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# Biometric Screening of Insecticidal Potency of Aqueous Leaf and Stem Extracts of Medicinal Plants on female *Anopheles*Mosquito

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***Abstract*—***Formulated chemical insecticides which are used for combating malaria vector have been linked to some ecological challenges including adverse human health impacts and severe environmental pollution. Potent plant-based extracts are environmentally friendly for controlling the malaria vector. Upon this, concentration-based effects of A. sativum, C. citratus A. indica and C. officinalis stem and leaves extracts were tested on adult mosquitoes. The results revealed significant differences ($P<0.05$) in vector mortality in terms of extract concentration and plant extract exposure. Linear regression techniques indicated that within the range of 5-25mls of extracts exposure for 24hours,A. indica was the most potent in eliminating 98% of vector population whileA. sativum was the least potent (85%) in terms of vector mortality. The entomocidal effects of extracts followed the trend: A. indica> C. citratus>C. officinalis>A. sativum. This study shows that plant extracts are effective in eliminating female Anopheles Mosquitoes. In line with this results, investigation of the mechanism of the action of active principles of these plants is necessary*.

***Index Terms— malaria, plant extracts, vector, mortality, mosquitoe.***

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## I. INTRODUCTION

Malaria is an infectious disease which is very common in most tropical and sub-tropical regions. In the very recent past, precisely in 2015, a WHO estimate indicated that about 212 million cases of malaria were recorded globally, with the greatest burden in Sub-Saharan Africa. Specifically, in some African countries with Kenya, malaria is responsible for about thirty (30%) of outpatient attendance and about 19% of patient admissions in hospitals [Okiro*et. al.,* 2010]. Indisputably, the effects of persistent fluctuations in climate patterns has resulted in the shrinkages of river systemswhich have markedly receded in some regions, giving rise to suitable excellent breeding sites for mosquitoes. This trend gives a simple explanation for the observed surge in vector population around different human settlements. Aside from the fuelling effects of climate change driving vector range into areas which there where hitherto not abundant, the increasing propensity in large scale farming, increasing urbanization and deforestation increase the types and number of mosquitoes found around human settlements. In line with the fore going, there is need for effective control of vector population in other to reduce the burden of financial and environmental burdens associated with malaria.

The pervasive use of conventional pesticides (including insecticides) in tackling vectors population is popular and keeps increasing on continental and global scale over the last few decades. This popularity directly correlates with ecological problems such as air contamination, environmental persistence and bioaccumulation of toxicants (Socorro *et. al.,* 2016). This also bears the burden of major acute and chronic toxicity risks to both target pests and non-target organisms in the environment. Other worrisome trends in the observed result of perpetual application of pesticides include emergence of pesticide resistant strains (Kole *et. al.,* 2019). The detrimental impact of pesticides cannot be over emphasized since this subject has been of great concern since the last few decades and has led to several researches as reported by scholars. Due to ecological issues and other matters arising from the uncontrolled utilization of synthetic pest control substances, it is now a compulsory practice prior to registration to test novel pesticides for its potential deleterious effects against beneficial organisms and non-target species especially in the advanced world(WHO, 2015).

Aside from the known environmental and human health concerns, the widespread dependence on synthetic pesticides against vectors and pest populations also bring to the end users a serious economic burden of cost. This is a serious issue especially in "consumer" countries such as Nigeria where most of the goods and services in circulation are imported from producing countries. In this situation the cost burden depends on the

exchange rate and in this process there is a transfer of inflation drain from producer countries (exporters) to the consumers (importing countries) at the receiving end. Within the context of this challenge, it becomes necessary and imperative to explore the possible alternatives to these "unfriendly" synthetic options. Plant-derived pesticides may serve as promising possibilities since they are accessible, safer, relatively cheaper and eco-friendly (Ileke and Olabimi, 2019).

## II. MATERIALS AND METHODS

**Collection of plants**

Plant samples (Neem, Lemon grass and Marigold) free from herbivory were obtained locally from the Science Laboratory Department botanical garden, Heritage Polytechnic, Eket, Nigeria. Garlic was obtained from '*Nka'*marketin the same city.

**Preparation of Plant Extracts**

The freshly collected plant parts were thoroughly washed to remove impurities and spread on a clean dry surface to sun dryfor five days. Then 500 grams was weighed out, ground and placed in a conical flask for extraction. Extraction was done as described by Adeniyi *et al.,* (2010).

**Collection of adult Specimen**

Test tube method and Insecticide spray methodwere used to collect the adult specimens as proposed by the WHO (1992). Indoor mosquitoes and those waiting for their victims at toilets were captured between 6pm and 9pm in some selected household within the Heritage Polytechnic in Eket.

## III. RESULTS AND DISCUSSIONS

**Table 1: Mean mortality scores of Adult mosquitoes from the leaves extracts**

| Conc. (ml) | *A.sativum* | *C. citratus* | *A. indica* | *C. officinalis* |
|---|---|---|---|---|
| 5 | 0 | 0 | 0 | 0 |
| 10 | 5.50 | 5.50 | 6.50 | 4.00 |
| 15 | 12.25 | 13.00 | 16.50 | 12.50 |
| 20 | 19.50 | 24.50 | 24.50 | 19.50 |
| 25 | 48.00 | 44.00 | 38.00 | 38.50 |

***Mean values are obtained from triplicate determinations.**

**Table 2: Mean mortality scores of Adult mosquitoes from the stem extracts**

| Conc. (ml) | *A.sativum* | *C. citratus* | *A. indica* | *C. officinalis* |
|---|---|---|---|---|
| 5 | 0 | 0 | 0 | 0 |
| 10 | 4 | 2.00 | 4.50 | 3.50 |
| 15 | 5.5 | 12.00 | 10.50 | 11.50 |
| 20 | 13.0 | 14.50 | 18.50 | 18.00 |
| 25 | 26.5 | 34.50 | 25.00 | 20.50 |

***Mean values are obtained from triplicate determinations.**

**Table 3: Regression modeling of insecticidal properties of extract on vector population**

| | Equation | $R^2$ |
|---|---|---|
| *A.sativum* | 2.20(X) – 15.95 | 0.8575 |
| *C. citratus* | 2.14(X) – 14.70 | 0.9371 |
| *A. indica* | 1.88(X) – 11.10 | 0.9854 |
| *C. officinalis* | 1.85(X) – 12.85 | 0.9253 |

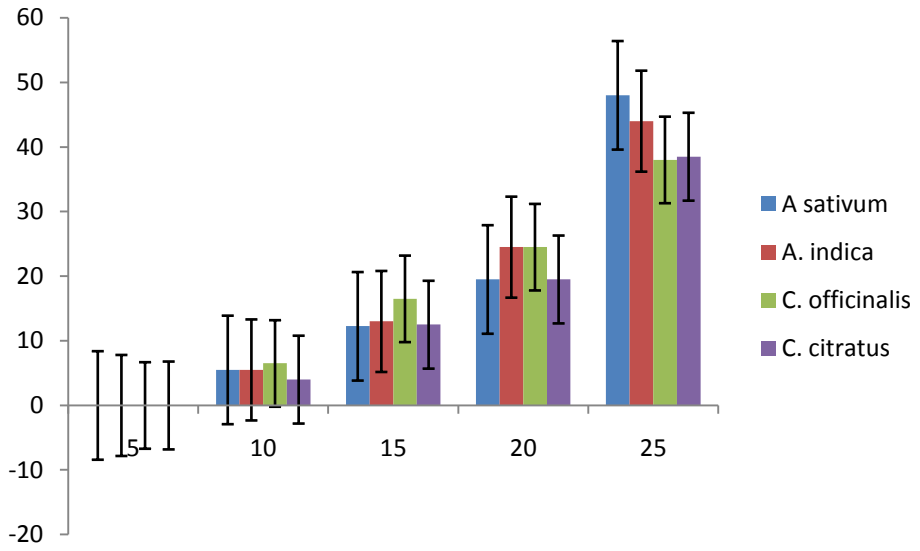


**Figure 1: Comparative insecticidal efficacy of Leaf extracts on adult Mosquitoes**

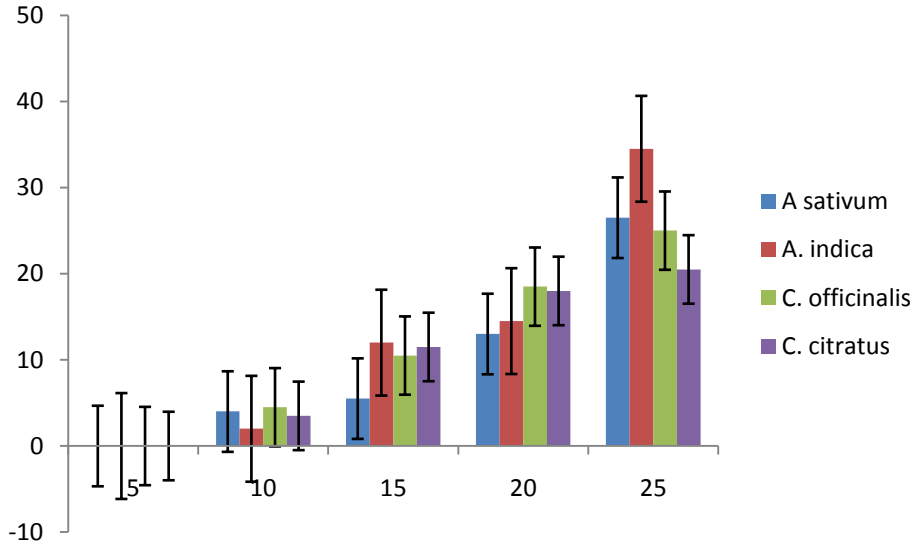


**Figure 2: Comparative insecticidal efficacy of stem extracts on adult Mosquitoes**

## IV. DISCUSSION

Several studies have indicated that plants contain active principles which have insect repelling and insecticidal properties and this sustains the possibility of identifying plant-based derivatives with the needed potency against malaria and other associated vectors (He *et. al.,* 2002). The application of plants extracts in vector control efforts bears reasonable level of environmental and health safety(Rakhshan, 2018).

A close comparison of the studied plants indicates that *A. indica* possess higher insecticidal potency and so yields promising potentials which may be harnessed for effective control of mosquitoes in different malaria endemic communities. Previous studies including those of Asadollahi*et. al.*, (2019)and (Maia and Moore, 2011) presented a list of various plants species which have in diverse experiments exhibited repellency as well as mortality effects against malaria vector at different life cycle stages. The current research gains significance in that in its novelty, it compares the mortality response of adult mosquitoes to varying concentrations of two parts of four commonly used medicinal plants.

The current results bear evidences to show the insecticidal potency of crude aqueous extracts of *Azadirachtaindica, Allium sativum, Cymbopogon citratus*as well as C*alendular officinalis* on an insect of public health significance. It shows that the effects of the extract on vector population significantly ($P<0.05$) differed with plant species. This is similar with previous reports (Shaalan*et. al.,* 2005; He *et. al.,* 2002). Vector mortality is concentration dependent and also varies with the plant part used. Plant potencydepends on extraction techniques, plant parts, extractionsolvent,strain of mosquito, as well as on the biologically active compounds

such as steroids, phenols, alkaloids, saponins tannins and terpernoids (Shaalan*et. al.*, 2005). In this study, the mortalities associated with the leaves extract treatments were higher than those which were obtained with the stem extract treatments. This observation contradicts the views of Overgaad*et. al.*, (2014) who reported low vector mortalities resulting from the administration of leaf and seed extracts in comparison with stem bark extracts while testing the insecticidal property of *Zanthoxylum heitzii* against the same vector. The gaps in mortality responds of mosquitoes noted in this experiment underscores the likelihood of storage or concentration of phytochemicals and other phytotoxic compounds in the leaf organs of test plants much more than it is contained in the stem of test plants.

## V. CONCLUSION

The current study has verified the insecticidal properties of*Allium sativum* (Garlic), *Azairachta indica* (Neem), *Calendula officinalis* (Marigold) and *Cymbopogon citratus*(Lemon grass) differ significantly. The results also furnish evidence that the active effects of this plants may be due to the accumulation of bioactive phytochemicals such as alkaloids, phenols, tannins,saponins,flavonoidsand others present in these extracts. However, further work is advocated to elucidate other therapeutic values of*Allium sativum* (Garlic), *Azadirachta indica* (Neem), *Calendula officinalis* (Marigold) and *Cymbopogon citratus*(Lemon grass).

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