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Short communication

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MOSQUITO REPELLENT ACTIVITY OF PIPER GUINEENSE AND XYLOPIA AETHIOPICA FRUITS OILS ON AEDES AEGYPTI

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Abstract

Repellent activity of *Piper guineense* and *Xylopia aethiopica* fruits oils in liquid paraffin were evaluated against adult *Aedes aegypti* in the laboratory. Results showed that repellency is dependent on both the concentration and time after application. *P. guineense* and *X. aethiopica* oils showed complete protection from mosquito bite for 2h at 35%(v/v) and 30% respectively. The activity of eucalyptus oil (positive control), a commercial repellent, at 30% was only able to protect for 2h. Both oils used could be applied as repellents where protection from mosquito bite is sought for, over a short period of time.

Key words: *Piper guineense*, *Xylopia aethiopica,* volatile oils, *Aedes aegypti*, repellency

Introduction

Aedes aegypti L. mosquito is known worldwide as the carrier of some major deadly diseases such as yellow fever, dengue fever, filariasis and encephalitis. These diseases are transferred by the bites from infective female mosquitoes. Historically, the strategies for reducing the incidence of mosquito-borne disease have been two-pronged, centering on habitat control (through chemical and biological means) and the use of personal protection in the form of insect repellents (Fradin, 1998). Sharma and Ansari (1994) have reported the effectiveness of neem oil as an alternative and safe method of protection from mosquitoes. Citronella, the active ingredient of *Cymbopogon nardus* (L.) Rendle is most commonly found in "natural" or "herbal" insect repellents marketed in the United States. In addition, Citronella candles have been used to prevent bites by *Aedes* mosquitoes under field conditions (Lindsay, *et al*, 1996).

X. aethiopica (Dunal) A. Richard is known as Guinea or African pepper or spice tree. The fruits are used both as remedy and spice. The composition of its volatile oil was reported by Lamaty, *et al* (1987) to be diverse with mainly monoterpene hydrocarbons (66.6%) among which sabinene is the most abundant (23.9%), but with

Afr. J. Trad. CAM (2006) **3 (2):** 79 - 89

25.1% of oxygenated compounds (essentially terpinen-4-ol and α-terpineol) and 8.3% of sesquinterpenene hydrocarbons (with 4.3% of α-murolene). Biological activities that have been carried out on *X. eathiopica* include antimicrobial (Thomas, 1989), oviposition deterrence and ovicidal properties against *Callosobruchus maculatus* in stored cowpea (*Vigna unguiculata*) seeds (Ofuya, 1990), insecticidal effect on the cowpea aphid *Aphis craccivora* Koch (Homoptera: Aphididae) (Ofuya and Okuku, 1994) and termite antifeedant property (Lajide *et al,* 1995).

P. guineense (Schum and Thonnhas) has a reputation for its medicinal values. The plant is utilized in different forms, such as whole herbs, powders, extracts and vapours, for a variety of purposes (Martins, *et al*, 1998). The leaves and fruits are essential ingredients in herbal drug preparations for cough, colds, bronchitis. The essential oils have been reported to be rich in β-Pinene and β-caryophyllene, β-elemene, bycyclogermacrene and α-humulene (Martins, *et al*, 1998). The investigation of the chemical constituents of black pepper and other Piperaceae species has led to the identification of approximately 145 lipophilic amides as the major type of metabolites that are responsible for the insecticidal properties of these plants (Parmar *et al* 1997).

In spite of the extensive studies carried out on both plants, their volatile oils have not been tested against adult mosquitoes. The repellent results of theses oils on adult *A. Aegypti* mosquito are presented.

Materials and Methods

Plant Materials

The fruits of both *P. guineense and X. aethiopica* were purchased from herbs sellers at Ile-Ife (Osun State, Nigeria) market and authenticated in the department of Pharmacognosy, Obafemi Awolowo University, Nigeria. Essential oil from each plant was obtained by hydro-distillation in a Clevenger-type apparatus.

Repellency Test

Repellency was performed using the methods described by Gbolade, *et al* (2000). Graded concentrations (10-35%) of each oil in liquid paraffin as solvent were made. Appropriate oil solution was thinly applied using camelhair brush to the bare skin of the experimental bird. The bird was then placed on the roof of the netted cage. The number of mosquitoes that bit within 2 minutes was counted. This was done three times with 2 minutes intervals. The solvent liquid paraffin did not show any repellent activity.

Percentage repellency was calculated thus:

$$\%R = \{ \frac{C - T}{C} \} \quad X \ 100$$

C and T are numbers that landed on the control and treated respectively. Repellency was determined at hourly intervals for up to 5h. after application of oil solution. The result was compared to Eucalyptus oil, a commercial repellent.

Afr. J. Trad. CAM (2006) **3 (2):** 79 - 83

Results and discussion

Tables 1 and 2 contain the results of the repellency tests carried out on the adult *A. aegypti* mosquitoes. The results showed that repellency is dependent on both the concentration of oil in solution and time after application. Repellency increased with concentration and also decreased with time after application. At the tested concentrations (10-30%v/v), protection from mosquito bites varied from 11-100%. The oil of *X. aethiopica* showed greater repellency. It offered complete (100%) protection at 30% for more than 1h (Table 1); the effect of which was possible at 35% for *P. guineense* (Table 2). No significant protection could be obtained when using the oil at below 15% and 20% for *X. aethiopica* and *P. guineense* respectively. Protection from mosquito bites could not be sustained for a longer time due to evaporation of the oils from the skin shortly after application. Increased repellency at later time was possible at certain concentration levels, as majority of the mosquitoes had already taken their full blood meals at earlier times. Fewer numbers, which fed later, had not done so at the initial stage. The activity of eucalyptus oil at 30% was similar to that of *X.aethiopica* at 20% and *P, guineense* at 20%.

Table 1: Mean repellency (% ±S.D) of *X. aethiopica* oil against adult *A. aegypti* mosquitoes

Conc.	**Time after exposure (hour)**				
(%v/v)	**0**	**1**	**2**	**3**	**5**
10	54±13	52±7	47±7	10±5	96±10
15	78.7±5	57.4±13	21±5	9±5	30±7
20	100	74±11	52±5	89±17	81±7
25	100	79±11	10±11	10±13	0
30	100	100	86±10	54±5	36±10

Table 2: Mean repellency (%±SD) of *P.guineense* and Eucalyptus oil against adult *A. aegypti* mosquitoes.

Conc.	**Time after exposure (hour)**				
(%v/v)	**0**	**1**	**2**	**3**	**5**
15	80±12	76±10	75±7	54±4	50±12
20	96±10	70±7	57±5	52±10	13±11
25	100	75±5	62±20	89±17	12±15
30	100	82±15	43±7	25±10	11±15
35	100	100	98±5	93±10	76±5
Eucalyptus oil					
30%	100	68±5	56±7	56±7	55±5

Afr. J. Trad. CAM (2006) **3 (2):** 79 - 83

Since the oil of *X. aethiopica* is showing greater protection, the use could be encouraged by rural dwellers that could not afford synthetic insecticides. Interestingly the fruits are cheaper and more abundant than that of *P. guineense.* Gbolade *et al* (2000) observed similar performances with the volatile oils of two Nigerian *Ocimum* species. The two oils demonstrated pronounced bite protection (≥70%) for 2 to 3 hours at all the concentrations tested after application of oil. The repellency was said to be comparable to a commercial wipe containing synthetic repellents. Also Oyedele *et al* (2000) reported good concentration-dependent repellency for the essential oil a Lamiaceous herb, *Hermizygia welwitschii* (Rolfe) M. Ashby. Complete protection was observed within 2h after application of sample.

In order to achieve a longer protection using any of the oils used in this experiment, it may be necessary therefore to consider reapplication after an expiration of 2h of the first use. It is suggested that the oils can be useful where protection from mosquito bites is sought for over a short period.

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