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Production of natural insecticide from Neem leaves (*Azadirachta indica*)

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ABSTRACT

Research into the insecticidal effects of azadirachtin, a limonoid from the Neem tree (Azadirachta indica) has been ongoing for some 30 years. Its strong antifeedant, insect growth regulatory and reproductive effects are now well understood and documented. Antiffedancy varies markedly between species with mosquitoes being particularly sensitive to azadirachtin. The mode of action of azadirachtin lies in (i) effects on deterrent and other chemoreceptors resulting in antifeedancy and (ii) direct effects on most other tissues studied resulting in an overall loss of fitness of the insect. The complexity of the molecular structure of azadirachtin has precluded its synthesis for pesticide use although novel synthesis of the parent molecule is now almost complete and research into simpler mimetic substances is ongoing. Applied research has concentrated on a variety of natural formulations from neem seed kernels which contain azadirachtin together with several structurally related molecules. This study brings the reader up to date with both pure and applied research in the field, and provides a detailed overview of present thinking into the mode of action of azadirachtin. Wherever possible comparative approaches have been made between species of the effects of pure azadirachtin and areas for future research are indicated.

Keywords: *Azadirachtin indica*; Neem leaves; Green Chemistry, Synthetic Insecticide, Limonoid; triterpense; Pest control; Antifeedancy; Reproduction; Beta-sitossterol Mode of action.

INTRODUCTION

In developing countries, the losses of crops due to pest, plant disease and competition from weeds is great. In households, pest and insects such as mosquitoes, cockroaches, mice etc pose risks such as the destruction of furniture, clothing and to the causation of various diseases, most seriously; malaria.

Pesticides/insectides produced to kill these pests in order to prevent these damages, also tend to have adverse effects on humans in various ways, most especially those produced from synthetic materials. These adverse effects of headache, dizziness, catarrh and other factors make this topic worth investigating. The insecticides range from agricultural to household pesticides. Every category has its own effect, both on the targeted pest/insect and the environment in which it lives. This research targets insecticide produced from natural products and the need to choose these pesticides rather than those of synthetic origin.[1]

The neem tree is drought resistant and thrives normally in areas with sub-arid to sub-humid conditions, with an annual rainfall between 400-1200mm. Neem is a life giving tree, especially for the dry coastal, southern districts. [2]

It has been observed that the various medicinal values of neem are its constituent phytochemicals present. The seed kernels of neem yield about 90% of a fixed oil comprised primarily of glycerides. The yellow, bitter oil has a garlic-like odor and contains approximately 2% of bitter principles including nimbidin, nimbrin, nimbinin, nimbidol and other related minor limonoid triterpense [Windholz, 1987] [3]. All parts of the tree yield beta-sitosterol. Azdirachtin is the most complex secondary metabolite present in the plant.

The neem is a bitter tonic herb that reduces inflammation and clears toxins, while promoting healing and improving all body functions. Apart from this,it has parasitic, insecticidal spermicidal properties and hence destroys a wide range of organisms according to [Dixit 1988] [4].

The Chemical structure of Azadirachtin is shown in scheme 1 below.

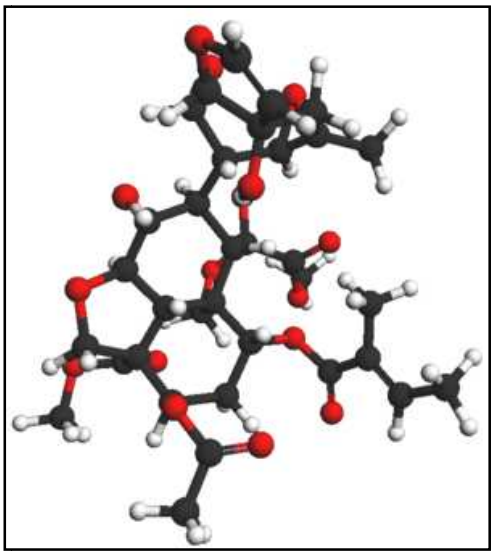

Figure 1: Chemical structure of Azadirachtin.

MATERIALS AND METHODS

Study area

The research was conducted in the University of Cape Coast, Cape Coast, Ghana, West Africa.The samples of the neem leaves were obtained from Apewosika, Kokoado and Amamoma; communities around the University of Cape Coast campus. The plant was identified according to the description by Felter and Lloyd [1898 [5] and later authenticated by comparing with voucher specimens at the herbarium section of the University of Cape Coast.

Preparation of the insecticide

A weighed quantity of dried neem leaves were blended into powder with a blender to obtain a homogeneous mixture. The dried neem powder was used for making the insecticide while the fresh blended leaves were used for the extraction.

10.00g of the powdered neem leaves sample was weighed into a 200ml beaker. 5.0g of a binding material (starch) was weighed and added to the neem sample in the beaker. The mixture was stirred to obtain a homogeneous mixture. 5.0ml of distilled water was added gradually to the mixture in quantity of 1.0ml while stirring [6].

The cleaned weighed beaker (M_1) was filled with the mixture and the weight taken (M_2). To obtain the true weight of the prepared mixture (M), the difference between the weights $M_2$and $M_1$was computed as M. thus $M= M_2-M_1$

The beaker with the wet insecticide mixture was dried in an oven at a regulated temperature range of 30^o-40^oC. The sample was weighed after every 10 minutes until a constant dried weight was obtained after 30minutes. The beaker with the dried insecticide was weighed to obtain the accurate weight by deducting from that of M.

Statistical analysis

Data were analyzed statistically using student's t-test. The results were expressed at the mean (±) S.D. the significance of the differences between control and the test groups were determined by the student's t-test and the values of $P<0.05$ were taken to be statistical significant [Parker, 1979] [7]. The stat graphics software was employed in the analysis of the data.

RESULTS

Results for Application of the Prepared Insecticide

The prepared neem insecticide was distributed among households within the study area and they were educated on how to use them. The households used them and were closely monitored for the effectiveness. They applied the insecticide in the evening in the comfort of their homes. The results were obtained based on the following:

- Time of application
- Number of bites received before, during and after bites period.
- Adverse effects suffered.

Tables 1 and 2 below shows the efficiency rate of the insecticide with respect to the time of application.

Table 1: Bites Received before Application of Insecticide.

Time/Hour	USERS					Total
	A	B	C	D	E	
1	2	4	4	3	4	17
2	4	3	5	3	3	18
3	4	3	4	5	4	20
4	6	5	5	6	4	26

Table 2:Bites received moments after Application

Time/Hr	USERS					Total	rate of efficiency	% efficiency
	A	B	C	D	E			
1	0	0	0	0	0	0	17	100
2	0	0	0	0	0	0	18	100
3	1	1	0	1	0	3	17	85
4	2	1	0	1	0	4	22	84.6

Efficiency Rate = total number of bites received before application /Total number of bitesreceived after application

%Efficiency = (Efficiency rate / Total number of bites received before application) x 100%

The users, A, B, C, D and E are the households which were randomly selected in the study area.Questionnaires were also issued to students and the general public to assess their views on the adverse effects they usually experience upon exposure to insecticides. Common effects suffered by most people include headache, irritation, and catarrh. Others also specified other effects such as dizziness, breathing problems especially asthmatic patients. To those who could not read the content of the questionnaire, they were helped through our interviews.The results obtained are tabulated below.

Table 3:The Adverse Effect of Using Synthetic Insecticide

Effects	Number of Complaints
Catarrh	12
Dizziness	8
Headache	10
Irritation	14

Table 4: The Adverse Effect of Using the Prepared Insecticide

Effects	Number of Complaints
Catarrh	2
Dizziness	1
Headache	1
Irritation	2

Table 5:Effects of Prepared Insecticide

Household	Heat	Smoke	odour	Effectiveness
A	Normal	Normal	Unpleasant	Positive
B	Normal	Normal	Unpleasant	Positive
C	Normal	Not much	Unpleasant	Positive
D	Normal	Little	Unpleasant	Positive
E	Normal	Too much	Unpleasant	Positive

DISCUSSION

From the results on the statistical tables, it was observed that bites were recorded half an hour after application of the insecticide. Yet, an hour later, no mosquito bites were recorded leading to an efficiency of 100%. An hour and half and even two hours later, only a few bites were recorded leading to an efficiency of 84.5%-85%. This is seen in the questionnaire administered.

Also the results collated from the questionnaires and the interviews showed that in both cases (synthetic and sample prepared), the users complained of headache, catarrh, dizziness and irritation of the eye. It however, showed that the detrimental effect of synthetic insecticide was severe compared to the prepared sample. 14 cases were reported for irritation, 12 cases for catarrh, 10 cases for headache and 8 cases for dizziness from the use of the synthetic insecticide while 2 cases for irritation, 2 cases for catarrh, no cases for headache and 1 case for dizziness were reported for the prepared sample.

In general no adverse effects were reported from the use of the prepared sample. The prepared insecticide burn and smoke effectively as required and are non-toxic and non-allergic to humans. Environmentally, the production process is over 90% pollution free and does not involve any known chemical reactions. The raw materials for the production are entirely natural products.

CONCLUSION

The research has shown that insecticides made from natural botanical source such as neem leaves for mosquito eradication are less toxic as compared to those from the synthetic origin hence it is safer to use insecticides prepared from natural raw materials since they have little or no adverse effects on human health.

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