

Full Length Research Paper

Laboratory evaluation of the effect of *Khaya senegalensis* and *Cassia occidentalis* ethanolic leaves extracts against worker termites (Isoptera: Rhinotermitidae) on treated wood sample

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Khaya senegalensis and *Cassia occidentalis* ethanolic leaves extract were evaluated for their effectiveness to suppress wood damage by termite at the Department of Biological Sciences, Bayero University, Kano, Nigeria. *K. senegalensis* was collected from Nana hall female hostel, old campus of Bayero University Kano, and *C. occidentalis* was collected from wild areas of Aminu Kano Teaching Hospital Zaria Road, Kano. Both plants were identified at the herbarium of the Department of Biological Sciences. The leaves were extracted using Soxhlets extraction method. Termite was collected at Bayero University quarters, new site and identified using taxonomic key. Wood sample used for the bioassay were collected from a carpenter shop at Tarauni Local Government Kano and was disinfested by drying in an oven at 60 °C overnight. Bioassay was conducted in plastic containers. Extracts from these plants were separately prepared into different concentration (0.5, 1.0 and 1.5 g) and inoculated into separate plastic containers containing 20 g of disinfested wood sample which correspond to 2.5, 5.0 and 7.5% w/w, respectively. Forty (40) workers termite were introduced into these containers separately. Control treatment was set along. Each treatment was replicated three times; mortality of the insect was assessed after 24 h interval. This study indicated that both *C. occidentalis* and *K. senegalensis* ethanolic extracts at varying level of application recorded mortality of the workers termite within the shortest duration of application when compared with the untreated wood. 100% mortality of workers termite was observed on wood treated with *C. occidentalis* extract at all level of application after 120 h of treatment while 100% mortality of the workers termite was recorded on wood treated with *K. senegalensis* at all level of application after 240 h of treatment. This indicated that extract of *C. occidentalis* was more effective than the extract of *K. senegalensis* in killing workers termite on wood treated with the extract.

Key words: *Cassia occidentalis*, *Khaya senegalensis*, workers termite, ethanolic leaf extract.

INTRODUCTION

Wood is one of the most frequently used material for construction purposes worldwide and had been directly linked to civilization of man (Tolunay et al., 2008). Wood as construction materials is prone to damage by termite

by posing a lot of socio and economic problems. Termites are social insect living in colonies which belong to the order isopteran (Grimaldi and Engel, 2005). The termite colony comprises of soldiers, workers and reproductive. The workers termite causes most of the damage by eating wood. They also maintain the colony, build or repair nest, forage for food and also help care for the young. The destructive activities of termite as a result of

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their feeding can not be over emphasized. It include the damage done to agricultural crops such as cash crops and food crops (Harris, 1961; Abe et al., 2000), timbers in building, post, fences, damage to clothes, books, underground cables and airfield. They also reduce water retaining capacity of the soil, by removing plant cover and thus, promote erosion to some extent (Lee and Wood, 1971). The damage done to all these materials are great and amount to millions of naira. Termite cause over 3 million dollars in damage wood structure annually throughout the united state (Lewis, 1997). Similarly, Ohiagu (1979) has reported damage done by termite to three major cereal crops (maize, millet and sorghum) in Nigeria. The use of synthetic chemical has been the dominant method used for wood preservation against termite attacks; however, these chemicals are associated with dangers of environmental pollution and in addition to that, they are too expensive for low resource individuals. The search for alternative control measures is therefore essential. Botanical insecticide compared to synthetic ones may be safer to the environment and less expensive, easily processed and used by farmers and small industries (Bellmain et al., 2001). Several plant extract which include neem, wild tobacco, and dried chillies were reported to be effective against termite (Shail et al., 2009). The present study was conducted to evaluate the potential of *Cassia occidentalis* and *Khaya senegalensis* ethanolic extract against workers termite. Workers termite is the termite that causes most of the damage by eating wood. The present research was conducted in order to investigate the efficacy of some plants extracts as a possible alternative for the control of worker termites. *C. occidentalis* and *K. senegalensis* are found in Kano State of Nigeria and these species has been used in this region for various medical purposes as well as protection against some insect pest. In Nigeria, *C. occidentalis* occur at lowland and medium altitude as a weed in waste places, in and about town throughout the riverside. *K. senegalensis*, which is indigenous to Mali, Northern Nigeria is found at elevation between sea level and 1800 m.

MATERIALS AND METHODS

Collection and identification of plant material

The plant of *K. senegalensis* was collected from Nana hall female hostel, old campus of Bayero University Kano, Nigeria. *K. senegalensis* is a tree with shining foliage reaching up to 100 m high with wide dense crown and thick stem while the plant *C. occidentalis* was collected from wild areas of Aminu Kano Teaching Hospital Zaria Road, Kano. *C. occidentalis* usually get matured at 0.5 to 20 m in height. The species produces a hard, woody tap root with relatively few laterals. It has a single purplish stem and sparse branching young stem. Both plants were collected from November to December, 2010. Both plants were identified at the herbarium of the Department of Biological Sciences. These plants were readily available in various places of Kano State of Nigeria and can be found where termites are also abundant. Little or no work has been reported so far in this region on the use of these plants extracts for

protection of timber against attack by worker termites.

Processing of plant materials

The leaves were randomly collected from plant part, washed thoroughly to remove soil debris and shade dried at room temperature to get rid of moisture content of the leaves (Mulungu et al., 2007) after drying, they were pounded into powder using a clear pestle and mortar and then sieved to get the fine powder (Muktar and Tukur, 2000).

Extraction of plant materials

The crude extracts were prepared using Soxhlets extraction method as described by Joseph and Ranjit (2008). Soxhlet apparatus was fixed in suitable protective place. The water was regularly checked. The solvent ethanol was taken in Soxhlet flask. Sample preparation for the Soxhlet extraction consisted of preparing a 100 g composite of leaf powder of both *K. senegalensis* and *C. occidentalis* separately. The composite was loosely packed into 43 × 143 mm cellulose extraction thimble and inserted into a preparative scale Soxhlet extractor fitted with an Allihn condenser. Then the resulting solutions were evaporated to dryness on a water bath at 40°C.

Collection workers termite

The termite was collected at Bayero University quarters new site using a method described by Tamashiro et al. (1973). This is done by setting "termite" wooden trap to collect the termite. The infested stakes where covered by these wooden 'traps' boxes then, collected after some days. The termites were taking to the Department of Biological for culturing.

Identification and culturing of workers termite

Soldiers termites were identified at Biological Sciences Department and were confirmed using the identification key described by Durr et al. (2000) and the termites were cultured using a method describe in (<http://www.ehow.com/how=5653001-raise-termites.htm>).

Collection of wood sample

An Iroko wood was collected from a carpenter shop at Tarauni Local Government Kano where they were cut into various parts of smaller size.

Bioassay

Wood sticks (popsicles ticks) which were collected from Tarauni Local Government of weight 20 g each were dried in the oven at 60°C overnight and weighed (Ewart, 2000). Force feeding test were conducted in the plastic container for both plant separately. The bioassay was conducted based on the procedure described by Acda (2007) with some modifications. The wood sticks were separately placed into different plastic container. Three different concentration (0.5, 1.0 and 1.5 g) of the ethanol extracts from *C. occidentalis* and *K. senegalensis* were prepared separately which were diluted in an organic solvent (acetone). The diluted extracts of different concentrations from both plants were separately rubbed on the 20 g of wood stick set in the different containers using brush which corresponded to 2.5, 5.0 and 7.5% w/w, respectively. These

Table 1. Mortality of workers termite on wood treated with *K. senegalensis* and *C. occidentalis* ethanolic extracts.

Plant extract	Amount applied /20 g [Concentration (%)]	Number of insects	Percent mortality of workers termite (h)									
			24	48	72	96	120	144	168	192	216	240
<i>K. senegalensis</i>	0.5 (2.5)	40	0	2.5	10	22.5	32.5	40	50	52.5	57.5	100
	1.0 (5.0)	40	0	2.5	15	15	20	35.0	40	55	75	100
	1.5 (7.5)	40	0	2.5	2.5	17.5	30	37.5	55	75	90	100
<i>C. occidentalis</i>	0.5 (2.5)	40	0	5	25	42.5	100					
	1.0 (5.0)	40	0	7.5	37.5	57.5	100				-	
	1.5 (7.5)	40	0	10	50	55.0	100				-	
Control (untreated)		40	0								15	15

Each observation is based on three replicates.

treatments were allowed to stand for 24 h in order to evaporate the solvent (acetone) used in the dilution of the ethanol extract. Forty (40) workers termites were separately introduced into each of the plastic containers containing wood coated with different concentration of different plant extracts. Control treatments were also set along. Each treatment was replicated and arranged in completely randomized block (CRD). Observation on the mortality of the soldier was taken on daily basis.

RESULTS AND DISCUSSION

Mortality of the worker termite on wood treated with *C. occidentalis* and *K. senegalensis* extracts increased in a dose-dependent fashion. The highest mortality (100%) was noted on wood treated with *C. occidentalis* leaf extract at all level of application after 120 h of treatment (Table 1). However 100% mortality of the worker termites was seen on wood treated with *K. senegalensis* extract at all level of application after 240 h of treatment and this was found to be better than untreated control treatment (Table 1).

The use of several plant extracts has been reported to be effective against termite by several

authors (Sohail et al., 2009). The present study was therefore in agreement with the finding where *C. occidentalis* and *K. senegalensis* ethanolic extracts were found to be effective against workers termite when compared with untreated control. Studies have further shown that herbal extracts were also effective natural preservative of wood against termite (Grafium and Hayden, 1988; Sen, 2001). This also conform with the finding reported in this study where *C. occidentalis* and *K. senegalensis* ethanolic extracts at varying level of application recorded mortality of the worker termites within the shortest duration of application when compared with the untreated wood (Table 1). 100% mortality of workers termite was observed on wood treated with *C. occidentalis* extract at all level of application after 120 h of treatment while 100% mortality of the workers termite was recorded on wood treated with *K. senegalensis* at all level of application after 240 h of treatment (Table1). The finding in this study indicated that extract of *C. occidentalis* was more effective than the extract of *K. senegalensis* in killing worker termites on wood treated with the

extract. The precise mechanism of action of these extract was not clear. However, the mode of action might be through contact of the extract coating the wood with the body wall of the insect and the chemical constituent of the extracts might probably get into the body system of the insect and interfere with the normal development causing mortality of the worker termites. The finding from this study was in agreement with the finding of Sohail et al. (2009) who compare the effectiveness of extracts from *Aksen*, *Withania somnifera*, *Artemisia absinthium*, *Amaranthus viridis* and *Psoraleae corylifera* with standard chemical insecticide Claryprifos used in Pakistan for the control of termite. Their findings indicated that the extract of the plants used were effective against termite. Nakayama et al. (2001) have also investigated the effect of plant extract against termite on treated wood and the result of their study shows that the extract recorded 100% mortality of the termite within the shortest duration of application and this was found to be quite similar to the finding in this study which were extract from *C. occidentalis* and *K. senegalensis*

ethanolic extracts proved to be effective against workers termite. Furthermore, Elsayed (2011) have also reported the insecticidal activity of *W. somnifera* and *Solanum incanum* against worker termites. The result of his study indicated that crude extract of *S. incanum* were more toxic to workers termite than *W. somnifera* extract and this support the finding from this which were *C. occidentalis* *K. senegalensis* extract found to be more effective against worker termites. The people in this region can extract the plant using ethanol. However, there is a need for further research to determine whether the use of different extraction technique using different solvent can bring about variation in the effectiveness of the extracts which can assist in using the most commonly available an easily processed solvent for extraction of the plants.

Conclusion

The importance of *C. occidentalis* and *K. senegalensis* to Sub-Saharan African cannot be overemphasized as these plants are readily available and can be use to protect timber against damage by worker termite. *C. occidentalis* and *K. senegalensis* ethanolic extracts at varying level of application in this study cause mortality of worker termites within the shortest duration of application when compared with the untreated wood. This indicated that these plants extract might possess some insecticidal potency which may be useful for protection of wood against wood damage by workers termite

RECOMMENDATIONS

Leaf extract of *C. occidentalis* and *K. senegalensis* may serve as a useful source of bioactive agent against workers termite; we therefore, recommended that further studies be conducted in order to isolate these agents and characterized them for developing economically commercial formulation which can be used in the control of workers termite.

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