with the standard. The result was analyzed by catechin equivalent (CE) g/100 g of DW. As per the researcher, 80% methanol and 80% ethanol contained higher TFC as compared to absolute ethanol. About 80% methanol flowers extract of TFC is higher (13.76 g CE/100 g DW) than leaves extract (13.41 g CE/100 g DW) [29]. El-Sayed *et al*. (2017) studied that the TFC of leaves, stems, and flowers of *L. camara* was determined. Leaves, stems, and flowers are extracted separately with 85% methanol. The methanolic extract was further defatted

with petroleum ether and fractionated with solvents such as dichloromethane, ethyl acetate, n-butanol, and water. The TF content was determined AlCl3 method; rutin is used as a standard. In that methanolic flowers extract contains higher (99.7 mg RE eq./g of extract) TFC than stems (42.63 mg RE eq./g of extract) and leaves (63.76 mg RE eq./g of extract) extract and ethyl acetate fractions also gives higher (126.17 mg RE eq./g of extract) TFC than other solvents fractions [30].

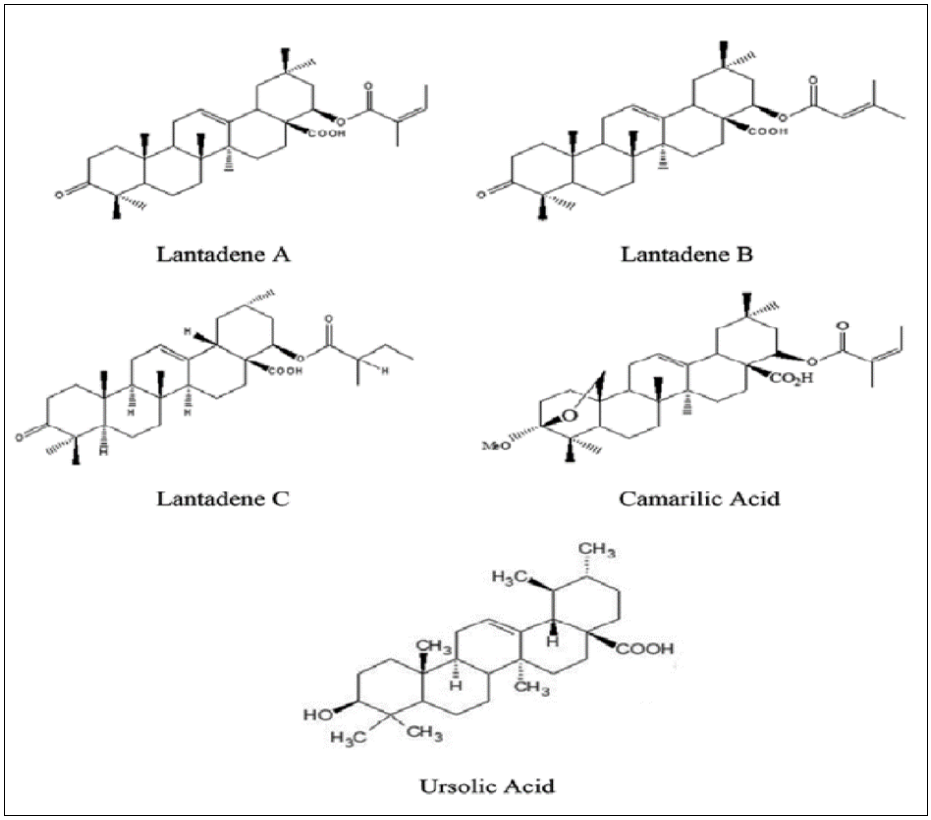

Fig 1: Phytoconstituents of *Lantana camara*

Pharmaceutical potential of *Lantana camara*

Being known as an invasive weed plant, *Lantana camara* has also been known for its pharmaceutical activities such as antimicrobial, anti-inflammatory, sleeping aid, antidiabetic, antiviral, and antitumor. The following sections cover the pharmaceutical value and physiochemical properties that can change the approach of this plant from an unwanted weed to a useful phytochemical source.

Antimicrobial activity

Kedar *et al*. (2012) studied that, *in vitro* antimicrobial activity of dried leaves extract of *L. camara* on species of Escherichia coli, Bacillus subtilis, and Staphylococcus aureus by the Agar Plate Method. Four types of solvent extracts can be used for maximum zone inhibition. On ethyl acetate extract showed resistant by S. aureus and E. coli. Aqueous extract showed resistant by B. subtilis. Methanolic extract showed moderate, aqueous extract showed minimum, and ether extract showed the highest antimicrobial activity [31].

Anti-inflammatory activity

Millycent *et al*. (2017) studied that *in vivo* anti-inflammatory and analgesic activities of aqueous extract of *L. camara* were studied using animal models. As per the researcher's work, the anti-inflammatory activity was studied using carrageenan-induced lung edema and pleurisy mice, while, the analgesic effect was studied using a formalin pain test in rats. The administered doses exhibited significant (p<0.05) minimal toxic effects, anti-infammatory. Methanolic extracts of the leaves and bark were screened for analgesic activity by carrageenan and histamine-induced paw edema models. Concerning the antipyretic activity, the plant of ethyl acetate and ethanolic extract start dropping the body temperature from 1.5th [32].

Anti-hyperglycemic effects

Ganesh *et al*. (2010) studied that, *in vivo* anti-hyperglycemic activity. Oral administration of a methanol extract of *L. camara* leaves in alloxaninduced diabetic rats showed significant dose-dependent reduction of blood glucose concentration and also promising anti-hyperglycemic activity against alloxan-induced diabetic rats. Aqueous extract of the leaves of it was evaluated using both alloxan-induced hyperglycemic rats and normoglycemic rats also show anti-hyperglycemic activity [33].

Anti-cancer activity

Badakhsan *et al*. (2011) studied that, *in vitro* anti-cancer activity. Different solvent extracts such as petroleum ether, chloroform, ethanol, and aqueous extract for *L. camara* are screened for anticancer activity, in that ethanolic extract shows a better effect. By MTT assay, root and leaf extracts were investigated against Jurkat leukemia cells. The root and leaves extract of it might be studied for further identification and fractionation of new anticancer agents [34].

Anti-Oxidant activity

Based on research conducted by Kalita *et al*., 2012, the antioxidant activity of lantana leaves from 42.66 g/ml distilled water is very strong, in the distilled water extract of lantana leaves there are phenolic compounds. In another study by Bhakta *et al*. 2009, methanol extract of lantana leaves, phenolic compounds 0.036 g/ml are very strong, flavonoids 10.7 g/ml is very strong, proantoyanding 135.5 g/ml is moderate [35]. The presence of antioxidant activity is thought to be due to the presence of secondary metabolites contained in lantana leaves. This was obtained from the results of the lantana leaves extract group containing flavonoids, alkaloids, paolofeno/tannins, steroids, and terpenoids. Flavonoids are one of the most common examples of polyphenols found in plants. Polyphenolic compounds have antioxidant activity by inhibiting oxidation reactions by scavenging free radicals. The more polyphenol components, the higher the antioxidant activity [36].

Wound healing activity

Abdulla *et al*. (2009) studied that *in vivo* wound healing activity of ethanolic leaf extract on adult male Wistar rats. Topical application of ethanolic leaf extract on wounds showed increasing wound healing activity. Using excision wound model aqueous extract of leaf showed significant wound healing activity in rats. Topical application of the extract on the wound significantly increased the rate of wound contraction, synthesis of collagen, and decreased wound healing time [37].

Conclusion

Lantana camara species are considered to be waste/unwanted weeds that are generally burned or killed to increase the growth of primary crops. Considering the biological activity of this unwanted plant in the fields of antibacterial, antidiabetic, anti-inflammatory, anti-hyperglycemic, anti-oxidant activity, anti-cancer activity and wound healing activity and its other significant pharmaceutical and industrial applications, it can be converted into an economically valuable plant. These plants are normally killed or burned or destroyed; instead, these could be used as a source of valuable chemical and biological agents, to benefit the economy. Further studies in demand for confirmation of the concept, however, in a world trying to attain a sustainable economy, it would be best to exploit all natural sources to their best quality, even if the source is a weed such as *Lantana camara*.

Acknowledgement

The author sincerely thank the management of Guru Nanak College (Autonomous), Chennai, for their support to carry out this work.

Conflicts of Interest

The author confirm that there are no conflicts of interest for this review article.

References

1. Day MD. Lantana: current management status and future prospects. Australian Centre for International Agricultural Research. 2003 December 24, ISBN 978-1863203753. Retrieved March 24, 2014.
2. Cruz F, Cruz J, Lawesson JE. *Lantana camara* L. A threat to native plants and animals. Noticias de Galapagos. 1986;43:10-11.
3. Yesuf Mohammed Seid, Ecological and Economic Dimensions of the *Lantana camara* and challenges in Ehiopia. International journal of research in agriculture and forestry. Volume 7, Issue 10, 2020, PP35-39 ISSN 2394-5907(Print) & ISSN 2394-5915(Online).
4. Roger W. Blowey BSc BVSC FRCVS FRAgS, A. David Weaver BSc DR MED VET PHD FRCVS, in Color Atlas of Diseases and Disorders of Cattle (Third Edition), 2011
5. Dr. Kavitha S Raj, Chirom Aarti, Atul Damani, Suraj Begoor, Jayashree DR. *In vitro* study on production of bioethanol from *Lantana camara* leaves. International Journal for Research and Development in Technology. 2015, 3(6).- ISSN(0)- 2349-3585.
6. Ghosal K, Saha B, Gupta Bhattacharya S. Clinical and immuno-proteomic approach on *Lantana camara* pollen allergy—a major health hazard. Allergy Asthma Clin Immunol. 2016;12:33. https://doi.org/10.1186/s13223-016-0135-z
7. Kohli RK, Dogra KS, Batish DR, Singh HP. Impact of invasive plants on the structure and composition of natural vegetation of northwestern Indian Himalayas. Weed Technology. 2004;18:1296-1300.
8. Hakimuddin M. *Lantana* in Northern India as a pest and its probable utility in solving the cowdung problem. Indian Forester. 1929;5(6):405–410.
9. Adams CD. Flowering plants of Jamaica. Mona: University of the West Indies, 1976.
10. Cruz F, Cruz J, Lawesson JE. *Lantana camara* L., a threat to native plants and animals. Noticias de Galapagos. 1986;43:10-11.
11. Bhagwat SA, Breman E, Thekaekara T, Thornton TF, Willis KJ. A battle lost? Report on two centuries of invasion and management of *Lantana camara* L. in Australia, India and South Africa. PLoS ONE. 2012;7(3):e32407. http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0032407.
12. Kwabiah AB, Stoskopf NC, Voroney RP, Palm CA. Nitrogen and phosphorus release from decomposing leaves under sub-humid tropical conditions. Biotropica. 2001;33:229-240.
13. Thirunavukkarasu PS, Prathaban S, Dhanapalan P. Pathological studies of *Lantana camara* poisoning in experimental calves. Indian Veterinary Journal. 2001;78:676-678
14. Broughton S. Review and evaluation of lantana biocontrol programs. Biological Control. 2000;17(3):272-286; 3 pp. of ref
15. Ganeshaiah KN. UAS, Bangalore, India. Kailash, B. R., UAS & ATREE, Bangalore, India. Indian Bioresource Information Network (IBIN), Department of Biotechnology, New Delhi, India.
16. Vivian-Smith G, Panetta FD. Lantana (Lantana camara) seed bank dynamics: seedling emergence and seed survival. Invasive Plant Science and Management. 2009;2(2):141-150. http://www.wssa.net
17. Ashmole P, Ashmole M. St Helena and Ascension Island: A natural history. Oswestry, UK: A. Nelson, 2000.
18. USDA, NRCS. 2012. Plants Database: *Lantana camara* Plants Profile. Accessed February 23, 2012. http://plants.usda.gov/java/county?state_name=Florida &statefips=12&symbol=LACA2.

19. Rana RS, Singh LN. Eradication of *Lantana camara* and wasteland utilization in Kandi region of Himachal Pradesh. Indian Journal of Soil Conservation. 1999;27(2):137-140; 1 ref
20. Julien MH, Griffiths MW. Biological control of weeds: a world catalogue of agents and their target weeds. Biological control of weeds: a world catalogue of agents and their target weeds. Ed. 1998;4:x + 223.
21. Lalita Battase, Daksha Attarde. Phytochemical and Medicinal study of *Lantana camara linn.* (Verbenaceae): A review. Asian Journal of pharmaceutical and clinical research, 2021.
22. Satish R, Vyawahare B, Natarajan K. Antiulcerogenic activity of *Lantana camara* leaves on gastric and duodenal ulcers in experimental rats. J Ethnopharmacol 2011;134:195-7.
23. Begum S, Ayub A, Zehra SQ, Siddiqui BS, Chaudhary MI. Leishmanicidal triterpenes from Lantana camara. Chem Biodivers. 2014;11:709-18.
24. Sharma OP, Sharma S, Pattabhi V, Mahato SB, Sharma PD. A review of the hepatotoxic plant Lantana camara. Crit Rev Toxicol. 2007;37:313-52
25. Sousa EO, Almeida TS, Menezes IR, Rodrigues FF, Campus AR, Lima SG, *et al*. Chemical composition of essential oils of *Lantana camara* L. (Verbenaceae) and synergistic effect of the aminoglycosides gentamicin and amikacin. Rec Nat Prod. 2012;6:144-50.
26. Begum S, Wahab A, Siddiqui B, Qamar F. Nematicidal constituents of the aerial parts of Lantana camara. J Nat Prod. 2000;63:765-7.
27. Zandi-Sohani N, Hojjati M, Carbonell-Barrachina AA. Bioactivity of *Lantana camara* L. Essential oil against Callosobruchus maculatus (Fabricius). Chil J Agric Res. 2012;72:502-6
28. Shamsee ZR, Al-Saffar AZ, Al-Shanon AF, Al-Obaidi JR. Cytotoxic and cell cycle arrest induction of pentacyclic triterpenoids separated from *Lantana camara* leaves against MCF-7 cell line *in vitro*. Mol Biol Rep. 2019;46:381-90.
29. Farooq A, Manzoor M, Sultana B, Mushtaq M. Variation in Antioxidant Activity and phenolic and flavonoid contents in the flowers and leaves of Ghaneri (*Lantana camara* L.) as affected by different extraction solvents. Int J Pharmacol. 2013;9:442-53.
30. Mortada ME, Maher MH, Afaf AA, Heba A, Ezzat EA, Eman AM. Total phenolic and flavonoid contents and antioxidant activity of *Lantana camara* and Cucurbita Pepo (squash) extracts as well as GCMS analysis of *Lantana camara* essential oils. World J Pharm Res. 2017;6:137-53.
31. Kedar KA, Pawar KT, Chaudhari PD, Chaudhari SR. Pharmacognostic, phytochemical evaluation and comparative antimicrobial activity of *Lantana camara* (L) var. *Aculeate* (L) mold. (Verbenaceae). J Pharm Res. 2012;5:4125-6.
32. Millycent SA, John MK, Kelvin JK, Piero NM, Mwaniki NE. Evaluation of analgesic, anti-inflammatory, and toxic effects of *Lantana camara* L. Int J Phytopharmacol. 2017;8:89-97.
33. Ganesh T, Sen S, Thilagam E. Pharmacognostic and anti-hyperglycemic evaluation of *Lantana camara* var. *aculeate* leaves in alloxan-induced hyperglycemic rats. Int J Res Pharm Sci. 2010;1:247-52.
34. Badakhsan MP, Lachimanan YL, Sreenivasan S. Cytotoxicity and oral acute toxicity studies of *Lantana camara* leaf extract. Molecules. 2011;16:3663-74.
35. Bhakta D, Ganjewala D. Effect of Leaf Positions on Total Phenolics, Flavonoids and Proanthocyanidins Content and Antioxidant Activities in *Lantana camara* (L)," J. Sci. res., 2009;1(2):363–369. Doi:10.3329/jsr.v1i2.1873
36. Mulyani Y, Febiani L. Review of the article of the Bandotan (*Ageratum Conyzoides* Linn.) Plant As Anti-Bactery, Antioxidant And Anti-Inflammatory. Review of the article of Bandotan (*Ageratum conyzoides* Linn.) 2021;5(1):1-19.