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TOXICITY BIOASSAYS OF FOUR DIFFERENT BOTANICALS AGAINST THE HOUSE HOLD PEST : *PERIPLANETA AMERICANA* (LINNAEUS)

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ABSTRACT

Studies were carried out on the toxicity of the powders of four botanicals on Periplaneta americana. The tested plants include: Parquetina nigrescens, Azadirachta indica, Zanthoxylum zanthoxyloides and Eugenia cariophyllus. Each of the plant materials (PM) was pulverized and then applied to the insects in four different doses. The dosage rates were 25%PM+75% biscuit, 50%PM+50%biscuit, 75%PM +25%biscuit and 100% PM+0% biscuit. Mortality of insects was monitored and recorded on daily basis for three days. Three of the tested plants, that is, P nigrescens, Z zanthoxyloides and E caryophyllus were very effective as mortality of insects treated with all the doses were significantly different P≤0.5 from the control from the first day to the third day. The least dose(0.5g) of P nigrescens and Z zanthoxyloides produced mortality of 83.3 % each, at the end of the second day of application. The same dose of E caryphyllus produced 100% at 2 days post treatment. Higher doses of these three plants produced 100% mortalitic on the second and third day. However, for experiments involving A indica, only the highest dose of 100% PM gave a significantly high mortality rate when compared with the control.

Keywords: *Toxicity,Botanicals, Periplaneta americana.*

INTRODUCTION

Cockroaches are classified as public health pests and live alongside man in most areas of the world; preferring the warm, moist, food rich habitats we create in our houses, commercial premises and public buildings (Williams *et al.*, 2007). They are among the most difficult household pests to control. They feed upon a wide variety of foods, including cereals, sugar containing foods, meat, cheese, beer and soda pop as well as leather, book bindings and wall paper paste (Annon 2004).They prefer carbohydrates to proteins or fats, however, when they are hungry, they will feed on almost anything (Robinson *et al*.,1996).

They are one of the most disagreeable insects that may invade homes. The presence of cockroaches often cause serious mental anguish for some home owners. Cockroaches often associate themselves with filth and are known to be involved in the spread of bacterial infections such as *Salmonella* food poisoning, diarrhoea, dysentery, typhoid, Tuberculosis and Poliomye-

litis. Cockroaches can also cause allergic reactions in susceptible individuals e.g asthmatics, mite allergen sufferers and individuals exposed to infestations for long period of time (Mullen, and Lance 2002; Agr. Evo, 1998; Piper and Antoneli, 2007).

Various measures have been used to control this insect pest; this includes the use of trap, which are inexpensive, easy to use, disposable and contain non-toxic substances, (Piper and Antoneli, 2007). However, these methods could be time consuming. Also, lowering the habitat temperature below freezing point may render most of the eggs infertile (Christopher, 2002), sealing hiding spots and entry points and cleaning the kitchen thoroughly daily has been reported to be effective (Mullen and Durden, 2002).

The most effective method of control is the use of chemicals. This may come in the form of surface sprays, space sprays and insecticide baits. Good examples are Pyrethrins which are contact poisons that penetrate the nervous system making the cockroaches unable to move. (Pesticides Trust, 1999).

Increased public concerns regarding the safety of synthetic pesticides and their effects upon human health and the environment, together with the increasing problem of cockroach resistance to insecticides, have resulted in a demand for effective environmentally friendly and positive methods of control (Anchor pest control, 2008) that is why some botanicals were evaluated.

Zanthoxylum zanthoxyloides (Prickly ash plant)
This tree belongs to the division Magnoliophyta, class Magnoliopsida, order Sapindales, family Rutaceae and genus Zanthoxylum. It is usually found in the tropical regions. (Arbonnier, 2004). It is a common plant of the rain forest vegetation of Southern Nigeria, (Adesina, 2005). The main component, pellitorine, N-isobutyldeca-trans-2-trans-4-dieanamide is very potent causing marked paralysis of mucous membranes and was about half as toxic as the pyrethrine to house fly, *Musca domestica* L. (Gregor, 1984).

*Azadirachta Indica (*Neem Plant)
The Neem (*Azadirachta indica*) belongs to the family Miliaceae, the mahogany family. In the Yoruba tribe, it is popularly known as 'Dongoyaroo'. Neem has been labelled the wonder tree of the humid tropics. Many parts of the neem tree have insecticidal properties (Lale, 1995) and it is known to provide effective ingredient for traditional and modern tooth pastes, medicine, consmetics and insects repellants. Dried neem leaves have been traditionally used to protect stored foods and fabrics from insect damage. A special chemical has been identified in neem that prevents insects feeding and reproducing properly(Bell, 2000)

Euginea caryophyllus (clove)
This is a tropical plant which *belongs to the family Myrtaceae. It has a potent odour and is a very good insecticide, repelling* both mosquitoes and other insects such as cockroaches and moths (John, 1996). In some areas, a natural insect repellent is traditionally made by studding the skin of oranges with cloves, this is kept in different areas in the house to ward off insects (Jade and Tamara, 1998). Furthermore, experiments conducted by some experts showed that a mixture of garlic juice, rubbing alcohol and water, and *Eugenia* when sprayed on plant could get rid of aphids, spider mites and scale mites (Anon, 2007).

Parquetina nigrescens (Periploca)
These are common shrubs and sometimes tuberous. They are self supporting or climbing. Physiologists recorded that alkaloids, proanthocyanidins and cyandin are the chemical compounds present. They are widely distributed from temperate to the tropical region, especially in tropical Africa. Recent research works have shown that the chemical compounds present in *Parquetina* sp have strong insecticidal properties (Watson and Dallwitz, 1992). This study assessed the insecticidal properties of the

four plants and their effects on major household pest.

MATERIALS AND METHODS

The stems of *Parquetina nigrescens*, *Zanthoxylum zanthoxyloides* and *Azadirachta indica*, and the flower buds of *Eugenia caryophyllus* were collected at Iworoko Ekiti (a town in the southern part of Nigeria) and dried on the laboratory table for one month, after which the barks of the stems were removed, and with the aid of mortal and pestle, pounded into powder form. The resulting powder was sieved using 40 mesh screen and kept in the refrigerator to retain its freshness before application.

Collection of Cockroaches

Immature cockroaches (Nymphal stage) were collected from some selected houses in Iworoko town. They were carefully handpicked (without injuring them) and kept in a well aereated container so as to sustain them. When they were brought into the laboratory, were fed with pieces of biscuits to sustain them till the time the experiments were set up.

Bioassay

Six (6) cockroach nymphs were picked from the stock and kept in Kilner-jars on the laboratory bench for varying rates application.

(i) 2.0g of Biscuit powder only = control

(ii) 1.5g of Biscuit powder+ 0.5g of Neem powder = Treatment 1

(iii) 1.0g of Biscuit powder+1.0g of Neem powder = Treament 2

(iv) 0.5g of Biscuit powder+1.5g of Neem powder = Treatment 3

(v) 2.0g of Neem powder only = Treatment 4

The above set ups were replicated three times and repeated for all the other plant materials used. They were then left on the laboratory bench at ambient conditions of 37^{o}C and 51% R.H. Insect mortality was monitored on 24 hourly basis for three days and the results obtained were recorded.

Statistical Analysis

All data obtained was subjected to Analysis of variance (ANOVA); and the means were separated using Fisher's Least Significant Difference (LSD).

RESULTS

Table 1 shows the percentage mortality of nymphs of *Periplaneta americana* treated with different concentrations of the powder of *Parquetina nigrescens* for 3 days. The highest mortality was recorded with the highest dose of (2.0g neem powder) in which case 100% insect mortality was recorded 1day after exposure. The potency of the plant powder however reduced with decreasing concentration for instance 1.5g and 1.0g% application rates produced 66.67% and 100% mortality each after 24hrs and 48hrs respectively. In the case of the experiment involving 0.5g (25% concentration), mortality was 66.67% on the first day post treatment, to 83.34% on the second day and 100% on the third day. Mortality of insects remained at zero level in the control experiment for the three days. There were significant differences between each of the treatments and the control at 5% level of probability using Fisher's Least Significant Difference (Table 1).

Table 1. Mean Percentage Mortality of *P. americana* treated with different concentrations of the powder of *P. nigrescens* for 3 days

Treatment	Mean Percentage Mortality For 3 Days		
	Day 1	Day 2	Day 3
0.5g (25%)	66.67b	83.34bc	100b
1.0g (50%)	66.67b	100b	100b
1.5g (75%)	66.67b	100b	100b
2.0g (100%)	100bc	100b	100b
Control	0a	0a	0a

Within columns, Means followed by the same letters are not significantly different at 5% Using Fisher's Least Significant Difference (LSD)

Table 2 shows the mean percentage mortality of nymphs of *Periplaneta americana* treated with different concentrations of the powder of *Azadirachta indica* bark for 3 days. With the exception of the highest rate of application which gave 66.67% and 83.34% insect mortality for the second and third day respectively, all other rates were significantly ineffective on the insects. Mortality ranged from 0.00%-33.34% from the first day to the third day post application in the lower rates. No mortality was recorded for the control throughout the study period (Table 2).

Table 2. Mean Percentage Mortality of *P. americana* treated with different concentrations of the powder of *A. indica* for 3 days

Treatment	Mean Percentage Mortality For 3 Days		
	Day 1	Day 2	Day 3
0.5g(25%)	0.00a	6.67a	6.67a
1.0g(50%)	8.33a	33.34b	33.34b
1.5g(75%)	0.00a	0.00a	33.34b
2.0g(100%)	66.67bc	83.34d	83.34d
Control	0.00a	0.00a	0.00a

Within column, Means followed by the same letters are not significantly different at 5% Using Fisher's Least Significant Difference (LSD)

Mean percentage mortality of nymphs of *P. americana* treated with different concentrations of the powder of *Euginea caryophyllus* for is presented in Table 3. In this experiment, the least dosage (0.5g) produced insect mortality of 33.33% on the first day post treatment. All other dosages were highly toxic on the insects with mortality ranging from 83.30 % to 100%. Percentage mortality was 0% in the control on the first day through to the third day. There were significant differences in each of the treatments and the control ($P < 0.5$)

Table 4 shows the percentage mortality of nymphs of *Periplaneta americana* treated with different concentrations of the powder of *Zanthoxylum zanthoxyloides.* In the case of 25% concentration, 33.33% mortality was recorded on the first. Mortality increased to 83.34% on the second day and 100% on the third day post treatment. Insect mortality was 66.67% for each of the experiments involving dosage rates of 50% and 75% concentrations on the first day post treatment. Mortality for both concentrations rose sharply to 100% on the second and thirds. The control experiment did not record any mortality throughout the period of observation. There were significant differences between each of the treatments and the control at 5% level of probability (Table 4).

Table 3. Mean percentage mortality of *P. americana* treated with different concentrations of the powder of *Euginea caryophyllus* for 3 days.

Treatment	Mean Percentage Mortality For 3 Days		
	Day 1	Day 2	Day 3
0.5g (25%)	33.33bc	100b	100b
1.0g (50%)	83.34b	100b	100b
1.5g (75%)	100b	100b	100b
2.0g(100%)	100bc	100b	100b
Control	0.00a	0.00a	0.00a

Within column, Means followed by the same letters are not significantly different at 5%.

Table 4. Mean percentage mortality of *P. americana* treated with different concentrations of the powder of *Z zanthoxyloides* for 3 days

Treatment	Mean Percentage Mortality For 3 Days		
	Day 1	Day 2	Day 3
0.5g (25%)	33.33b	83.34bc	100b
1.0g (50%)	66.67c	100b	100b
1.5g (75%)	66.67c	100b	100b
2.0g (100%)	100d	100b	100b
Control	0.00a	0.00a	0.00a

Within column, Means followed by the same letters are not significantly different at 5% level.

DISCUSSION

This experiment has shown that three of the plant materials, *Parquetina nigrescens, Euginea caryophyllus and Zanthoxylum zanthoxyloides,* are effective in the control of the household pest, *Periplaneta americana.* The insecti-

cidal property of *Zanthoxylum* as found in this study, corroborates the earlier findings of Ogunleye (2000), Ogunleye *et al*, 2003. Ogunwolu and Odunlami 1996, According to them, the plant material have excellent insecticidal properties on storage insect pests of Cowpea, *Callobruchus maculatus* and Maize, *Sitophilus zeamais*.. Metabolites isolated from *Zanthoxylum* sp. so far include; alkaloids, aliphatic and aromatic amides, lignans, coumarins, sterols and carbohydrate residues. Some of the metabolites have shown cytotoxic, molluscidal, pesticidal, anticonvulsant, anti–sickling, anaesthetic, anti-bacteria, anti-hypertensive and anti-inflammatory properties (Principe, 1989). In recent times, these odoriferous substances, mainly volatile oils, have been put into good use by man. These include, as pesticides and insect repellants in agriculture, particularly crop protection, as anti-infective agents, particularly as anti-bacterial and anti-fungal agents (Adesina, 2005). Biologically, the isobutyl amides present in the *Zanthoxylum sp* have been shown to have strong insecticidal properties (Principe, 1989).

All these phytochemicals present in this plant might have been responsible for its high toxicity on varieties of insects including the fairly big ones, cockroaches which was studied in this work. Anon, 2007, Jade and Tamara, 1998 Watson, and Dalwitz, 1992 also listed all the three plants as those that have great potentials for the control of various field and storage pests.

According to Penelope (1993) the most important and major compound constituent which is present in the volatile clove oil is called Eugenol, which is chemically identified as a phenol. This chemical compound displays very strong antiseptic as well as potent anesthetic ability by virtue of being a phenolic compound.

This work showed little evidence of direct mortality of insects in the experiment with *A indica* . This result is however contrary to reports of past researchers conducted on the toxicity of these plants on some storage pests of cereals and grain legumes (Lale, 1995; Lale and Mustapha 2000, Ofuya , 2009).

The fairly large size of *P americana* may have assisted them in resisting the toxic effects of the plants on them. In addition to this, it has been established that, unlike chemical insecticides, neem compounds work on the insects' hormonal system, not on the digestive or nervous system and therefore may not neccessarily lead to spontaneous death of some insects (Ram, 2001). These compounds belong to a general class of natural products called "Limonoids". The most significant liminoids found in neem with proven ability to block insect growth are Azadirachtin, Salamin, meliantriol, nimbin and nimbidin. Azadirachtin is currently considered as neem's agent for controlling insect. (Randhawa and Parmar,1993). These hormones control the process of metamorphosis as the insects pass from larva to adult; Azadirachtin block those parts of the insect brain that produce these vital hormones. As a result, insects are unable to moult. It is through these hormonal effects that this important compound of neem breaks the life cycle of insects (Vietmeyer, 1992).

Vijayalakslimi, (1995) through his experiments, concluded that Azadirachtin is the most potent insect growth regulator and feeding deterrent ever assayed because it will repel or reduce the feeding of many species of pest insects as well as some nematodes.

In view of the foregoing, it is obvious that more work still need to be done on the effects of *A indica* on *P americana* . Exposure of this insect to the plant material for a longer period may have a serious negative effects on the developmental processes.

CONCLUSION

It was evident from this study that botanicals can be used as an alternative to synthetic insecticide, in bringing down the population of insect pests and more specifically, the notorious

household pest, *P americana.* There is therefore the need to ensure the cultivation of these plants in large quantities so as to ensure that they are readily available for use.

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