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LARVICIDAL ACTIVITY OF A PERENNIAL HERB, *SOLANUM XANTHOCARPUM* AGAINST THE LARVAE OF CULICINE SPECIES

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ABSRACT

Several plants indigenous to many continents are used as natural insecticides especially for the control of mosquitoes which carry pathogens causing human diseases.

In this study, Larvicidal activities of the fruit and root of a perennial herb, *Solanum xanthocarpum* on the fourth instar larvae of culicine species were carried out at various concentrations of 1ml, 2ml, 3ml, 4ml and 5ml . The bioassays were carried out following the methods recommended by World Health Organization, using the root aqueous extract at the volume of 1ml and 5ml for 24 and 48 hours of exposure. At 24 hrs of exposure, there were 36.6% and 66.6% mortality rates respectively. But after 48 hours of exposure, there were 90% and 100% mortality rates. At both 24 and 48 hours exposure of the culicine larvae, the mortality rates increased to 66.67%± 4.71 and 96.67%± 4.71 which showed a significant difference on the hours of exposure. At 1ml and 5ml volume of the fruit extract, the percentage mortality was 86.7% and 90.7% respectively after 24 hours of exposure while at the same volume, after 48 hours there were 90% and100% mortality rates respectively. At both 24 and 48 hrs of exposure of the larvae, there was high mortality rate of 90.00± 2.89 and 100.00± 2.89 (P.>0.05). However, there was a significant difference (P<0.05) between the percentage mortality rate of the fruit and root extracts, this revealed that the fruit of *S. xanthocarpum* have proved to be more efficient in the control of culicine larvae.

Keywords: *Solanum xanthocarpum*, Culicine, Fruit, Root, Mortality

INTRODUCTION

Mosquitoes transmit more diseases which affect millions of people throughout the world than any other group of arthropods (WHO, 1998). However, in 1992, World Health Organization (WHO) declared mosquitoes as public enemy number one. Mosquito borne diseases are prevalent in more than one hundred countries across the world, infecting over 700.000 people every year globally (Maharaj *et al.*, 2010). They act as a vector for most of the life threatening diseases like malaria, yellow fever, dengue fever, filariasis encephalitis etc. To prevent proliferation of mosquito borne diseases and to improve quality of the environment and public health, mosquito control is essential. The major tool in mosquito control operation is the application of synthetic insecticides such as organochlorine and organophosphate compounds. But this has not been successful due to human, technical and economic factors (Govindarajan, 2010). In recent years, the use of many of the former synthetic insecticides in mosquito control programme has been limited. It is due to high cost of synthetic insecticides, concern for environmental sustainability, harmful effect on human health and other non-target populations. These factors have resulted in an urge to look for environmental friendly, cost effective, biodegradable and target specific insecticides against mosquito species (Arivoli and Tennyson, 2011).

One of the most effective alternative approaches under biological control programme is to explore the flora biodiversity and enter the field of using safer insecticides of botanical origin as a simple and sustainable method of mosquito control (Harve *et al.*, 2004).

Approximately, 1,200 plants species have been described as having potential insecticidal value while Sukumar *et al*. (1991) listed and discuss 344 plant species that only exhibited mosquitocidal activity.

Simakova and Pankova (2008) reviewed the current state of knowledge on larvicidal plant species, extraction processes, growth and reproduction, inhibiting phytochemicals, botanical ovicides, residual capacity and effects on non-target organisms.

Adeiza *et al*. (2008) reported that more than 2000 plant species have been known to produce chemical factors and metabolites of values in pest control programmes. Members of the plant families include *Solanaceae, Labratae, Asteraceae, Miliaceae, Cladophoraceae, Oocystaceae and Rutaceae.* Phytochemicals are botanicals which are naturally occurring insecticides obtained from floral resources. The active toxic ingredients of the plant extracts are secondary metabolites that they are endowed with to protect them from herbivores. Some of their functions include the blockage of calcium channels in the cell membrane, hormonal imbalance and disruption of molecular events of morphogenesis. Applications of these plant phytochemicals in the control of mosquitoes have been in use since 1920s (Shahi *et al.*, 2010). The efficacy of phytochemicals against mosquito larvae can vary significantly depending on plant species, Plant parts used, age of plant parts (young, mature or senescent), solvent used during extraction affect the efficacy of plants used against vector species.

Therefore, this study was carried out to determine the larvicidal effect and at different concentrations of *S. xanthocarpum* on the larvae of culicine mosquitoes, since mosquitoes could be easily controlled at the larval stage.

MATERIALS AND METHODS

The research was carried out at the Federal University of Technology, Akure, Ondo State. Akure is the capital city of Ondo State, Southwest, Nigeria. It is situated at Longitude 50^0E and Latitude 70^0 N. The plant materials (*Solanum xanthocarpum)* were collected from Akure metropolis.

Collection of Mosquito Larvae

The second and third instar larvae stage of culicine species were collected from artificial sources of water within the University. After collection, they were transferred into the Laboratory and reared into the fourth instar stage.

Extraction of plant materials

The unripe fruits and the roots of *S. xanthocarpum* were weighed, blended and centrifuged at 270r.p.m. The suspensions were filtered using a fine muslin cloth. Serial dilution with distilled water were made from the stock solution to obtain different concentrations of 1.0, 2.0, 3.0, 4.0 and 5.0Mg/L

For the phytochemical analysis of the extraction, the extracts of fruit and root were gotten using ethanol and distilled water. 10g of the blended sample of both the fruit and root were weighed, each into a beaker and 60ml of the solvent added, covered and the mixtures were left for 72 hours. The extracts were separated from the filtrates using Whatman filter paper. The solvent were left to evaporate and the filtrates weighed to determine the percentage residue yield.

A total of ten (10) fourth instar larvae were introduced into a 500ml glass beaker containing various concentrations of the root and fruit extracts. The treatments replicated three times and each replicate set contain one control (5ml of distilled water).

Observations were made after 24 and 48 hours of exposure. The dead larvae from each concentration and replicates were counted and recorded.

Phytochemical screening

The extracts were screened for the presence of secondary metabolites and constituents using conventional protocol for detecting the presence of alkaloids, tannin, saponins and resins.

Data Analysis

The data obtained were statistically analyzed using one way ANOVA at 95% level of significance for the mean and Standard Error.

RESULTS

The results obtained from the phytochemical screening of the plants revealed the presence of Saponin and Alkaloids in the fruits and only Saponin in the roots (Table 1).

The highest mortality rate of 66.67% at 5ml volume and the lowest mortality rate of 36.67% at 1ml volume were obtained after 24 hours exposure of the larvae in the root extract while at 48 hours exposure of larvae, 96.67% and 100% mortality rates were obtained at 1ml and 5ml volume (Table 2).

The fruit extracts result showed that, after 24 hours exposure of larvae at 1ml concentration, the mortality rate was 86.67% and at 5ml concentration, the highest mortality rate was 90.00%. 100% mortality rates were obtained for 1ml - 5ml concentrations after 48 hours which showed a significant difference from the mortality rates obtained from root extracts (Table 3).

Table 1: Phytochemical composition of Ethanolic Extract of seed and root of *Solanum xanthocarpum*

Solanum Xanthocarpum	**Tannin**	**Saponin**	**Phlobatannin**	**Salkowski**	**Alkaloid**	**Keller-Kelani**	**Flavonoid**
Seed	-	+	-	-	+	-	-
Root	-	+	-	-	-	-	-

Key: Absent –
Present +

Table 2: Mortality rate of Culicine larvae at different concentration of Aqueous extract of *Solanum xanthocarpum* root.

Plant extracts	**Time(hr)**	**1ml**	**2ml**	**3ml**	**4ml**	**5ml**
of root	**24**	**36.67 ± 4.41b**	**40.00 ± 2.89c**	**53.33 ± 2.36c**	**63.33 ± 4.71**	**66.67 ± 4.71b**
	48	**96.67 ± 4.41c**	**96.67 ± 2.89d**	**96.67 ± 2.36d**	**96.67 ± 4.71c**	**100.00 ± 4.71c**
	24 (control)	**10.00 ± 4.41a**	**00.00 ± 2.89a**	**00.00 ± 2.36a**	**00.00 ± 4.71a**	**00.00 ± 4.71a**
	48 (control)	**10.00 ± 4.41a**	**10.00 ± 2.89b**	**00.00 ± 2.36a**	**00.00 ± 4.71a**	**00.00 ± 4.71a**

Figures are percentage Mean + SE of three replicates, means having the same letters in the same column are not significantly different by New Duncan's Range Test ($p<0.05$).
SE = Standard Error

Table 3: Mortality rate of Culicine larvae at different concentrations of aqueous extract of the seed of *Solanum xanthocarpum*

Plant extracts	Time (hr)	1ml	2ml	3ml	4ml	5ml
Seed	24	86.67 ± 4.41b	88.00 ± 2.89b	88.67 ± 6.24b	89.00 ± 5.77b	90.67 ± 5.77b
	48	100.00 ± 4.41b	100.00 ± 2.89c	100.00 ± 6.24c	100.00 ± 5.77c	100.00± 5.77c
	24(control)	10.00 ± 4.41a	0.00 ± 2.89a	00.00 ± 6.24a	10.00 ± 5.77a	0.00 ± 5.77a
	48(control)	10.00 ± 4.41a	0.00 ± 2.89a	10.00 ± 6.24a	10.00 ± 5.77a	0.00 ± 5.77a

DISCUSSION

This research work demonstrated the potency of the fruit and root extracts of *Solanum xanthocarpum* in the control of mosquito larvae (Culicine). The highest mortality rates were obtained in the fruit extracts after 48 hours exposure while the lowest mortality rate was obtained in 1ml volume of the root extract. Fruit extracts seemed lethal than the root extract which may be as a result the presence of active chemicals; Saponins and Alkaloids in the fruit extract. Alkaloids such as Carpaine work by constricting blood vessels and depressing autonomic nervous system activity. This compound contributes to the insecticide's effectiveness in controlling the larvae of mosquitoes. Users spray the insecticide in pools of stagnant water where the mosquito lays its eggs. The alkaloid kills the larvae, disrupting the life cycle of the mosquito.

This is similar to the findings of (Singh and Bansal, 2003) who investigated the larvicidal activity of *S. xanthocarpum* crude extract against the larvae of *Anopheles culicifacies, Anopheles stephensi* and *Aedes aegypti* at different degrees of toxicity of the crude extract of different parts of the plant .They observed that the fresh seed extract were more effective than other parts. There was a significant difference (P<0.05) between the percentage mortality of the extracts of seed and that of the root of *Solanum xanthocarpum*. This is in agreement with the findings of (Mohan *et al*, 2005) where they observed that the root extracts of this plant showed synergistic effect with cypermethrin when evaluated against the larvae of *Culex quinquefasciatus* and *Anopheles stephensi.*

Total mortality rate was observed at 48 hours and at different concentrations of the seed and root which may be due to environmental changes of these larvae which make them more susceptible. Sukumar, (1991) also stated the existence of variations in the toxicities of phytochemical compounds on target species of the plant parts from which they are extracted, responses in species and developmental stages of species to the specified extract, solvent of extraction, geographical origin of the plant, photosensitivity of some of the compounds in the extract and the effect of growth and reproduction.

S. xanthocarpum fruit with highest percentage mortality could be used as a larvicide while the root also can be administered at higher dosages where the seed is not available. This study shows that aqueous extracts of *S. xanthocarpum* plant can be used as environmental-friendly and sustainable insecticide to control mosquito vectors, since its application neither cause any toxic effects nor any additional economic burden. Also *S. xanthocarpum* plant is available and acceptable to the people; therefore further studies should be carried out on effective formulations to be utilized in integrated vector control measures.

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