Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Anti-microbial and Anti-insecticidal activity along with GC-MS report of Lantana camara and development of Innovative Insecticide

Kashish Agrawal

kashishjbp@gmail.com

St. Aloysius' College (Autonomous)

Dr. Mamta Gokhale

Shrim Bio-Innovation & Research

Rumana Faraz

St. Aloysius' College (Autonomous)

Research Article

Keywords: Anti-insecticidal, Anti-microbial activity, Ethanolic extract, GC-MS, Lantana camara, Secondary metabolites, Zone of inhibition

Posted Date: March 5th, 2024

DOI: https://doi.org/10.21203/rs.3.rs-3972837/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Weeds are still major problem in all over the World. Human society is unable for total eradication of weed till today. It is demand of time that we must move towards positive aspect of weeds. Present work is based on the same strategy, in which an innovative product is developed using the leaves of *Lantana camara.* The leaves of the *L.camara* have fungicidal, antibacterial and insecticidal activities. During the process of development of product ethanolic extract of leaves was analysed for its antimicrobial analysis, secondary metabolite analysis and activity against insects. Antimicrobial activity was tested against three pathogenic bacterial strains i.e.; *Micrococcus luteus, Citrobacter freundii, Staphylococcus aureus* and two fungal strains i.e.;*Aspergillus niger* and *Paecilomyces sinensis.* The fungi *Paecilomyces sinesis*is an Entomopathogenic fungi, that infect and kill harmful insects. In some cases, it is also found as Endophytic fungi.

The maximum zone of inhibition was found in *Citrobacter freundii* and *Aspergillus niger* when tested with 10% concentration of ethanolic extract of *L.camara*. Secondary metabolite analysis was performed using GC-MS,which reveals 27 compounds. The research reveals that Diethyl Phthalate has the maximum area percent in this ethanolic extract which is mainly used in insecticides. Anti-insecticidal activity was analyzed on the plant C*alotrope gigantea* against the insect *Oleander aphid* and on the *Hibiscus rosa-sinensis* against the insect *Aphis fabae*.

1. INTRODUCTION

Weeds are unwanted, persistent, and harmful plants that hinder the growth of other agricultural plants and negatively impact human activities, agriculture, natural processes, and the national economy. The *Cannabaceae* family of plants includes the weed plant, which has been used for both therapeutic and recreational purposes for thousands of years. Chemical insecticides are used to control pests or stop them from acting in an unfavorable or destructive way (Mariajancyrani et al., 2014). Chemical insecticides pose a risk to humans and have the potential to destroy more creatures than planned. Additionally, they affect aquatic creatures when they interact with water sources due to leaching, drift, or runoff. Birds die when they consume contaminated insects and drink contaminated water. Chemical pesticides are determined to be extremely harmful to the environment, humans, and animals over the long term. As a result, there is increasing social pressure to reduce pesticide use and progressively replace it with biopesticides, which are safe for both humans and non-target creatures (Swamy et al., 2015).

The most widely distributed species of the genus *Lantana* is *Lantana camara L*., which is a member of the Verbenaceae family and is commonly referred to as wild or orange sage. It is a very famous evergreen weed that may be found almost everywhere on the earth. It is also considered as a garden ornamental plant. It is commonly utilized to treat a variety of health issues in many traditional medical systems. Many human diseases are cured using various plant parts. *L.camara's* essential oil and plant extracts have a variety of bioactivities, including antibacterial properties. The presence of several bioactive phytocompounds in the plant is what gives it its medicinal potential. For the past ten years, experts and

researchers from all around the world have thoroughly investigated the chemical makeup of the entire plant of *L. camara* as well as its biological functions (Saraf et al., 2011).

The word "Raimuniya" is the Hindi name for *Lantana camara* (Fig. 1). A thorny shrub reaching a height of 2–3 m, *L. camara* grows erect, partially climbing, or occasionally more or less hanging. Angled stems and branches with curved spines are positioned along the edges. The leaves are straightforward, opposite, decussate, oval, regularly dentate, and have an acute tip. An inflorescence is a hemispherical head that can be axillary or terminal, and it can be yellow, pink, or orange in colour. It is made up of several little tubular flowers. The fruits are tiny, meaty drupes with a diameter of around 3 mm with colours ranging from blue to black. A stalk with long hairs covering it that is between 5 and 7 mm long carries the cotyledons. The lamina is oval, light green, emarginate at the apex, 5 mm long, and 6 mm wide. Simple, opposite, decussate leaves are linked by a 2 to 3 mm long, short, hairy petiole (Ganjewala et al., 2013). The blade is tiny, oval, hispid, and has a serrated border. It measures 10 to 12 mm long by 6 to 8 mm wide. Its superficial root system, which can grow to a height of 2–4 m or more, is made up of a small taproot and lateral roots that branch out to create a carpet of roots. *L.camara* seeds can grow all year long if the right circumstances for moisture are present. In the first wet season, thickets develop after slow development establishes a solid root structure. The dry season's flowering lasts until the end of the rainy season, when the fruits are fully developed. *L.camara* is a perennial, evergreen plant throughout the year, multiplies through seeds, blossoms, and fruits. Birds, monkeys, and rivers washing downstream all spread seeds. Bisexual *Lantana* species have functional male (androecium) and female (gynoecium) gonads, as well as stamens, carpels, and ovaries (Negi et al., 2019).

Therefore, present research work was carried out as the replacement of chemical insecticides, by the ethanolic extract of *L.camara*. The leaves of the *L.camara* have fungicidal, antibacterial and insecticidal activities. The leaves are simple, opposite, and widely oval. When crushed, they release a potent odour (K, 2017). The *L.camara* fruit is a drupe that resembles a berry and matures from green to dark purple. Both people and animals are unable to eat green, unripe fruits. Birds and other animals consume the mature, dark purple fruits, which disperse the seeds over great distances and aid in the spread of the plant.

The ethanolic extract of *L.camara* has great potential for inhibiting damage caused by various types of insects to horticulture and agricultural crops. It is an organic substitute for chemical insecticides. It shows a significant impact on crop plants and flowering plants. Consequently, the purpose of this work is to minimize the use of Chemical Insecticides by plant extracts from natural sources to control insects, and also to protect farmers and gardeners from harmful chemical exposure. The ethanolic extract of *L.camara* was named as “Lantocide”.

2. MATERIALS AND METHOD

2.1 Collection and Preparation of Plant Material

The leaves of *Lantana camara* was collected from the reserve forest area of Jabalpur district, Madhya Pradesh. Leaves were first washed thoroughly with tap water and then dipped in sterile distilled water to remove the fine dust particles. After washing, leaves were oven dried at the temperature 100°C for 45 minutes to 1 hourand finely powdered by grinding in pestle mortar and then strained with the help of strainer.

2.2 Extract preparation from leaves of *Lantana camara*

Three different concentrations of ethanolic extract of *L.camara* was prepared to evaluate the best concentration. 1gm, 5gm and 10gm of dried powdered leaves of *L.camara* was dissolved in three different flasks containing 100 ml of 70% ethanol. Then the solution was boiled on hot plate for 40–45 minutes at 100°C to 150°C. After boiling the solution was cooled up to room temperature and then filtered with the help of Whatman filter paper no. 1. Filtrates of different concentrations (1 gm, 5 gm and 10 gm) were then applied to analyze their antimicrobial activity against three human pathogenic bacterial strains, one fungal strain and one Entomopathogenic fungal strain.

2.3 Bacterial strains for antibacterial activity

Pure cultures of *Micrococcus luteus* [Causing agent sepsis, or endocarditis - an infection of the lining of the heart], *Citrobacter freundii* [Leading pathogens of nosocomial infections], *Staphylococcus aureus* [Causing agent of skin infections, food poisoning and septic arthritis] were usedfor analyzing the antibacterial activity of different ethanolic extracts of *L.camara*. The bacterial suspensions of the above pure cultures were prepared by inoculating the lyophilized form of the pure strains into the nutritional broth. These cultures were maintained on sterile Nutrient Agar Media (NAM) slants and stored at 4°C until further use.

2.4 Fungal strains for antifungal activity

Pure cultures of *Aspergillus niger* [Causing agent of black mold on certain fruits and vegetables, several allergies, infections in lungs and other organs], *Paecilomyces sinensis* [Causing agent of various infection in humans and other vertebrates] were used for analyzing the antifungal activity of different ethanolic extracts of *L.camara.* The fungal suspensions of the above pure cultures were prepared by inoculating the lyophilized form of the strains into the nutritional broth. These cultures were maintained on sterile Potato Dextrose Agar media (PDA) and stored at 4°C until further use.

2.5 Antimicrobial tests of ethanolic extract of *Lantana camara* by well diffusion method

Well diffusion method was used to test the antimicrobial activity of ethanolic extract of *L.camara*. 20-25ml of melted agar media was poured in each petri plate. Nutrient Agar Media (NAM) was used for antibacterial and Potato Dextrose Agar (PDA) was used for antifungal tests respectively. 15µl of pure cultures were inoculated on solidified agar plates. Four wells in each plate were created using cork borer. Three wells were filled with 50µl of ethanolic extract of *L.camara*, each well with different concentration

(1gm, 5gm and 10gm) and one well was kept as acontrol (Ethanol). The plates were then kept in Incubator for 24-hour at 35°C for analyzing antibacterial activity and at 28°C for the antifungal activity.

2.6 Measurement of zone of inhibition against pathogenic bacteria and fungi

After incubation, the antimicrobial activity was evaluated by measuring the zone of inhibition around each well for each bacteria and fungi. The diameter of the zone of inhibition was measured in mm. One well is created as control in each petri plate.

2.7 GC-MS analysis of various ethanolic extracts of *L.camara*

Gas chromatography-mass spectrometry (GCMS) analysis of ethanolic extract of *L.camara* was carried out at the advanced instrumentation research facility (AIRF), Jawaharlal Nehru University, Delhi. The analysis was performed on a Shimadzu GC-MS-QP-2010 ultra system.

Following operating conditions: oven temperature program from 60°C with holding time of 2 min, 250°C at 10°C/ min with holding time of 5 min, and the final temperature was 280°C kept for 12 min at 15°C/ min. The injector temperature was maintained at 260°C, pressure 73.3 k Pa, total flow 16.3 ml/min, column flow 1.21 ml/min, linear velocity 40.1 cm/sec, purge flow 3.0 ml/min, split ratio 10.0, ion source temperature 220.00°C, scan mass range 40–650 m/z, and interface line temperature 270°C. The identification of compounds was performed by comparing the mass spectra with data from NIST14.lib (National Institute of Standards and Technology, US) and WILEY8.LIBlibraries.

2.8 Anti insecticidal activity of ethanolic extract of *L.camara*

Anti insecticidal activity of *L.camara* was tested on the infected plants *Calotrope gigantean* against the insect *Oleander aphid* and *Hibiscus rosa-sinensis* against the insect *Aphis fabae*. Name of insects were confirmed by Department of Zoology, St. Aloysius' College, Autonomous, Jabalpur, M.P. Ethanolic extract of *L.camara* was sprayed on the leaves of infected plants where insects and larvae were present. It was sprayed about 1–2 ml in every three days. Observations were made after every third day of spray.

3. RESULTS AND DISCUSSION

The findings of the antibacterial activity of ethanolic extract of *L.camara* in three different concentrations (1gm, 5gm and 10gm) are shown in Table 1. The best results of antibacterial and antifungal were revealed by the ethanolic extract of 10gm/100 ml, after which GCMS analysis was documented.

3.1 Antibacterial activity of leaf extract of *L.camara*

Ethanolic extracts of leaf of *L.camara* showed strong antibacterial activity against pathogenic bacterial strains. A clear, prominent zone of inhibition was obtained against *Micrococcus luteus and Citrobacter freundii* in 5% and 10% concentration. Zone of inhibition was obtained around 11.66 mm in 5% extract

and 11.0 mm in 10% extract against *Micrococcus luteus* (Fig. 2). Zone of inhibition was obtained around 16.6 mm in 5% extract and it was increased with increasing concentration of leaf extract (10%) i.e. 18.0 mm against *Citrobacter freundii* (Fig. 3). Enhancement in the size of zone of inhibition is an indication of increasing antibacterial activity with increasing concentration of *Lantana* leaf extract against *Micrococcus luteus and Citrobacter freundii, Lantana* leaf extract was not showing any activity against *Staphylococcus aureus* (Fig. 4). Maximum zone of inhibition was observed against *M. luteus* (Graph 1). The antibacterial potential of extracts was evaluated in terms of the inhibition zone (Table 1).

Pathogenic bacteria are one of the major causative agents of food and water borne diseases. Pathogenesis refers both to the mechanism of infection and to the mechanism by which disease develops (Kishore, 2021). They cause damage to the cells and tissues by releasing toxins and spread through skin contact, body fluids, air, contaminated items and water (Váradi et al., 2017). Earlier it was studied that *Pseudomonas aeruginosa* can cause pneumonia and blood infections; *Mycobacterium tuberculosis* causes tuberculosis; *Listeria* causes food borne infections and flu-like symptoms; *Salmonella* causes typhoid and *E.coli* causes intestinal infections with symptoms like fever and diarrhea (Pandey et al., 2014). Methanolic extract of *L.camara* was used against *Escherichia coli, Staphylococcus aureus, Enterobacter fecalis, Proteus vulgaris, Micrococcus luteus* and *Salmonella typhi* (Anand et al., 2018)*;* (Anand et. al., 2018); (Swamy et al., 2015).

In our studies the antibacterial activity of the ethanolic extract of *L.camara* was examined against, two Gram-positive bacteria, *Micrococcus luteus* causes brain abscess, native valve endocarditis, bacteremia, and septic arthritis in immune suppressive patients (Erbasan, 2018); (Ianniello et al., 2019). *Staphylococcus aureus* causes skin and soft tissue infections such as abscesses (boils), furuncles, and cellulitis (Ghalehnoo, 2018). One Gram-negative bacteria, *Citrobacter freundii* causes urinary tract, liver, biliary tract, peritoneum, intestines, bone, respiratory tract, endocardium, wounds, soft tissue, meninges, and the bloodstream (Liu et al., 2018). These strains have been chosen based on their potential for use in further formulation research. Industrial use of *L.camara* is, it is used to activate carbon prepared from the stems of *L.camara* plant which is investigated as adsorbent for the removal of chromium (VI) from polluted water using batch methods of extraction (Ravulapalli & Kunta, 2018). The decoction prepared from *L.camara* leaves is mostly used in herbal medicine for wound healing, fever treatment, cough treatment, influenza treatment, stomach ache, malaria, etc. It has also been recorded that can be used for the treatment of cancers, chickenpox, measles rheumatism, and ulcer (Gillela et al., 2024).

3.2 Antifungal activity of leaf extract of *L.camara*

Ethanolic extracts of leaf of *L.camara* showed strong antifungal activity against pathogenic fungal strains. A clear, prominent zone of inhibition was obtained against *Aspergillus niger*, in 1%, 5% and 10% concentration of ethanolic extract of *L.camara.* Zone of inhibition was obtained around 10.66 mm in 1%, 10.33 mm in 5% and 11.66 mm in 10% against *Aspergillus niger* (Fig. 5). Enhancement in the size of zone of inhibition is an indication of increasing antifungal activity with increasing concentration of *Lantana* leaf extract against *Aspergillus niger, Lantana* leaf extract was not showing any activity against

Paecilomyces sinesisis (Fig. 6). Maximum zone of inhibition was observed against *A.niger* (Graph 1). The antifungal potential of extracts was evaluated in terms of the fungal growth inhibition zone (Table 1).

Pathogenic fungi causes disease in humans or other organisms. Approximately 300 fungi are known to be pathogenic to humans (Viegas et al., 2019). Fungal plant pathogen species are primarily in the phyla Ascomycota and Basidiomycota (Doehlemann et al., 2017). Pathogenic fungi, particularly yeasts, have the ability to gain access to the bloodstream, reaching the internal organs of patients and causing systemic or disseminated fungal infections (Barros et al., 2022). Earlier it was studied that that *Candida albicans* can cause heart, brain, eyes and blood infections; *Cryptococcus neoformans* causes infection in immune systems; *Aspergillus fumigates* damages lungs; *Coccidioides immitis* occurs by breathing into lungs; *Histoplasma capsulatum* causes Histoplasmosis with symptoms like mild flu; *Blastomyces dermatitidis* causes infection in lungs through inhalation and *Pneumocystis jirovecii* causes damage in lungs without causing symptoms, individuals with weakened immune systems, such as people with HIV/AIDS, cancer patients, and people with inflammatory or autoimmune diseases are at greatest risk (Martin-Loeches et al., 2022). Methanolic extract of *L.camara* was used against *Candida albicans* and *Aspergillus niger* (Zare, 2021).

In our studies the antifungal activity of the ethanolic extract of *L.camara* was examined against, *Aspergillus niger* causes cutaneous infections and pulmonary disease (Dai et al., 2016). *P.sinensis* is not an pathogenic fungus, it enhances soil fertility. In present work *L.camara* has not shown any anti-fungal activity against *P.sinensis.* Such type of extract which are supported for beneficial microbs can be suggested to apply as insecticide in agricultural land. Their particular activities against pathogenic microbs can support agriculture crop system. It proves that *L.camara* can be use in soil because it does not cause any damage to *P.sinensis*.

Table 1: Antimicrobial activity of different concentrations of ethanolic extract of leaves of *L.camara.*

S. No.	Microbe's Name	Concentration of ethanolic extract of L.camara (gm/100ml) (%)	Zone of Inhibition (mm)
A.	**Bacterial Strains (Bacteria)**		
1.	*M.luteus*	1	No zone
		5	11.66
		10	11.0
2.	*C.freundii*	1	No zone
		5	16.6
		10	18.0
3.	*S.aureus*	1	No zone
		5	No zone
		10	No zone
B.	**Fungal Strains (Fungi)**		
• 1.	*A.niger*	1	10.66
		5	10.33
		10	11.66
2.	*P.sinensis*	1	No zone
		5	No zone
		10	No zone

Our findings are consistent with earlier research that has established ethanol as the most effective solvent for recovering more extractable chemicals from a variety of medicinal plants. Formerly, ethanolic extract was used less by researchers for their studies than methanolic extract (Mansoori et al., 2020). However, a review of the literature reveals that, as of now, there are very few publications on the comparative yield analysis derived from ethanolic solvent (Swamy et al., 2015).

3.3 GC-MS Analysis

GC-MS is an efficient method for identification of compounds present in the extract. Here only best resulted, 10% ethanolic extract of *L.camara* was sent to JNU, Delhi. In this extract GC-MS chromatogram showed the presence of 27 compounds. According to our study these 27 compounds can be categorized into 2 different classes (Table 2) and (Table 3). Name of different compounds identified has been mentioned in both table 2 and 3 with their Rt (retention time) and with different percent area and structure. Out of 27, 23 compounds (Table 2) are mentioned in literature for their characteristics and

economic importance. We can state remaining 4 compounds out of 27, as novel compounds, as they are not described in literature for their characteristics (Table3):-

Phytochemical are very important in medicine and constitute most of the valuable drugs. Several chemicals which are derived in this GC-MS report act as a drug that are currently used in more countries in the world. The various phytocomponents have been identified from the GC-MS chromatogram (Fig. 7) and compared with the NIST and WILEY library.

Previous studies of methanolic extract of *L.camara* revealed 65 peaks based on separation, retention time and percent area. Mass spectra of all identified compounds were matched with WILEY8.LIB and NIST08.LIB and the function of only 19 components was predicted, functions of other components could not be identified due to a lack of library data corresponding to compounds. Most of the components identified and reported belong to different biological activities like antioxidants, anticancer, antifungal, antibacterial, antiviral, anti-inflammatory, etc. (Mansoori et al., 2020).

While in our report peak of 27 components are present among which application of 23 components were found and 4 are novel compounds. Out of 27, 3 compounds comes under functional group of Benzoic acid i.e., Diethyl Phthalate; Dibutylphthalate and Di-n-octylphthalate which is used in making insecticides, plastics and cosmetic products like nail polishes. 1 compound i.e., 2-amino-3-cyano-6-methyl-4,5,6,7-tetra hydropyrido(3,4-b)thiophene comes under Carboxy group which is used in making primary bile acid and white crystalline substances. 2 compounds i.e., 2-Pentadecanone,6,10,14-trimethyl; 8-Octadecanone comes under *Carbonyl group* which is used by several species of insect as a pheromone. *6 compounds i.e.,* (S,E)-6-Hydroxy-6-methyl-2-((2S,5R)-5-methyl-5-vinyltetr; (S,E)-6-Hydroxy-6-methyl-2-((2S,5R)-5-methyl-5-vinyltetr; Ledol; 1,6,10,14,18,22-Tetracosahexaen-3-ol,2,6,10,15,19,23-hexamethyl-; (1R,3E,7E,11R)-1,5,5,8-Tetramethyl-12-oxabicyclo[9.1.0]d/Humulene epoxide; Cedran-diol,(8S,14)- *comes under Hydroxyl group +* alcohol group which is having some biological activities like anti-oxidant, anti-metastatic, anti-cancer, anti-inflammatory, anti-microbial, anti-inflammatory and anti-tumor. Also ledol can cause cramps, paralysis, and delirium. 1 compound i.e., LilacalcoholD comes under oxolanes which is used in making insecticides, soaps, perfumes, food additives as flavors and household products. 6 compounds i.e., Pregn-4-ene-3,20-dione/beta.-progesterone; Neophytadiene; Phytol, acetate; Geranyl linalool isomer b; Undec-10-ynoicacid,tridec-2-yn-1-ylester; Phytol $$ 2-Hexadecen-1-ol, 3,7,11,15-tetramethyl- comes under methyl group which is having some biological activities like anti-inflammatory, anti-microbial, anti-oxidant, anti-nociceptive, antimicrobial and cytotoxic properties. Also can be use in treatment of cancer and post-translational modification. 1 compound i.e., 1H-purine-2,6-dione, 3,7-dihydro-1,3,7-trimeth/coffein comes under alkaloid group which is used in making insecticide. 1 compound i.e., Octadecane,1-isocyanato/Isocyanic acid, octadecyl ester comes under alkane hydrocarbons which is used in making wool fabric softeners and intermediates for synthetic auxiliaries. 1 compound i.e., 5Beta.-guaia-7(11),10(14)-dien-8.alpha.-ol, 5,8-epoxy-/isocurcumenol, (+)-comes under monocarboxylic acid which is used for treating wounds, cancer and antiaging. 1 compound i.e., Squalene comes under triterpenoids which contains properties like anticancer, antioxidant, drug carrier, detoxifier and skin hydrating. While 4 were novel compounds i.e., 2,4,7,14-Tetramethyl-4-vinyl-

tricyclo[5.4.3.0(1,8)]tetradeca –; 9-(3,3-Dimethyloxiran-2-yl)-2,7-dimethylnona-2,6-dien-1-o -; Oxirane,hexadecyl-; Lanostan-3.beta.-ol,11.beta.,18-epoxy-19-iodo-,acetate –.

3.4 Anti insecticidal activity of ethanolic extract of *L.camara*

Anti insecticidal results revealed that 10% ethanolic extract of *L.camara* gave better results on the plant *Calotrope gigantea* against the insect *Oleander aphid* (Fig. 8 and 9) and *Hibiscus rosa-sinensis* against the insect *Aphis fabae* (Fig. 10). Ethanolic extract of *L.camara* was sprayed on the leaves of infected plants where insects and larvae were present. Observations were made after every third day of spray. Diseased plants of *C.gigantea* had presence of yellow spots, which are indicating presence of *O.aphid* on the leaves. After 3rd day of spraying of *L.camara* extract on *C.gigantea* leaves, yellow spots disappeared. Absence of yellow spot on *C.gigantea* leaves is an indication of eradication of disease from them. Fresh, green and healthy appearance of *C.gigantea* leaves even after 15 days is confirmation that it is totally eliminated from its disease host. Therefore, yellow spots were absent on plant.

Similar results was observed in diseased plants of *H.sinensis* had presence of bright black spots, which are indicating presence of *A.fabae* on the leaves. After 3rd day of spraying of *L.camara* extract on *H.sinensis* leaves, black spots became deadly, which were totally disappeared after 6 days of observation. Absence of black spots on *H.sinensis* leaves is an indication of extermination of disease from them. It was observed that even after 1 month *H.sinensis* leaves were undried, green and in a good condition, which was the evidence that the disease host has completely eradicated the plant. Therefore, black spots were absent on plant. On the basis of above observations it is confirmed that 10% ethanolic extract of *L.camara* is refered as anti-insecticidal activity.

Biotic stress in plants caused by insect pests is one of the most significant problems, leading to yield losses. Synthetic pesticides still play a significant role in crop protection (Tlak Gajger & Dar, 2021). Biopesticides being eco-friendly have significant advantages over conventional pesticides. They are also less prone to pest resistance, less toxic to non-target organisms. Biopesticides have diverse mode of action making them versatile (Khursheed et al., 2022). So there is a need of herbal insecticide so there is a replacement of herbal extract of *L.camara*. Previously ethanolic and methanolic extract of *L.camara* was used for controlling maize weevils against *Sitophilus zeamais* (Ayalew, 2020).

In our studies the anti-insecticidal activity of the ethanolic extract of L.camara was examined on the plant Calotrope gigantea against the insect Oleander aphid which causes discoloration, leaf curling, yellowing, and stunted growth of plant (Singh & Singh, 2021) and Hibiscus rosa-sinensis against the insect Aphis fabae which causes several damages through sucking sap, injuring leaves, the excretion of honeydew - inducing the development of sooty mould- and the transmission of plant viruses (Bennour et al., 2021).

4. CONCLUSION

The present investigation shows that the ethanolic leaf extract of *L.camara*, has a wide spectrum of bioactive compounds, which can be utilized as a medicinal source in the development of drugs. The

identification of the composition and structure of biomolecules with potential therapeutic applications was detected by GC-MS. According to a preliminary screening of ethanolic extract of *L.camara* leaf, the extract has anti-oxidant, anti-metastatic, anti-cancer, anti-inflammatory, anti-microbial and anti-tumor properties. Present study is focusing on the antimicrobial properties of some more pathogens and beneficial microbes along with the anti-insectidal activity against plant damaging insects. Reports detected from prior and present studies, might result in the conception of medicinal formulation to save the plants against insects and microbes. In our studies, on the basis of the qualities of the ethanolic extract of *L.camara*, an innovative herbal insecticide (Lantocide) was prepared. Presently world is facing the problem of dreadful effects of chemical pesticides, therefore we are here with a solution of herbal insecticide. And so this extract may be further researched for commercial use as an improved herbal insecticide.

Declarations

Author Contribution

Conceptualization MG, Data curation KA, Formal analysis RF, Investigation KA, Methodology MG, Project administration RF, Supervision MG and RF, Validation MG, Writing KA, Writing-review and editing KA, RF and MG.

References

1. Anand, J., Choudhary, S., & Rai, N. (2018). Lantana camara enhances antibacterial potency of antibiotics and exerts synergistic inhibitory effect against pathogenic bacterial species. *Oriental Pharmacy and Experimental Medicine*, *18*(4), 381–389. https://doi.org/10.1007/s13596-018-0321-2
2. Ayalew, A. A. (2020). Insecticidal activity of Lantana camara extract oil on controlling maize grain weevils. *Toxicology Research and Application*, *4*, 2397847320906491. https://doi.org/10.1177/2397847320906491
3. Barros, I. L. E., Corrêa, J. L., Veiga, F. F., Bruschi, M. L., Negri, M., & Svidzinski, T. I. E. (2022). Chapter 7—Effect of propolis on fungi of human clinical interest. In D. Boyacioglu (Ed.), *Bee Products and Their Applications in the Food and Pharmaceutical Industries* (pp. 173–199). Academic Press. https://doi.org/10.1016/B978-0-323-85400-9.00004-6
4. Bennour, C., Belgacem, A. B., & Nasr, H. B. (2021). A review of the management of Aphis fabae Scopoli (Hemiptera: Aphididae). *JOURNAL OF OASIS AGRICULTURE AND SUSTAINABLE DEVELOPMENT*, *3*(1), Article 1. https://doi.org/10.56027/JOASD.052021
5. Dai, X., Wang, H., Ju, L.-K., Cheng, G., Cong, H., & Newby, B. Z. (2016). Corrosion of aluminum alloy 2024 caused by *Aspergillus niger*. *International Biodeterioration & Biodegradation*, *115*, 1–10. https://doi.org/10.1016/j.ibiod.2016.07.009
6. Doehlemann, G., Ökmen, B., Zhu, W., & Sharon, A. (2017). Plant Pathogenic Fungi. *Microbiology Spectrum*, *5*(1). https://doi.org/10.1128/microbiolspec.FUNK-0023-2016

7. Erbasan, F. (2018). Brain abscess caused by Micrococcus luteus in a patient with systemic lupus erythematosus: Case-based review. *Rheumatology International*, *38*(12), 2323–2328. https://doi.org/10.1007/s00296-018-4182-2
8. Ganjewala, D., Sam, S., & Khan, K. (2013). *Biochemical compositions and antibacterial activities of Lantana camara plants with yellow, lavender, red and white flowers*. https://doi.org/10.5053/ejobios.2009.3.0.10
9. Ghalehnoo, Z. (2018). Diseases caused by Staphylococcus aureus. *Albanian Journal of Medical and Health Sciences*, *11*, 65–67.
10. Gillela, S., Yadav, S. M., Sihag, K., Lubis, M. A. R., Wibowo, E. S., Negi, A., Iswanto, A. H., Antov, P., & Kristak, L. (2024). A review on Lantana camara lignocellulose fiber-reinforced polymer composites. *Biomass Conversion and Biorefinery*, *14*(2), 1495–1513. https://doi.org/10.1007/s13399-022-02402-7
11. Ianniello, N. M., Andrade, D. C., Ivancic, S., Eckardt, P. A., & Lemos Ramirez, J. C. (2019). Native valve infective endocarditis due to *Micrococcus luteus* in a non-Hodgkin's lymphoma patient. *IDCases*, *18*, e00657. https://doi.org/10.1016/j.idcr.2019.e00657
12. K, G. (2017). Antimicrobial activities of Lantana camara Linn. *Asian Journal of Pharmaceutical and Clinical Research*, *10*, 57–67. https://doi.org/10.22159/ajpcr.2017.v10i3.16378
13. Khursheed, A., Rather, M. A., Jain, V., Wani, A. R., Rasool, S., Nazir, R., Malik, N. A., & Majid, S. A. (2022). Plant based natural products as potential ecofriendly and safer biopesticides: A comprehensive overview of their advantages over conventional pesticides, limitations and regulatory aspects. *Microbial Pathogenesis*, *173*, 105854. https://doi.org/10.1016/j.micpath.2022.105854
14. Kishore, U. (Ed.). (2021). *Microbial Pathogenesis: Infection and Immunity* (Vol. 1313). Springer International Publishing. https://doi.org/10.1007/978-3-030-67452-6
15. Liu, L.-H., Wang, N.-Y., Wu, A. Y.-J., Lin, C.-C., Lee, C.-M., & Liu, C.-P. (2018). *Citrobacter freundii* bacteremia: Risk factors of mortality and prevalence of resistance genes. *Journal of Microbiology, Immunology and Infection*, *51*(4), 565–572. https://doi.org/10.1016/j.jmii.2016.08.016
16. Mansoori, A., Singh, N., Dubey, S. K., Thakur, T. K., Alkan, N., Das, S. N., & Kumar, A. (2020). Phytochemical Characterization and Assessment of Crude Extracts From Lantana camara L. for Antioxidant and Antimicrobial Activity. *Frontiers in Agronomy*, *2*. https://www.frontiersin.org/articles/10.3389/fagro.2020.582268
17. Mariajancyrani, J., Chandramohan, G., Brindha, P., & Saravanan, P. (2014). *GC-MS Analysis of Terpenes from Hexane Extract of Lantana camara Leaves*. https://www.semanticscholar.org/paper/GC-MS-Analysis-of-Terpenes-from-Hexane-Extract-of-Mariajancyrani-Chandramohan/12b15915472428287fb02749d9428482efaa54ea
18. Martin-Loeches, I., Nseir, S., Rodriguez, A., & Azoulay, E. (2022). Disease-specific gaps within fungal respiratory tract infections: Clinical features, diagnosis, and management in critically ill patients. *Current Opinion in Pulmonary Medicine*, *28*(3), 218–224. https://doi.org/10.1097/MCP.0000000000000865

19. Negi, G. C. S., Sharma, S., Vishvakarma, S. C. R., Samant, S. S., Maikhuri, R. K., Prasad, R. C., & Palni, L. M. S. (2019). Ecology and Use of Lantana camara in India. *The Botanical Review*, *85*(2), 109–130. https://doi.org/10.1007/s12229-019-09209-8
20. Pandey, P. K., Kass, P. H., Soupir, M. L., Biswas, S., & Singh, V. P. (2014). Contamination of water resources by pathogenic bacteria. *AMB Express*, *4*(1), 51. https://doi.org/10.1186/s13568-014-0051-x
21. Ravulapalli, S., & Kunta, R. (2018). Enhanced removal of chromium (VI) from wastewater using active carbon derived from Lantana camara plant as adsorbent. *Water Science and Technology*, *78*(6), 1377–1389. https://doi.org/10.2166/wst.2018.413
22. Saraf, A., Kalam, S., Sharma, D., Noor, A., & Khan. (2011). *Antimicrobial activity of Lantana camara L* (Vol. 2) [dataset].
23. Singh, R., & Singh, G. (2021). Aphids. In Omkar (Ed.), *Polyphagous Pests of Crops* (pp. 105–182). Springer. https://doi.org/10.1007/978-981-15-8075-8_3
24. Swamy, M. K., Sinniah, U. R., & Akhtar, M. S. (2015). In Vitro Pharmacological Activities and GC-MS Analysis of Different Solvent Extracts of *Lantana camara* Leaves Collected from Tropical Region of Malaysia. *Evidence-Based Complementary and Alternative Medicine*, *2015*, e506413. https://doi.org/10.1155/2015/506413
25. Tlak Gajger, I., & Dar, S. A. (2021). Plant Allelochemicals as Sources of Insecticides. *Insects*, *12*(3), Article 3. https://doi.org/10.3390/insects12030189
26. Váradi, L., Lin Luo, J., E. Hibbs, D., D. Perry, J., J. Anderson, R., Orenga, S., & W. Groundwater, P. (2017). Methods for the detection and identification of pathogenic bacteria: Past, present, and future. *Chemical Society Reviews*, *46*(16), 4818–4832. https://doi.org/10.1039/C6CS00693K
27. Viegas, C., Moreira, R., Faria, T., Caetano, L. A., Carolino, E., Gomes, A. Q., & Viegas, S. (2019). Aspergillus prevalence in air conditioning filters from vehicles: Taxis for patient transportation, forklifts, and personal vehicles. *Archives of Environmental & Occupational Health*, *74*(6), 341–349. https://doi.org/10.1080/19338244.2018.1472545
28. Zare, Z. (2021). Investigating of Anti-bacterial and Anti-fungal Activities of Lantana camara L. Against Human Pathogens. *International Journal of Basic Science in Medicine*, *6*(4), Article 4. https://doi.org/10.34172/ijbsm.2021.25

Tables

Tables 2 and 3 are available in the Supplementary Files section.

Graph 1

Graph 1 is available in the Supplementary Files section.

Figures

Figure 1

Lantana camara

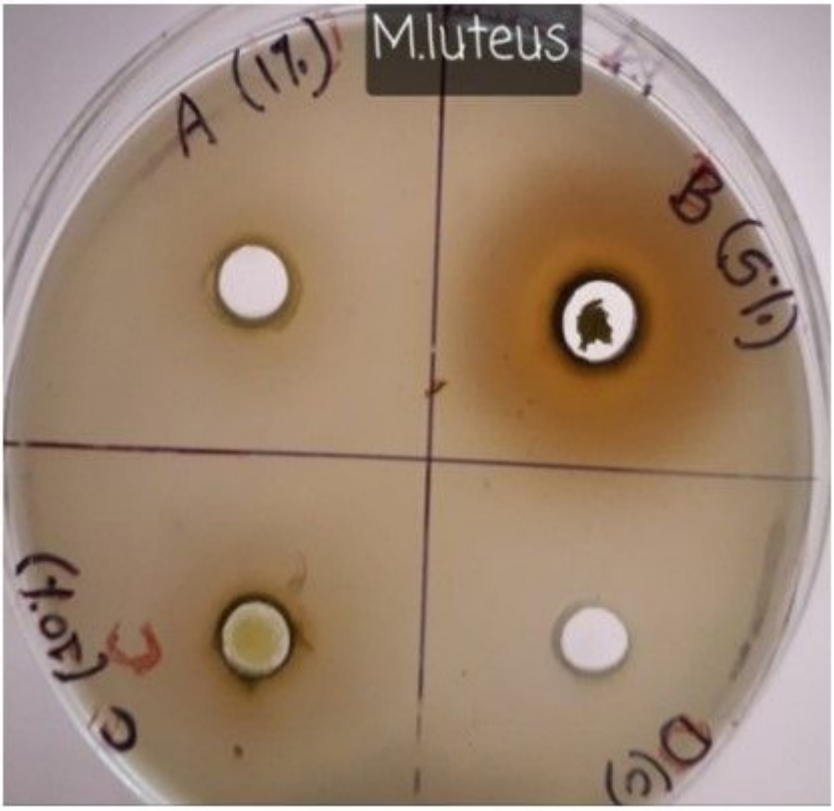

Figure 2

Antibacterial activity of extract of *L.camara* against *M. luteus*.

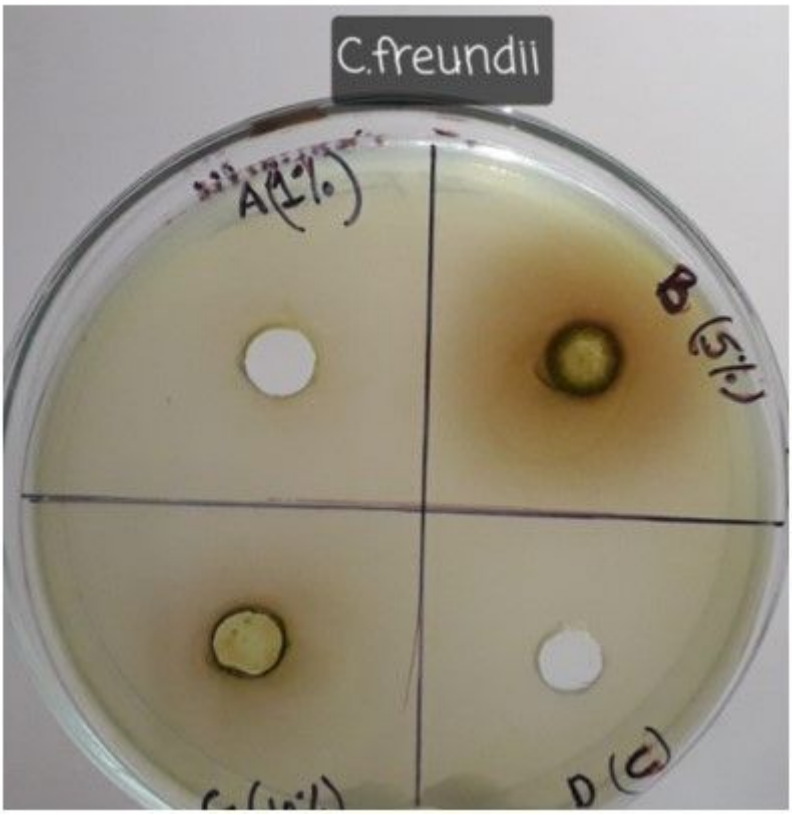

Figure 3

Antibacterial activity of extract of *L.camara* against *C. freundii*.

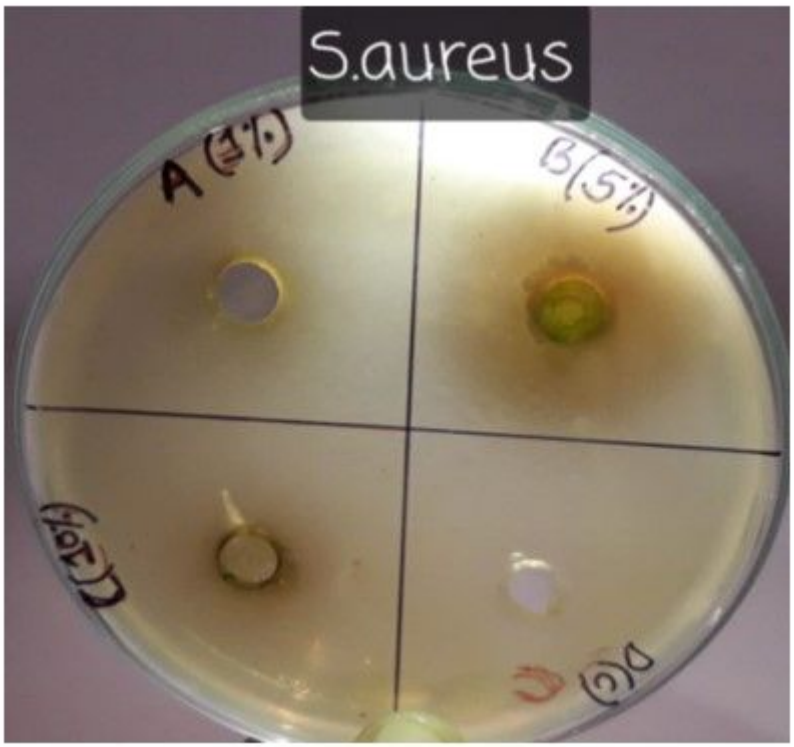

Figure 4

Antibacterial activity of extract of *L.camara* against *S.aureus*.

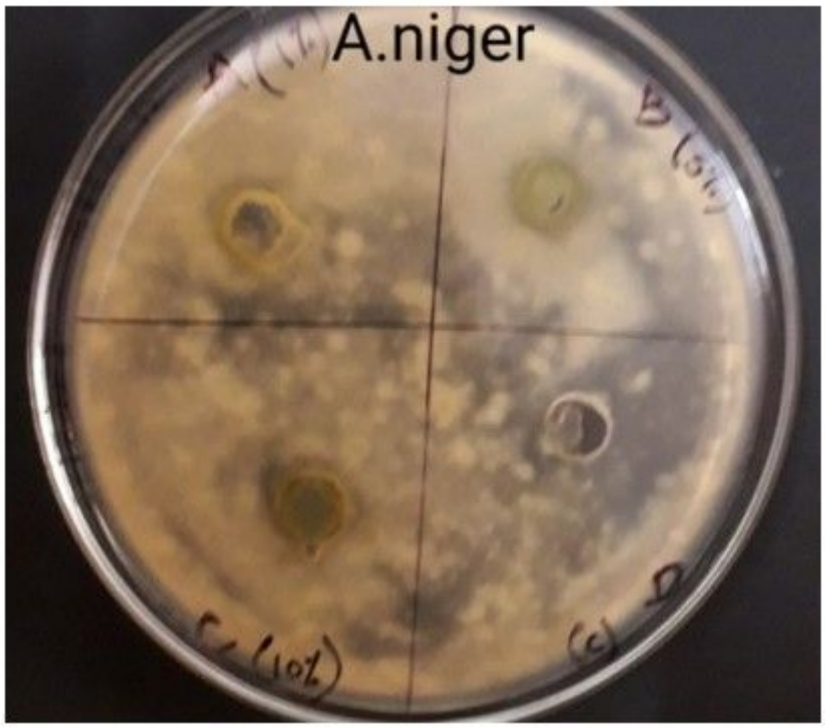

Figure 5

Antifungal activity of extract of *L.camara*against *Aspergillus niger*.

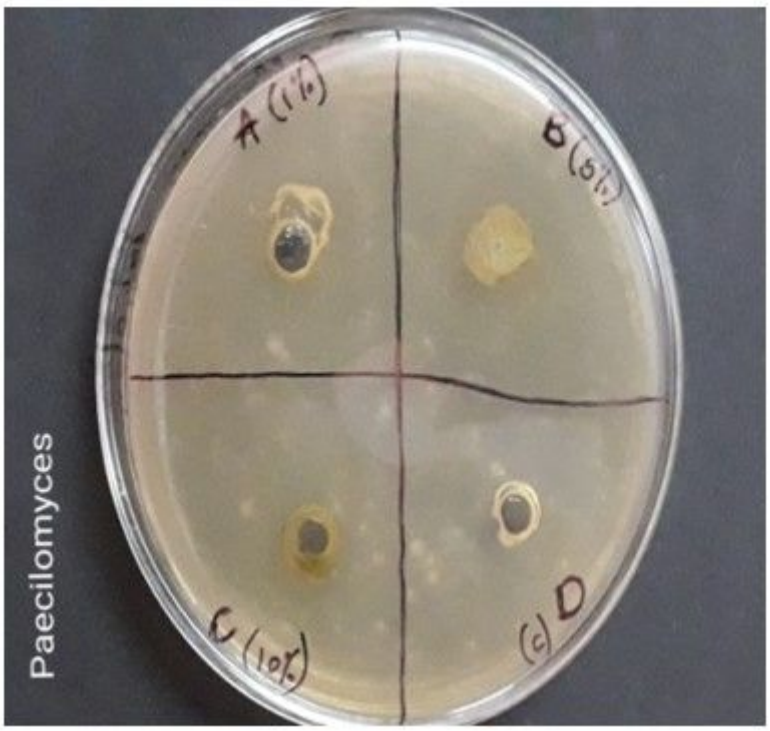

Figure 6

Antifungal activity of extract of *L.camara* against *Paecilomyces sinensis*.

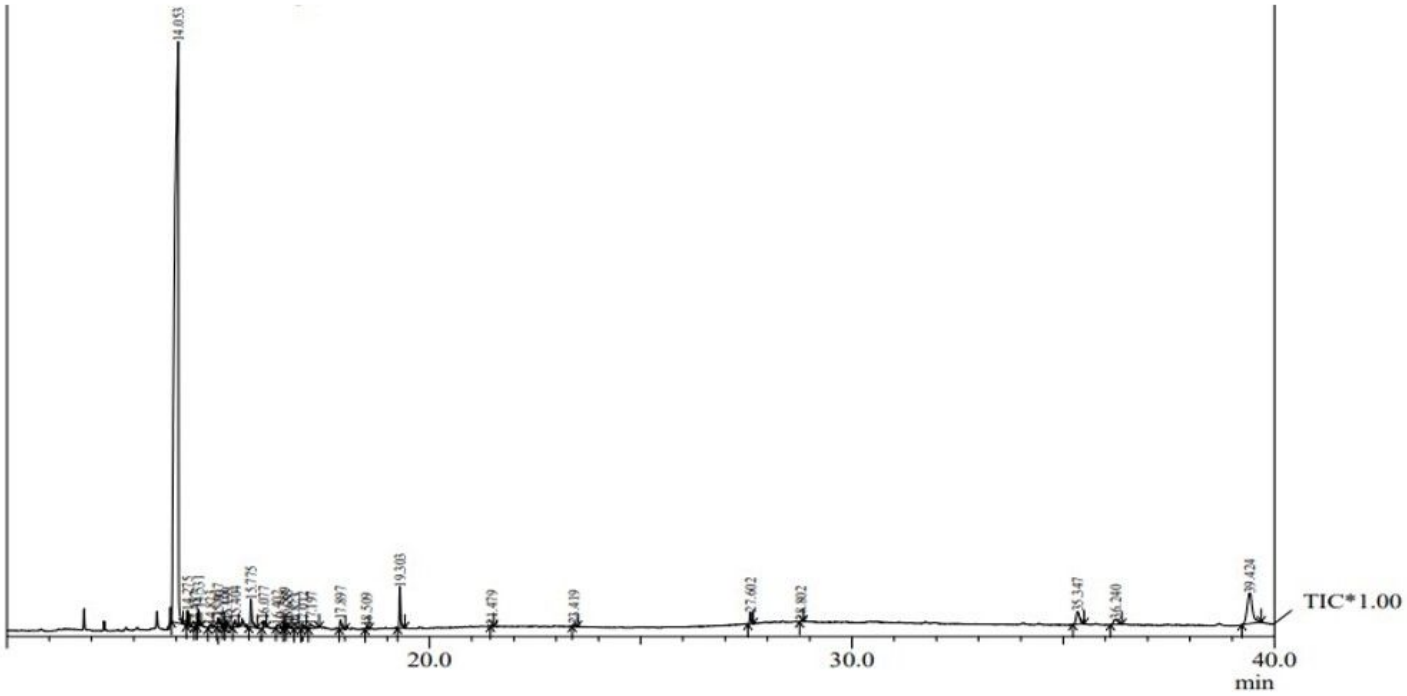

Figure 7

Chromatogram of ethanolic extract of leaf of *L.camara*

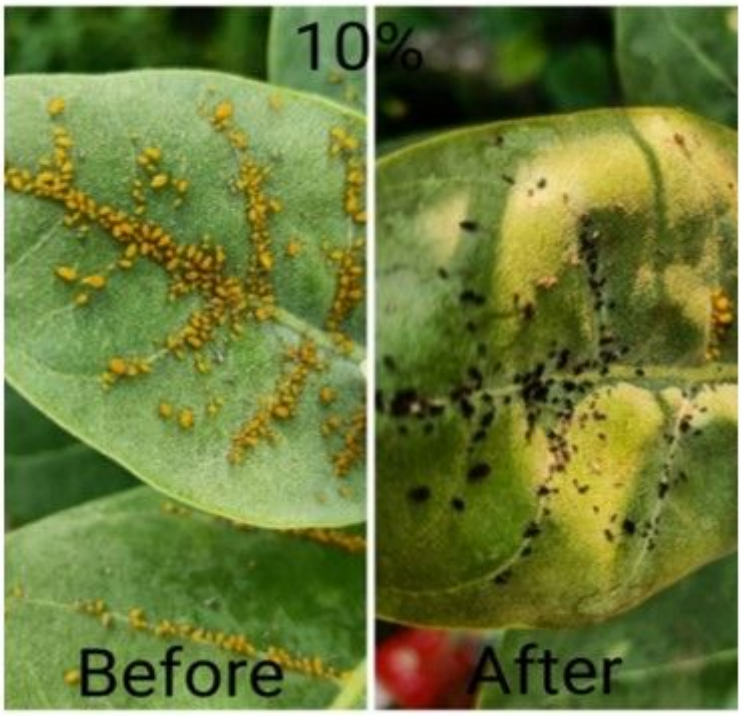

Figure 8

Plant- C*alotrope giganea* Insect**-** *Oleander aphid* Concentration- 10%

Figure 9

Plant- C*alotrope giganea* Insect**-** *Oleander aphid* Concentration- 5%

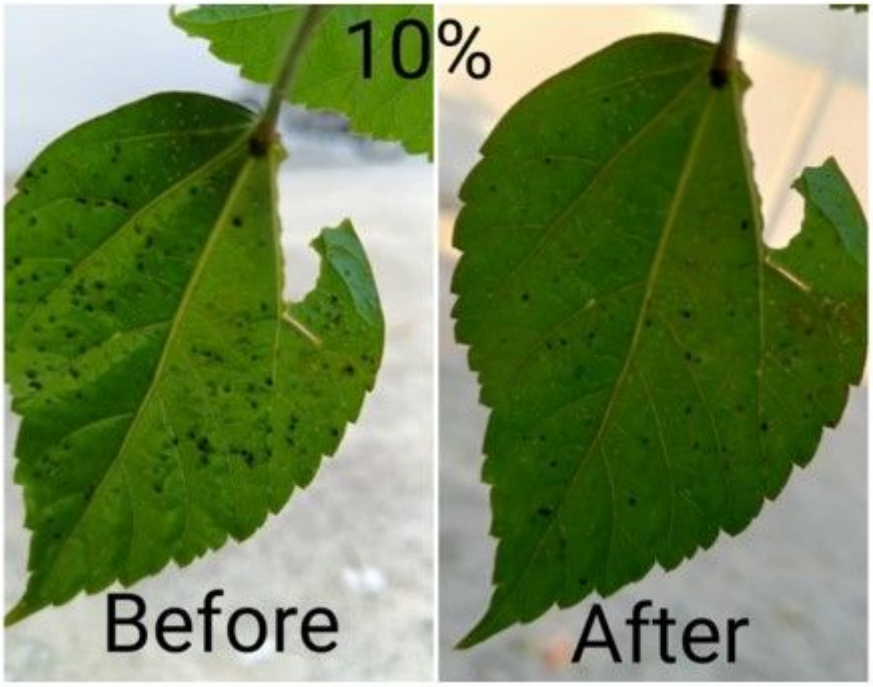

Figure 10

Plant- *Hibiscus rosa-sinensis* Insect- *Aphis fabae* Concentration- 10%

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Graph1.jpg
- Table.docx