

Insect Growth Regulator Activity of Cassava Plant *Manihot esculenta* Extracts Against *Culex quinquefasciatus*

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ABSTRACT

Background: The major tool in mosquito control operation is the application of synthetic insecticides, they develop resistant after repeated applications. The use of biological control method is to use natural enemies or predators for managing mosquito populations. *Culex quinquefasciatus*, also known as the southern house mosquito which causes various disease to human. **Methods:** The *M. esculenta* leaves were washed and dried. They were extracted with ethanol and evaporated. The plant extract was tested against 25 numbers of early 2nd instar larvae of *Cx. quinquefasciatus*. The plant extract was diluted to 250 ml dechlorinated water to obtain the test solution of 40, 80, 120, 160 and 200 ppm. The percentage emergences at different concentration of plant extract were recorded. The LI50 (larval inhibition) was calculated. Statistical analysis of the experimental data was performed using the computer software Stat Plus 2009 to find the lethal concentration against larvae (LC50 and LC90) out in 24 hours by probit analysis with a reliability interval of 95%. **Results:** The larvae of *Cx. quinquefasciatus* were exposed to different concentrations of *M. esculenta* plant extract viz., 40, 80, 120, 160 and 200 ppm. The larvae emergence inhibition was 6, 14, 26, 68 and 89 per cent at 40, 80, 120, 160 and 200 ppm. The EI50 and EI90 values of *M. esculenta* against *Cx. quinquefasciatus* were 139.44 and 208.76 ppm, respectively. The chi-square value was 7.46, which showed that the IGR activity was significant at 0.05 % level. **Conclusions:** In the present study, *Cx. quinquefasciatus* larvae exposed on *M. esculenta* to find out IGR activity. The results of the present study revealed that the plant extract showed good insect growth regulatory (IGR) activity against larvae of *Cx. quinquefasciatus*. The *M. esculenta* could have delayed development may be by acting as a growth hormone suppressant or could have disrupted the feeding activities of mosquito species.

Keywords: Insecticides, *M. esculenta*, Insect growth regulators, LC50, plant extracts

INTRODUCTION

Insect growth regulator (IGR) is a chemical substance that mimics juvenile hormone of the insects to prevent further development of insects. There are some 30 reports of IGR against mosquitoes. Al-Zahrani et al.(2019) investigated *Aedes aegypti* mosquito larvae against three insect growth regulators (IGRs) Diflox flowable, Baycidal and Sumilarv as well as three plant extracts, *Thevetia neriifolia*, *Plumeria acuiifolia* and *Lantana camara*. According to values of IC50 (the concentration that inhibited the emergence of 50% of adults), the IGR of Diflox flowable (0.0028 ppm) proved to be more effective against mosquito larvae of *Ae. aegypti* than Baycidal (0.0033 ppm). The plant extract *T. neriifolia* proved to be more effective against *Ae. aegypti* larvae, followed by *P. acuiifolia*

and *L. camara* by about 1.3 and 3.7 folds, respectively. This was highly pronounced on the basis of IC50 values obtained (85.5 ppm, 108.7 ppm and 317.4 ppm). Thus, the tested IGRs and plant extracts exhibited promising larvicidal activity and can be used as alternatives for mosquito control.

Shazad et al.(2018) stated that when the *Ocimum sanctum* extract were treated on larvae of *Ae. aegypti*, it revealed moderate toxicity. The treatment with the extract also had an adverse impact on the growth and development of the larvae. Consequently, there was an increase in the larval stage duration in the treated larvae. The developmental anomalies were observed in the treated fourth instar larvae. Olayemi et al.(2013) evaluated the potentials of the leaf-extract of *Carica papaya* as a larvicide and Insect Growth

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Regulator (IGR) against *Culex pipiens pipiens* mosquitoes. The results indicated larvicidal activity 24 hours post-exposure, with LC₅₀ and LC₉₀ of 25.49 and 49.68 mg/l, respectively. The sub-lethal concentration of the extract elicited significant ($p < 0.05$) growth regulatory effects against the mosquitoes. The findings of this study suggested that *C. papaya* was a promising source of lead compounds for sustainable mosquito vector control.

Kempuraj and Bhat (2011) reported that chemical analysis of acetone soluble fraction of seed extract of *Annona squamosa* contained ethyl oleate and iso-octyl phthalate as major components. The extract showed prominent adulticidal, larvicidal, ovicidal, ovipositional deterrent and chemosterilant activities against *An. albopictus*.

Mullai et al. (2008) studied the leaf extract of *Citrullus vulgaris* with different solvents viz, benzene, petroleum ether, ethyl acetate and methanol, which were tested for larvicidal, ovicidal, repellent and insect growth regulatory activities against *Anopheles stephensi*. The larval mortality was observed after 24 h exposure. The LC₅₀ values were 18.56, 48.51, 49.57 and 50.32 ppm, respectively. The mean percent hatchability of the eggs of *Anopheles stephensi* was observed after 48 h. 100 per cent mortality was exerted at 250 ppm with benzene extract, and the other extracts exerted 100 percent mortality at 300 ppm. Skin repellent test at 1.0, 2.5 and 5.0 mg per cm² concentrations gave the mean complete protection time ranging from 119.17 to 387.83 minutes for the four different extracts tested. The *Citrullus vulgaris* plant extract have shown insect growth regulatory activity against *Anopheles stephensi* at five different test concentrations ranging from 10 to 150 ppm with different solvents, and they exhibit the EI₅₀ values of 28.99, 70.02, 106.33 and 84.25 ppm, respectively.

According to Cooke, 1979 linamarin and lotaustralin, are the two different cyanogenic glucosides in cassava plant. Linamarin produces the toxic compound hydrogen cyanide (HCN) which can be hazardous to the consumer. Toxicity caused by free cyanide (CN⁻) has already been reported, while toxicity caused by glucoside has not. Oke, 1969 reports that linamarin and lotaustralin are β -glucosides of acetone cyanohydrin and ethyl-methyl-ketone-cyanohydrin,

respectively. Linamarin is the most representative glucoside accounting for about 80% of the total cassava glucoside.

MATERIALS AND METHODS

Collection of plants: The Cassava plant (*M. esculenta*) was collected near Chidambaram from C. Mutlur during the harvesting stages of the plant. The plant was authenticated by a taxonomist from the Department of Botany, Annamalai University. The identified plant was prepared and deposited as a voucher specimen number 366 at the Department of Zoology, Annamalai University.

Extraction of plant material: The leaves were washed and dried. The plant leaves (3.0 kg) were extracted with ethanol in a Soxhlet apparatus, and the extract was evaporated in a rotary vacuum evaporator to yield a dark greenish coloured mass. A standard stock solution of 1% was prepared by dissolving the residues in ethanol, which was used for the ovicidal and repellent bioassays.

Method of collection of mosquito larvae: The method adopted by Russel and Baisas (1935) was followed to collect the larvae from different habitats. To find out whether the habitats contained larvae or not, first water was collected with the help of white background spoon. If there were mosquito larvae in the water sample, the standard dipper of 250 ml capacity with 3 feet handle was used. One side of the dipper has a wire mesh through which water is filtered out and the larvae were retained inside. The larvae collections were carried out twice a month. Three dips were made in each spot. The collected larvae were placed in plastic containers and labelled. The nature of habitat, date and time of collection were noted. The larvae were identified at the generic level. The identified larvae were discarded and the unidentified larvae were reared in the laboratory for the confirmation at generic level. The presence or absence of larva and their abundance were noted.

The plant extract was tested for IGR activity against 25 numbers of early 2nd instar larvae of *Cx. quinquefasciatus* by following standard procedure (Amalraj et al., 1988). The plant extract was volumetrically diluted to 250 ml dechlorinated water to obtain the test solution of 40, 80, 120, 160 and 200



ppm. All larvae were monitored till adult emergence and were provided with larval food and observations were made at 24 hours intervals and dead larvae and pupae were removed daily and counted. Symptoms of test larvae such as convulsion, unnatural position, tremor, rigor, sluggish movement, failure of the body to balance in water and feeding were recorded at the time. The percentage emergences at different concentration of plant extract were recorded. The LI50 (larval inhibition) was calculated by Finney (1971).

RESULTS AND DISCUSSION

The *M. esculenta* was studied for IGR activity against *Cx. quinquefasciatus* and is represented in table 4.6. The larvae of *Cx. quinquefasciatus* were exposed to different concentrations of *M. esculenta* plant extract viz., 40, 80, 120, 160 and 200 ppm. The larvae emergence Inhibition was 6, 14, 26, 68 and 89 per cent at 40, 80, 120, 160 and 200 ppm plant extract concentrations, respectively. The EI50 and EI90 values of *M. esculenta* against *Cx. quinquefasciatus* were 139.44 and 208.76 ppm, respectively. The chi-square value was 7.46, which showed that the IGR activity was significant at 0.05 % level.

Insect growth regulators are chemicals that inhibit the moulting life cycle of insects. A large number of plant extracts has been reported to have growth regulator activity against mosquito vectors, but very few plant products have shown practical efficacy for mosquito control Olayemi et al., (2014). Thus, in the current study, we exposed *M. esculenta* on *Cx. quinquefasciatus* larvae to find out IGR activity. The results of the present study revealed that the plant extract showed good insect growth regulatory (IGR) activity against larvae of *Cx. quinquefasciatus*. The emergence Inhibition was 6, 16, 24, 68 and 89 per cent at 40, 80, 120, 160 and 200 ppm. The EI50 and EI90 values of *M. esculenta* against *Cx. quinquefasciatus* were 120.62 and 161.20 ppm, respectively. The *M. esculenta* could have delayed development may be by acting as a growth hormone suppressant or could have disrupted the feeding activities of mosquito species (MacRae, 2010).

TABLES

Table No. 1. Insect growth regulator (IGR) activity of *M. esculenta* plant extract against *Cx. quinquefasciatus*

Concentration (ppm)	Emergence Inhibition (%)	EI ₅₀ (ppm)	EI ₉₀ (ppm)	Regression Equation	95% confidence limit		x ²
					LCL (ppm)	UCL (ppm)	
					EI ₅₀ (EI ₉₀)	EI ₅₀ (EI ₉₀)	
40	6	139.44	208.76	Y=-2.578+0.018x	120.62(181.92)	161.20(262.23)	7.46
80	14						
120	26						
160	68						
200	89						



Control: nil mortality; EI: Emergence inhibition; LFL: lower fiducial limit; UFL: upper fiducial limit; χ^2 : Chi-square value; df: degrees of freedom.

SUMMARY

The larvae emergence Inhibition was 6, 14, 26, 68 and 89 per cent at 40, 80, 120, 160 and 200 ppm of *M. esculenta* plant extract concentrations, respectively. The EI50 and EI90 values of *M. esculenta* extract against *Cx. quinquefasciatus* were 139.44 and 208.76 ppm, respectively.

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