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TOXICITY OF WATER EXTRACT OF *KHAYA* GRANDIFOLIOLA BARK "MAHOGANY" ON MOSQUITO LARVAE

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ABSTRACT

Larvicides are crucial for the control of mosquito related diseases. The need to use pesticides derived from plants has received increased interest as an inexpensive technology compared to the high cost of the traditional synthetic compounds for mosquito control in the endemic areas of poor nations of the world. The aim of this study was to find out the toxic effect of a water extract of *Khaya grandifoliola* "Mahogany" bark on mosquito larvae. The bark was powdered, soaked in water and strained. It was then used as a stock solution. Serial concentrations of 3% up to 27% were tested on mosquito larvae. The larvae were subjected to the extract for 24hrs. Four replicates were made and the average was taken. The mortality rate was found to be ranging between 13% and 100%. The LC_{50} and LC_{90} were found to be 0.6% and 0.9% consecutively. The toxicity index compared to Abate (temephos) was found to be 0.45(45%). Because of the impacts of traditional insecticides on other aquatic fauna and the environment, quest for safer pesticides has attracted researchers to look into plants with pesticidal properties. *Khaya grandifoliola* "Mahogany" proved to be one of those plants. The aqueous extract of this tree has been found to be potent in controlling mosquito larvae. It is recommended to do more research on the water and other solvents extracts of the tree bark and may be other parts. Yet, since the chemical contents of plants generally depend on soil composition, it is of paramount importance to test extracts of "Mahogany" from different geographical areas.

Key words: *Khaya grandifoliola*, Environment, Caoba Dominicana.

INTRODUCTION

More than two billion people, mostly in tropical countries are at risk from mosquito-borne diseases such as malaria, dengue, haemorrhagic fevers and filariasis (Murugan K *et al*., 2007). The responsible pathogens are transmitted by bites of blood sucking mosquitoes which are considered to be harmful towards the populations in tropical and subtropical regions (Rahuman AA *et al*., 2009). Although there are proven strategies to control mosquito-borne diseases, mosquitoes still cause a huge public health problem in Africa. Across Africa, people are exposed to mosquito bites because the larval habitats are widely distributed in humid areas such as flood swamps and rice farms. These larval habitats may be altered to decrease the mosquito population for the interruption of disease transmission. One of the strategies recommended by the WHO is the use of organochlorines (DDT, endosulfan), organophosphates (parathion, temephos) and carbamates. However, these chemical interventions are severely compromised by the development of insecticide resistance in some mosquito vectors and by environmental concerns (Ruikar AD *et al*., 2012). Plants are rich source of alternative agents for control of mosquitoes, because they possess bioactive chemicals that act against limited number of species including specific target-insects and are also eco-friendly. Traditionally, plant based products had been used in human communities for many centuries for managing insects. Several secondary metabolites present in plants serve as a defense mechanism against insect attacks. These bioactive

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chemicals may act as insecticides, anti-feedants, moulting hormones, oviposition deterrents, repellents, juvenile hormone mimics, growth inhibitors, antimoulting hormones as well as attractants. Plant based pesticides are less toxic, delay the development of resistance because of their new structure and easily biodegradable (Ignacimuthu S, 2007). Mahagoni is a small, leafy, medium sized tree found in India and some African countries including Sudan, but native to West Indies. Across the world, the tree is commonly called West Indies Mahogany, Caoba, Caoba Dominicana or Acajou. It is one of the species of genus Swietenia which belongs to Chinaberry family, Meliaceae. Other species in the group include *S. humilis*, *S. condollie* and *S. macrophylla*. The tree is normally long- living, medium sized but it can reach very large sizes, depending on environmental conditions under which it grows. S. mahagoni was once the most sought-after cabinet wood in the world and continues to be famous for its wood. It is used in shipbuilding and furniture making. The species grows at a moderate rate. It is planted as an ornamental and managed in plantations and natural stands in dry and moist forests (Elbert L, 1978).

MATERIALS AND METHODS

Materials

Transparent 300 ml plastic cups, Petri dishes, strainer, beakers, Flasks, Measuring cylinders, scoop, and plastic pipettes.

Methods

Mosquito colonies were collected from the Faculty of Public Health, University of Khartoum, Central Market, Soba area and Al-Emtedad area. Larvae were collected by means of scoop.

Fresh mahogany bark was peeled from trees at Omdurman area, dried in shadow place and was then powdered using a clean electric powdering machine.

5% (w/v) stock solution of mahogany bark was prepared by adding 5 grams of powder to 100 ml of distilled water followed by vigorous shaking and the water extract was then strained and was kept in covered flask till use (within 24hrs).

Different concentrations were prepared from the stock solution using the formula: X/Y = Q/Z

Where:

X= Final volume

Y= Volume taken from the stock solution.

Q= Available Concentration

Z= Needed Concentration

Experiment protocol

Serial dilutions of mahogany water extract were made by adding certain amount of stock solution to the natural habitat water to bring the following concentration: 3%, 7%, 10%, 13%, 17%, 20%, 23% and 27%.

Approximately, 25 larvae were transferred to each transparent plastic cup (each one containing designated dilution of mahogany watery extract). About 25 larvae were transferred to another transparent plastic cup containing 100 ml of natural habitat water as control.

Mortality count was made after 24 hrs. The larvae were considered dead when either horizontally floating on the surface or settling on the bottom without moving.

Statistical analysis

Abbot's formula was used to correct mortality. Mortality was then transferred into probit units and tabulated against concentration.

Concentrations were transformed into logarithms. Negative logarithms were made positive by adding (+3) to each (table 1). The added (+3) was subtracted later when obtaining the log of LC_{50} and LC_{90} inferred from graph.

The results of experiments were analyzed using the analysis of variance and log probit analysis.

Normal graph was used instead of the logarithmic graph because of unavailability of the logarithmic scale.

RESULTS

Tables 1, 2, 3, 4, show the mortality in the four experiments and Table 5 shows the average mortality of mosquito larvae subjected to mahogany bark water extract. The average mortality was found to range between 13.25% and 100% (the probit units ranged between (3.87 to 7.33). There was no mortality in the control of all trials and hence Abbot's formula for corrected mortality was not applied.

Fig1 of graphical presentation of data revealed that the LC_{50} was 0.006 (0.6%) and the LC_{90} was 0.0095 (0.95%).

Fig 2 shows the mean of mortality at different concentration of the mahogany bark water extract.

Table 6: Show the toxicity index of mahogany bark watery extract compared to the traditional abate insecticide was 0.45.

Table 1. Toxicity of Mahogany bark water extract on mosquito larvae (Trial 1)

. Conc.	ppm.	Log conc.	Log conc+3	Mortality%	Corrected mortality	Probit unit
0.03	0.002	-2.69	0.31	12	12	3.82
0.07	0.003	-2.52	0.48	16	16	4.01
0.1	0.005	-2.30	0.70	28	24	4.42

Aisha AM *et al*. / *International Journal of Phytopharmacology*. 6(2), 2015, 102-105.

0.13	0.007	-2.15	0.85	44	44	4.86
0.17	0.008	-2.10	0.90	72	72	5.58
0.2	0.01	-2.00	1	76	76	5.71
0.23	0.011	-1.95	1.05	96	96	6.75
0.27	0.014	-1.85	1.15	100	100	7.33

Table 2. Toxicity of Mahogany bark water extract on mosquito larvae (Trial 2)

Conc.	ppm.	Log conc.	Logconc+3	Mortality%	Corrected mortality	Probit unit
0.03	0.002	-2.69	0.31	8	8	3.59
0.07	0.003	-2.52	0.48	20	20	4.16
0.1	0.005	-2.30	0.70	24	24	4.20
0.13	0.007	-2.15	0.85	48	48	4.95
0.17	0.008	-2.10	0.90	76	76	5.71
2	0.01	-2.00	1	80	80	5.84
0.23	0.011	-1.95	1.05	88	88	6.18
0.27	0.014	-1.85	1.15	100	100	7.33

Table 3. Toxicity of Mahogany bark water extract on mosquito larvae (Trial 3)

Conc.	ppm	Log conc.	Log conc+3	Mortality%	Corrected mortality	Probit unit
0.03	0.002	-2.69	0.31	12	12	3.82
0.07	0.003	-2.52	0.48	16	16	4.01
0.1	0.005	-2.30	0.70	32	32	4.53
0.13	0.007	-2.15	0.85	52	52	5.05
0.17	0.008	-2.10	0.90	72	72	5.58
2	0.01	-2.00	1	80	80	5.84
0.23	0.011	-1.95	1.05	96	96	6.75

Table 4. Toxicity of Mahogany bark water extract on mosquito larvae (Trial 4)

Conc.	ppm.	Log conc.	Logconc+3	Mortality%	Corrected mortality	Probit unit
0.03	0.002	-2.69	0.31	12	12	3.82
0.07	0.003	-2.52	0.48	20	20	4.16
0.1	0.005	-2.30	0.70	28	28	4.42
0.13	0.007	-2.15	0.85	52	52	5.05
0.17	0.008	-2.10	0.90	72	72	5.58
0.2	0.01	-2	1	84	84	5.99
0.23	0.011	-1.95	1.05	92	92	6.41

Table5. Toxicity of Mahogany bark water extract on mosquito larvae (Average of 4 trials)

Conc.	ppm.	Log conc.	Log conc+3	Exp1	Exp2	Exp3	Exp4	average	Probit unit
0.03	0.002	-2.69	0.31	12	8	12	21	13.25	3.87
0.07	0.003	-2.52	0.48	16	20	16	20	18	4.08
0.1	0.005	-2.30	0.70	28	24	32	28	28	4.42
0.13	0.007	-2.15	0.85	44	48	52	52	49	4.97
0.17	0.008	-2.10	0.90	72	76	72	72	73	5.61
0.2	0.01	-2	1	76	80	80	84	80	5.84
0.23	0.011	-1.95	1.05	96	88	96	92	93	6.48
0.27	0.014	-1.85	1.15	100	100	-	-	100	7.33

Table 6. The toxicity index of mahogany bark water extract compared to the traditional Abate insecticide

Insecticide	24hrsLC50	Toxicity index
Mahogany bark water extract	0.006	0.45
Abate (temephos)	0.0027	……………

DISCUSSION

Plant phytochemicals have more specific effects and could be usefully integrated with other control measures to design comprehensive, appropriate and effective management protocols with less collateral harm to the environment and non-target species.

Mahogany bark water extract was found to be effective in control of mosquito larvae even at moderately low concentrations. The toxicity index when compared to Abate, the traditional larvicide, was found to be about half although the extract was crude. Refining the extract to its active ingredient could result in an index approximating that of Abate or even higher. The tree is present in different climates of Sudan and became nearly native.

Hence, the cost of growing the tree is easy and the extract could fairly be an alternative to synthetic larvicides. Further studies on other solvents extract and from different soils is definitely needed.

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