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Study of Mosquito Larvicidal Effects of *Momordica charantia* (Bitter Gourd) Extracts as Nanopowder

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Abstract: Mosquitoes act as a vector for most of the life threatening diseases like malaria, yellow fever, dengue fever, chikungunya ferver, filariasis, encephalitis, West Nile Virus infection, *etc*. Worldwide emphasis is given on the application of alternative strategies in mosquito control. The continuous application of synthetic insecticides causes development of resistance in vector species, biological magnification of toxic substances through the food chain and adverse effects on environmental quality and non target organisms including human health. Application of active toxic agents from plant extracts as an alternative mosquito control strategy was available from ancient times. These are nontoxic, easily available at affordable prices, biodegradable and show broad-spectrum target-specific activities against different species of vector mosquitoes. In this research work, the mosquito larvicidal activity of *Momordica charantia* (bitter gourd) fruit extracts in the form of nanopowder have been studied.
Keywords: Mosquito, larvicide, mortality, bitter gourd.

Introduction

Mosquitoes are among the well known group of insect vectors that transmit deleterious human diseases, which pose as the major public health challenges eroding development in the poorest countries of the world[1]. The medical importance of mosquitoes as vectors for the transmission of serious diseases that cause morbidity, mortality, economical loss, and social disruption such as malaria, lymphatic filariasis, and viral diseases is well documented[2]. The best way of reducing the incidence of these diseases is by mosquito control, which is frequently dependent on applications of conventional synthetic insecticides[3].

In the past, synthetic organic chemical insecticides-based intervention measures for the control of insect pests and disease vectors have resulted in development of insecticide resistance in some medically important vectors of malaria, filariasis and dengue fever[4].

The frequent use of chemical insecticides to manage insect pests leads to a destabilization of the ecosystem and enhanced resistance to insecticides in pests[5] suggest a clear need for alternatives. Plants are the chemical factories of nature, producing many chemicals, some of which have medicinal and pesticidal properties[6]. The insecticidal and acaricidal properties of a number of plants have been discovered a long ago, and some of the plants can compete with synthetic means of control[7].

Momordica charantia is a tropical vine of the family Cucurbitaceae widely grown for edible fruit, which is among the most bitter of all vegetables. An English name for the fruit is bitter melon or bitter gourd. The fruits of Momordica charantia contain Charantin, Polypeptide - p as its constituent elements and also the leaves of the plant contains Charantin, Polypeptide- p as the main component whereas seeds contains Charantin, Polypeptide - p along with Vicine as its constituents[8].

Momordica charantia extracts using Hexane has shown good larvicidal activity against three container breeding mosquitoes - *An.stephensi, Cx. quinquefasciatus* and *Ae. aegypti* in laboratory experiments[9]. The present study showed that nanopowder synthesized from *Momordica charantia* methanol extracts acts as an effective and eco-friendly mosquito larvicide.

Experimental

Collection and processing of *Momordica charantia* fruits

Fresh fruits of *Momordica charantia* were obtained directly from the plants in field located in Melmaruvathur village in Tamilnadu. Methanol extracts of fresh fruits of *Momordica charantia* were used in the experiments. One kilogram of thoroughly washed and cleaned fresh fruits were cut into small pieces and immediately ground using a pestle and mortar.

Experimental Set Up

The experimental set up consists of a condenser, a Soxhlet extractor, and around bottomed flask. A Soxhlet extractor is a laboratory apparatus for the extraction of lipids and other molecules from a solid sample. Soxhlet extraction procedure thus allows a compound to be extracted from insoluble material using a chemical solvent. They are typically used for the extraction of plant materials.

Extraction

Methanol extract was obtained by extraction of 500 g of ground fruits in 500 ml of methanol using Soxhlet extraction apparatus. The ground material to be extracted was placed inside the Soxhlet extractor using a small pouch made of cotton cloth and methanol solvent was filled in the round bottom flask. A continuous water supply was given to the apparatus. It was fixed in a mantle and heated up to 500°C. Vapour was produced and condensation starts when vapour was contacted with cooling water. The condensate was passed through the ground material packed in the cotton cloth and extraction take place. After about 5 hours, the round bottom flask contains the extract and methanol solvent. The extract was then separated from methanol by vacuum distillation. It was mixed with gum Arabic in order to solidify it and was dried in oven. The dried material was powdered using an electric blender followed by finer grinding in a ball mill.

The powdered material was converted to nanosize by size reduction using a planetary ball mill. The product from planetary ball mill was analyzed for particle size by using particle size analyzer equipment. If it was above nanosize, it was repeatedly grinded in the mill till the confirmation of nanosize by particle size analyzer. The size was noted as 92.7 nm on an average.

Mosquito Culture

Fourth instar larvae of *Culex pipiens* were collected from stagnant water area to start the colony, and larvae were kept in plastic and enamel trays containing tap water. They were maintained and the experiments were carried out at 27 ± 2ºCand 75 to 85% relative humidity under 14:10 light and dark cycles. Larvae were fed with a diet of brewer's yeast and biscuits.

Mortality Testing

The nanopowder obtained was tested against the mosquito larvae. The mortality test was conducted with three beakers each having 200 ml of makeup distilled water with product. A control beaker and two test beakers containing larvae in each beaker with *Momordica charantia* nanopowder were used for every set of three replicates. Two different concentrations of the product viz., 5 mg/L and 10 mg/L were used for the test and the control beaker contains only pure distilled water. Each of these beakers was fed with 25 mosquito larvae. The effect of the nanopowder was assessed by counting of dead larvae within the interval of two hours in 24 hours and the percentage mortality was reported from the average of a set of three replicates.

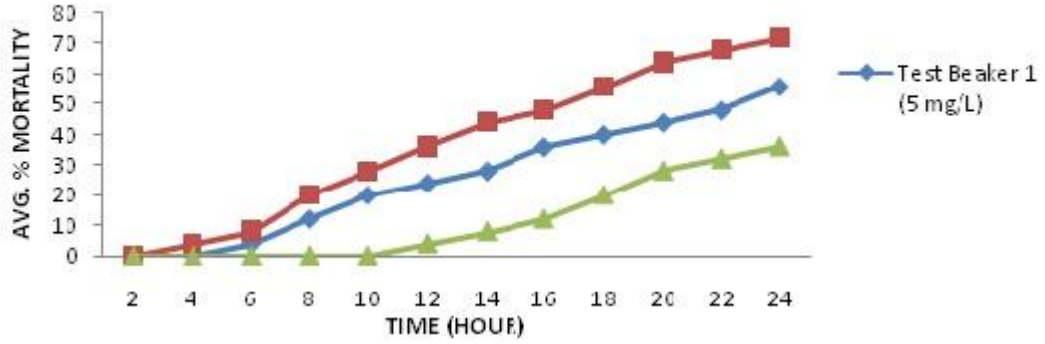
Early fourth instar larvae of *Culex pipiens* (common household mosquito), colonised in the insectary being maintained at Zonal Entomological Centre, Vellore, were used in all bioassays.

Results and Discussion

Mortality Test Results

The larvicidal mortality was noted after every 2 hours for 24 hours of exposure. The results are presented in the graph in (Figure- 1).

Figure 1: Average % Mortality of mosquito larvae using *Momordica charantia* nanopowder



In this study, it was observed that *Momordica charantia* nanopowder has shown a good mortality against fourth instar larvae of *Culexpipiens*. The graph indicates that 5 mg/L and 10 mg/L concentration of *Momordica charantia* has caused a maximum of 56% and 72% mortality respectively within 24 hours.

Conclusion

In conclusion, our findings showed that nanopowder obtained from *Momordica charantia* extract can be used as an effective mosquito larvicide against the fourth instar larvae of common household mosquito species *Culex pipiens*. This herbal mosquito larvicide was also cost effective as the raw materials required (bitter gourd fruits) are easily available and its usage leads to an effective ecofriendly approach in curbing the mosquito menace.

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