Research Article **CODEN: AJPAD7** **ISSN: 2321 - 0923**

Asian Journal of Pharmaceutical Analysis and Medicinal Chemistry

Journal home page: www.ajpamc.com

https://doi.org/10.36673/AJPAMC.2024.v12.i02.A05

ALCHEMY OF THE LANTANA BLOOM: EFFERVESCENT POTIONS TO BANISH THE WINGED PLAGUE

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ABSTRACT

Mosquitoes are a global public health concern, with over 100 species spreading diseases like malaria, dengue, and chikungunya. Plant-based compounds such as essential oils, alkaloids and saponins have shown mosquito larvicidal and repellent properties using larvicidal assay. The life cycle of a mosquito consists of four distinct stages: egg, larva, pupa and adult, all of which need stagnant water to develop. Malaria, a potentially deadly illness caused by Plasmodium parasites, is spread through the bite of female Anopheles mosquitoes. *Lantana camara* Linn, a medicinal plant, has demonstrated larvicidal and adulticidal effects. Effervescent tablets containing natural larvicides offer an eco-friendly, long-lasting method to control larvae in stagnant water.

KEYWORDS

Effervescent tablets, Larvicidal assay, Mosquitoes, Malaria, Dengue, Stagnant water and Mosquito life cycle.

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INTRODUCTION

Mosquitoes represent a significant public health challenge globally, Out of the 3,500 documented mosquito species across the globe, more than one hundred are recognized as carriers of diseases that affect humans and other vertebrates. These mosquitoes are responsible for the transmission of diseases like malaria, dengue fever, yellow fever, filariasis, Japanese encephalitis, and chikungunya affects humans[1]. Research has demonstrated the efficacy of plant-derived secondary compounds. Saponins, isoflavonoids, essential oils, alkaloids and tannins have demonstrated effectiveness as mosquito larvicides. Moreover, plant-derived

compounds and their essential oils offer promising alternatives for mosquito repellent agents[2].

Life cycle of mosquitoes in still water

The mosquito life cycle, which includes the 4 distinct stages egg, larva, pupa, and adult begins with the egg stage, during which eggs may be laid singly along the waterline in soil or containers, or collectively in rafts floating on the water surface, with incubation periods varying significantly depending on habitat, geographic location, daylight exposure, temperature and mosquito species; Under peak summer conditions, most mosquito eggs usually hatch into larvae within 48 hours. However, eggs laid in the fall may survive through the winter, and some mosquito species lay eggs that can withstand drying out, staying viable for extended periods for months or even years in a dried state[3]. The larval stage, often referred to as "wigglers," requires stagnant water to complete development and progresses through four developmental in stages. During this stage, larvae breathe by using a siphon that allows them to reach the water's surface for air, while they feed on microorganisms and organic matter. Certain mosquito species possess unique piercing siphons that allow them to draw oxygen directly from the roots of aquatic vegetation. Following this is the pupal stage, known as "tumblers" due to their distinctive motion, where the mosquito transforms within a comma-shaped, non-feeding body that breathes through trumpet-like tubes and remains in this transitional form for only a few days. Finally, the adult or imago stage begins as newly emerged adults rest on the water surface to allow their wings to dry and harden, with most adults living when overwintering individuals can survive for 6 to 8 months live up to 3 weeks; notably, only female mosquitoes seek blood meals, which are essential for development, though the 1st egg batch can be produced autogenously without a blood meal, and females mosquitoes are capable of laying up to 20% eggs per meal across multiple reproductive cycles, whereas males live briefly, solely to mate, and do not feed on blood[4].

Malaria is a serious and potentially fatal illness caused by Plasmodium parasites, which are spread to humans through the bites of infected female Anopheles mosquitoes. The main species responsible include P. falciparum, P. vivax, P. ovale, P. malariae and P. knowlesi. Common symptoms include fever, headpain, nausea, vomiting, muscle pain, and fatigue. In severe cases, the disease can lead to complications such as organ failure, coma, or even death[5] Figure No.1.

NATURAL PRODUCTS

Lantana camara

Lantana camara Linn, a member of the *Verbenaceae* family and commonly referred to as wild sage, red sage, or lantana weed, is a plant whose various parts have been traditionally utilized for treating a narrow range of conditions. It is used to treat aliments such diseases and possess properties including anthelmintic, diaphoretic, febrifuge and carminative effects. It have shown potential in adulticidal and larvicidal activities for biological control, with its broadly ovate, opposite, and simple leaves emitting a strong odor when crushed-an attribute particularly relevant given that mosquitoes, which pose a significant public health threat globally, are often the target of such plant interventions[6].

A reaction occurs between an organic acid, such as citric acid, and a base, like sodium bicarbonate, resulting in the release of carbon dioxide, which facilitates the disintegration of the tablet and the subsequent dispersion of the larvicidal agent into the surrounding environment. This provides an effective, convenient, and potentially long-lasting method for controlling mosquito larvae in common breeding sites like stagnant water in bottles, old tires, or drainage areas[7]. These tablets, which can incorporate a variety of larvicidal agents including plant-based extracts like neem oil or other eco-friendly compounds, not only provide ease of use and transport, but also offer the benefit of sustained residual activity that continues to inhibit larval development post-application, making them a promising and environmentally considerate alternative to conventional synthetic pesticides[8] Figure No.2.

MATERIAL AND METHODS

Collection and authentication of the Flower specimen

The Flower specimen was collected from the forest of Kolli Hills in Namakkal, Tamil Nada and the same was authenticated. It is important to keep flower in a clean and hygienic place to prevent contamination.Since mould produces aflatoxins, attention should be paid to preventing mould growth.

The Flower Material

All unwanted substances like stones, dust, dirt, sand and other debris must be thoroughly eliminated before herbal products are cut or ground for testing Figure No.3.

THE PLANT EXTRACT

EXTRACTION

The process of separating secondary metabolites or active flower components is called extraction of medicinal herbs[9]. It is possible to isolate bioactive compounds like terpenes, alkaloids, flavonoids, saponins, steroids and glycosides from otherwise inactive or inert materials[10].

PRE-EXTRACTION FLOWER SAMPLE PREPARATION

In medicinal plant research, flower samples must first be prepared prior to extraction to ensure the preservation of the plant's biomolecules. Examples of plant material that can be obtained from dried fresh plant material are leaves, bark, roots, fruits and flowers. The shelf life of phytochemicals in final goods is impacted by further pre-treatments of plant products, such as drying and grinding[11].

MACERATION

In this extraction method, a container is filled with coarsely powdered plant material (such as flowers), and a solvent (menstruum) is added until the material is fully submerged. The container is then sealed and allowed to stand for at least seven days[12]. The mixture should be stirred regularly, and if kept in a bottle, it should be shaken occasionally to promote thorough extraction.Following the extraction process, the liquid extract, known as the micelle, is separated from the solid residue, called the mare, using either decantation or filtration. The micelle is then concentrated by evaporating the solvent, either using an oven or a water bath. This method is especially suitable and effective for thermolabile (heat-sensitive) plant materials[12]. For thermolaible plant material, this approach is very practical and appropriate.

INFUSION

This extraction technique is comparable to maceration. The plant material is finely powdered and placed into a sterile container, after which it is soaked in an extraction solvent-either hot or cold-and allowed to stand for a brief duration[12]. This method is well-suited for extracting bioactive compounds that dissolve easily. It is also an effective approach for preparing fresh extracts in advance. The solvent-to-sample ratio, which can range from 4:1 to 16:1, is typically adjusted based on the specific requirements and objectives of the intended application[13].

Ultrasound-assisted extraction

This method uses sound energy at frequencies above 20 kHz to enhance solvent penetration by increasing the drug's surface area and breaking down flower cell structures, thereby facilitating the release of secondary metabolites. Before the extraction process begins, it is essential that the plant material undergoes thorough drying, followed by grinding into a fine powder and appropriate sieving to ensure uniform particle size; once these preparatory steps are completed, the processed sample is then combined with a suitable solvent and transferred into the ultrasonic extractor for further treatment[14].

Microwave-assisted extraction:

This is a modern and sophisticated extraction technique commonly used for processing medicinal plants. It functions by inducing dipole rotation and ionic migration, enabling the movement of charged particles within both the plant material and the solvent. This method is particularly effective for extracting flavonoids. The process involves the use of electromagnetic radiation with frequencies

ranging from 300 MHz to 300 GHz and wavelengths between 1cm and 1mm[15] Table No.1.

Larvicidal activity study

Mosquitoes are vectors of diseases that causes major health issues in humans and the development of resistance to chemical pesticides prompted a quest for alternate control methods measures. As a result, research is centred on discovering newer pesticides that will be effective, safe, and environmentally friendly also easily accessible at a minimal cost. There are numerous plants create additional components with insect properties Growth inhibition is a property of a substance. Aside from the use of such agriculture insect pest control compounds substances, its application in mosquito larvae control is an example interesting point of view. Many plants extract has been researched for their ability to kill larvae[16].

Life cycle of Aedes aegypti

The Aedes aegypti mosquito undergoes a complete metamorphic life cycle, consisting of four stages: eggs, larvae, pupae and adults Figure No.4.

Eggs

Female Aedes aegypti mosquitoes deposit their eggs on the inner surfaces of water-containing items, including artificial containers, flower vases and old tires.

Larvae

Within a few days, the eggs hatch into larvae that live in water. These aquatic larvae feed on organic debris and microorganisms found in their environment.

Pupa

After completing the larval stage, mosquitoes enter the pupal stage, during which they remain aquatic but do not feed, as this phase serves primarily as a transitional, resting period in which the organism undergoes metamorphosis into its adult form.

Adults

The pupae develop into adult mosquitoes. Aedes aegypti adults are known for their distinctive black and white striped appearance. Female mosquitoes require a blood meal for egg development and they host for blood-feeding[17].

Larvicidal assay

The experiment was carried out with test concentrations of 10, 20, 30, 40 and 50mg/ml of successive extracts namely hydroalcoholic, ethanolic and aqueous-of Lantana camara (L.). For each concentration, 1ml of the respective extract was added to a beaker and the final volume was adjusted to 250ml with water. Twenty larvae were introduced into each concentration setup. Larval mortality was monitored and documented at specific time intervals-0, 1, 2, 3, 6, 12 and 24 hours after treatment-and the corresponding percentage mortality was calculated, while a water-only control group was maintained to provide a basis for comparison; all experimental procedures were performed in triplicate, with the mean values used for subsequent analysis[18].

Larvicidal activity study

The term "larvicidal" denotes the ability or effectiveness of a substance or agent to kill or suppress the larvae of insects, especially mosquito larvae, thereby interrupting their life cycle and preventing their maturation into adult insects. Larvicidal measures play a crucial role in controlling insect populations, specifically targeting the larvae stage of development. This approach is particularly significant in combating disease vectors like mosquitoes, as it disrupts their life cycle and helps mitigate the spread of diseases such as malaria and dengue fever. Larvicidal agents can vary from chemical insecticides to biological control techniques, aiding in the development of efficient and precise pest control strategies. Understanding and implementing larvicidal interventions are key components of integrated pest control programs worldwide.

Larvicidal using *lantana camara* linn. Extract

Research has shown promising larvicidal activity using, *lantana camara* Linn. Extract. The extract *lantana camara* Linn, a commonly found green leafy vegetable, has showed effectiveness in suppressing the growth and maturation of mosquito larvae. The bioactive compounds present in the extract, such as secondary metabolites, may disrupt the physiological processes of the larvae, leading to larval mortality Studies have explored the potential

of *Lantana Camara* Linn. Extract as an eco-friendly and sustainable alternative to synthetic larvicides. The extract's effectiveness underscores its possible use in mosquito control programs, emphasizing the importance of harnessing natural sources for larvicidal activity. Further research is ongoing to understand the specific mechanisms involved and to optimize the use of *lantana camara* Linn. Extract in mosquito larval control strategies[19] Table No.2.

WET GRANULATION

Mixing and Granulation

The Lantana camara extract is combined with mannitol, dextrose, citric acid, tartaric acid, sodium bicarbonate, and sodium lauryl sulphate in an appropriate mixer. A suitable granulating agent is added gradually to form a cohesive wet mass, which is then passed through a sieve to produce uniformly sized granules.

Drying and Sieving

The granules are dried at a controlled temperature to eliminate any remaining moisture. After drying, they are sieved once more to ensure consistent particle size.

Lubrication

The dried granules are mixed with stearic acid, serving as a lubricant to enhance flow characteristics and prevent adhesion during tablet compression.

Compression

The lubricated granules are transferred to a tablet press, where they are compressed into uniform effervescent tablets with specific hardness and dissolution attributes. The finished tablets are stored in airtight containers to protect against moisture and preserve their effervescent quality.

RESULTS AND DISCUSSION

AUTHENTICATION OF PLANT SPECIMEN

The collected specimen was authenticated as Lantana camara (L.) by Dr. M. 1. SHARIEF SCIENTIST F and HEAD OF OFFICE, botanical survey of India.

Southern regional Centre Coimbatore-641003 Authentication no: BST/SRC/5/23/2024-25/Tech/455 Figure No.5.

LARVICIDAL STUDIES

Alcohol, hydro-alcoholic and aqueous extracts of the flowers of Lantana camara Linn were evaluated for its larvicidal properties at 10, 20, 30, 40, 50µg/ml against third and fourth instar larvae of Aedes aegypti. The study period was 5 hours and the percentage of mortality was calculated at various intervals. The evaluation clearly shows both the extracts exhibits good larvicidal property.

The larvicidal activity of the effervescens tablet was conducted through a series tests aimed at evaluating its efficacy in eliminating larvae Table No.3.

Table No.1: The extractive value of *Lantana camara* Linn flowers vary depending on the solvent used

S.No	Solvent	Extractive values
1	Ethanol	16.5%
2	Methanol	14.5%
3	Chloroform	11.4%
4	Acetone	11.7%
5	Water	8.9%

LARVICIDAL EFFERVESENT TABLET FORMULLATION

Table No.2: List of material used in the study and its suppliers

S.No	Material	Manufactures
1	Citric acid	Nice chemicals, Kochi
2	Dextrose	Nice chemicals, Kochi
3	Lantana camara extract	Laboratories
4	mannitol	Nice chemicals, Kochi
5	Sodium lauryl sulphate	Nice chemicals, Kochi
6	Sodium bicarbonate	Nice chemicals, Kochi
7	Steric acid	Nice chemicals, Kochi
8	Tartaric acid	Nice chemicals, Kochi

Formulation of efferverscent tablet

S.No	Ingredients	Working Formula
1	L.Camara flower extract(mg)	50
2	Mannitol(mg)	40.5
3	Steric acid(mg)	4
4	Dextrose(mg)	10.5
5	Sodium lauryl sulphate(mg)	5
6	Citric acid(mg)	35
7	Tartaric acid(mg)	40
8	Sodium bicarbonate (mg)	65

Preparation of tablet in three steps

Table No.3: Treatment, concentration and Percentage mortality in hours given below

S.No	Treatment Control	Concentration (mg\ml)-	Percentage Mortality				
			0 hr	1 hr	2 hr	3 hr	4 hr
			0	0	0	0	0
1	Lantana camara Linn Whole parts of hydroalcoholic Extract	10mg/ml	0	0	0	5	10
		20mg/ml	0	0	1	5	10
		30mg/ml	0	0	1	8	9
		40mg/ml	0	1	1	8	10
		50mg/ml	0	1	2	8	9
2	Lantana camara Linn Whole parts of ethanolic Extract	10mg/ml	0	0	0	7	9
		20mg/ml	0	0	1	5	10
		30mg/ml	0	1	1	5	9
		40mg/ml	0	1	2	7	10
		50mg/ml	0	1	2	7	10
3	Lantana camara Linn Whole parts of aqueous Extract	10mg/ml	0	0	0	6	9
		20mg/ml	0	1	1	5	9
		30mg/ml	0	1	1	8	9
		40mg/ml	0	1	2	8	10
		50mg/ml	0	1	2	9	10

Larvicidal Assay

S.No	Tablet with mg	First larva dead time (min)	100 larva Dead time (min)	After 1hr 100 Larva Killing time (min)	After 24 hr 100 larva Killing time (min)
1	250mg	4.20 min	78 min	100 min	420 min
2	500mg	3.70 min	76 min	95 min	412 min
3	750mg	3.50 min	75 min	97 min	400 min
4	1000mg	3.23 min	70 min	90 min	390 min

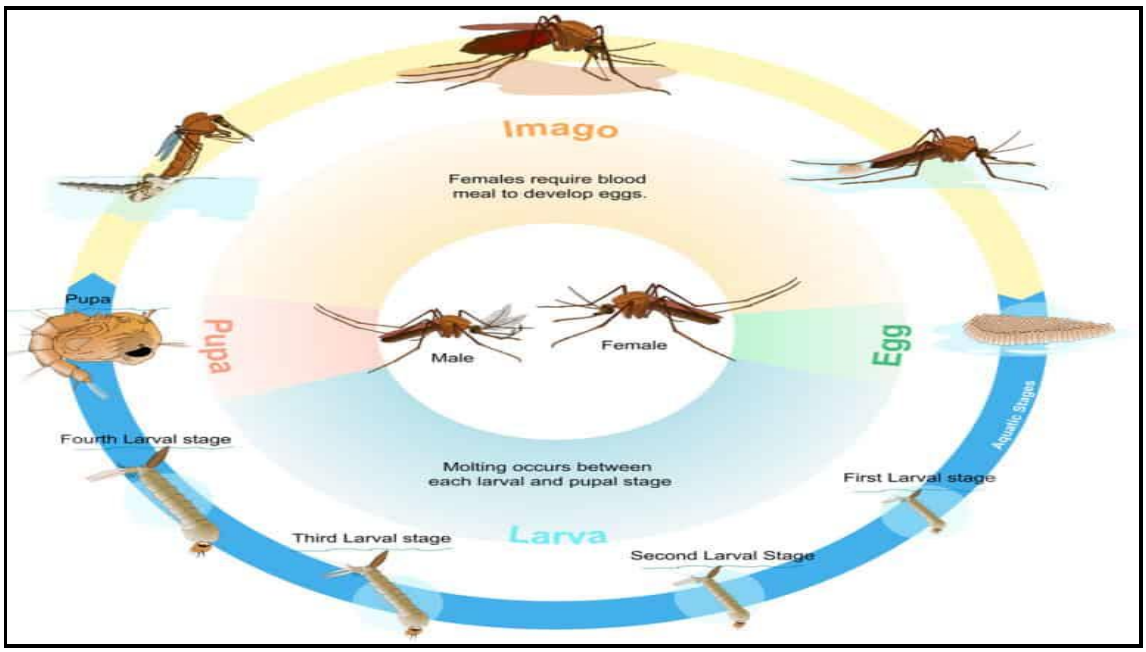

Figure No.1: Life cycle of mosquitoes in still water

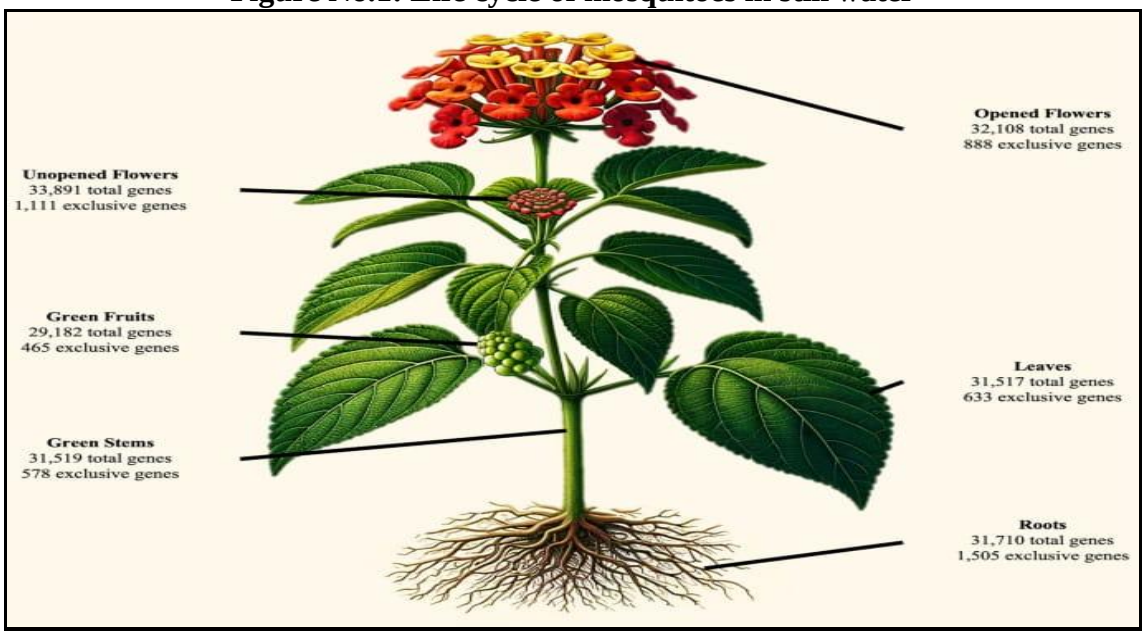

Figure No.2: Plant of Lantana Camara

Figure No.3: *Lantana Camara* Flowerpart

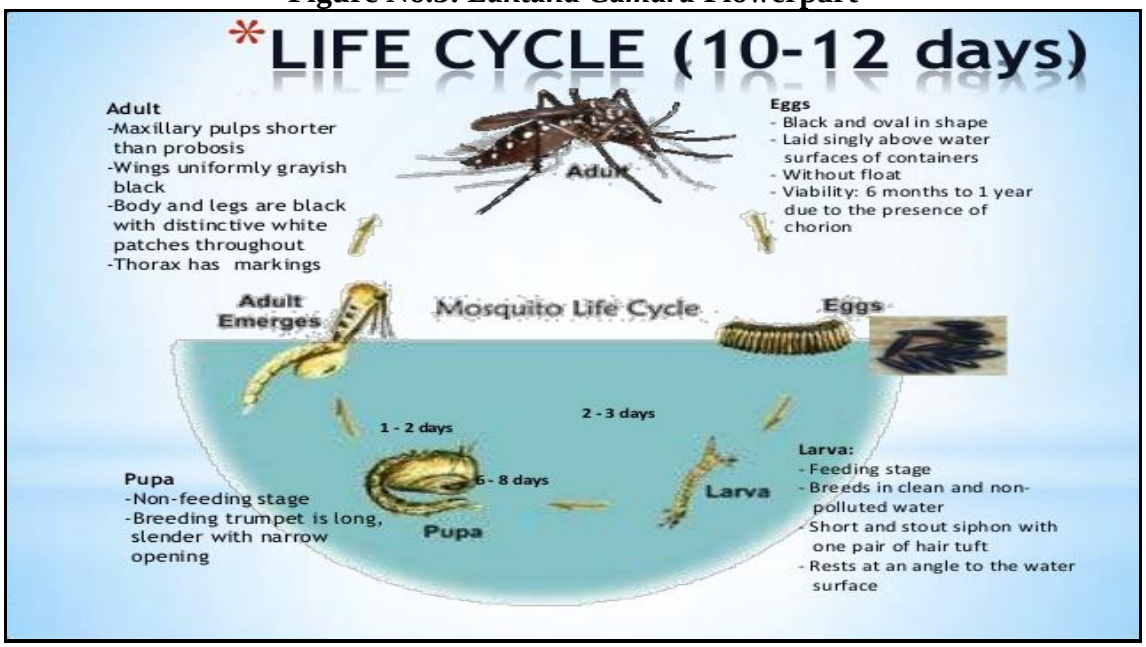

Figure No.4: Life cycle of aedes aegypti

THE PLANT MATERIAL

Figure No.5: Lantana camera linn flower extract

SUMMARY AND CONCLUSION

The collected specimen was authenticated as *Lantana camara* (1) by Dr. M. U. Sharief Scientist Fand Head of Office, botanical survey of India, Southern regional Centre Coimbatore-641003, Authentication no, BSI/SRC/5/23/2024-25/Tech/455.

The dried plant materials were extracted using hydro alcohol ethanol, and aqueous solvent by maceration technique

Hydroalcoholic extract: 8%

Ethanolic extract: 8.2%

Aqueous extract: 10%

Alcohol, hydro-alcoholic and aqueous extracts of the flowers of *Lantana camara* Linn were evaluated for its larvicidal properties at 10, 20, 30, 40, 50µg/ml. Against third and fourth instar larvae of AEDES Aegypti. The study period was hours and the percentage of mortality was calculated at various intervals.

The study focused on developing larvicidal effervescent tablets containing *Lantana camara* flower extract for mosquito larval control. The extract, known for its bio-insecticidal properties, was formulated with excipients like mannitol, citric acid, tartaric acid and sodium bicarbonate through wet granulation, lubrication and compression techniques. This eco-friendly approach offers an effective, safe and sustainable alternative to synthetic insecticides for mosquito population management. The study concludes that the prepared effervescent tablets offer a promising and eco-friendly approach for mosquito larval control with improved patient compliance and efficacy.

Hydroalcoholic, ethanolic and aqueous extracts of the flowers of *Lantana camara* (L.) was found to be significant against the larvae.

From the result of the present study, it is concluded that *lantana camara* (L) flowers possess significant larvicidal properties.

ACKNOWLEDGEMENT

The authors are thankful and express their sincere gratitude to Senghundhar College of Pharmacy, Kumaramangalam, Namakkal, India for providing required facilities to carry out this research work.

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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Please cite this article in press as: Astalakshmi N *et al*. Alchemy of the Lantana Bloom: Effervescent potions to banish the winged plague, *Asian Journal of Pharmaceutical Analysis and Medicinal Chemistry*, 12(2), 2024, 51-60.