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Evaluation of the Efficacy of Different Extracts of Gumbail Parts (*Cordia africana* Lam.) for Termite Control

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ABSTRACT

Gumbail tree is of wide distribution in forests of Sudan, and has many important uses. The aim of this study was to evaluate the effect of extracts of leaves, bark and root of Gumbail (*Cordia africana* Lam.) to Control Termite Attacking. The extracts of plant substances with different concentrations were separately spread on a three layers of cellulose pads to assay for their efficiency as anti-termite or termite repellency using the grave yard method. It was observed that all ethyl acetate extracts of leaves, bark and root have significantly reduced Termite`s infestation as compared to other extracts. Further analysis showed that all concentrations for different extract solvents significantly reduced termite attack compared to the untreated control. The ethyl acetate leaves extract had significantly higher anti-termite activity compared to the control and other test solvents, and it resulted in mean of (17.26% weight loss). The study proved the suitability of leaves ethyl acetate extract of Gumbail for controlling termites, and represents a good environmental and alternative method for synthetic insecticides of termites.

Key words: *Cordia africana, anti-termite, extraction.*

INTRODUCTION

Cordia africana is deciduous tree up to 30 m tall, characterized by very dense foliage consisting of large, dark green, cordial leaves (Bekele - Tesemma, *et al*., 1993). It is a large shady tree spreading for 10 m. It is sometimes named *Cordia abyssinica* and the local name in Sudan is "gumbail" (Bein, 1996). It's also wide spread in tropical Africa. In Sudan, the tree is confined to the areas of Ad-Damazin, Darfor (Jabal Merra) and Kordofan (Drummond, 1981). *Cordia africana* is a species of flowering tree that belong to Boraginaceae family (Nadja *et al*., 2002). This multipurpose tree is valued for food, fuel, and relatively termite resistant and timber; it is used for high quality furniture (Bekele - Tesemma *et al*., 1993).

Many secondary metabolites play ecological and physiological roles in higher plants. Investigations in the area of biochemical ecology indicate that some secondary compounds produced by plants are important either to protect these plants against microorganisms and animals, or to enhance the ability of one plant species to compete with other plants in a particular habitat (Richard and Roger 1994).

Termites are soft-bodied Arthropods described as social insects (Forschler and Jenkins, 2000). They are usually classified at the taxonomic rank of order Isoptera (Engel and Krishna 2004). On the whole, termites live on the cellulose of woody vegetation, many species burrowing into dead wood of trees and in buildings (Mackean, 2011). Strategies of termite control vary greatly from place to place across the world. Generally, termite control is best achieved in buildings by providing physical and chemical barriers (Jones 2003; Wonju *et al*., 2004).

Problems associated with the use of pesticides have led to an increasing interest in the development of alternative termite control methods and plants with pesticide properties may be one such alternative (Omer *et al.*, 2009). Anti-termite activity has been observed in many hardwood (Angiosperm) species and plant extracts (Logan *et al*., 1990) and natural pesticides based on plant extracts have been commonly used in pest control during the earlier half of the 20th century. Examples of some of these extracts are rotenone, nicotine and pyrethrum (Ibrahim *et al*., 2004). The present study was aimed to find environmentally friendly alternatives to insecticides for control of termites from locally occurring *Cordia africana* plants.

MATERIALS AND METHODS

Extraction procedure

Fresh and healthy samples of leaves, bark and roots from naturally growing plants of *C. africana* were (randomly) collected from Zalignei area to be shade dried and powdered. Each sample (40 g) was used for extraction. The pulverized samples were placed in a thimble and extracted exhaustively and sequentially, using petroleum ether, ethyl acetate, ethanol and distilled water in a soxhlet apparatus. The extractions were carried out until a clear solvent was observed. Extracts were further concentrated in a rotary evaporator at temperatures adjusted according to the solvent used. After the exhaustive extraction the remained plant materials were then soaked in water for 24 hours, to get the water extracts. Furthermore, new different samples (from the same original plant materials) were separately soaked in water only to get water extracts. The obtained extracts were clarified by filtration through whattman No.1 filter paper (Houtman *et al*., 2007). The extracts of plant substances were assayed for their efficiency as anti-termite or termite repellency using the grave yard method (ASTM, 1989).

Assay of anti-termite activity of the extracts

The test solutions were prepared by dissolving an amount of 0.3 g. of the extracts (leaves, bark and roots) separately in 20 ml of each of the above mention solvents. To standardize the concentration for all extracts the equation $C_1V_1 = C_2V_2$ (Mongay and Cerdá, 1984) was used to obtain the following concentrations; C_1 = 15 ppm, C_2 = 10 ppm, C_3 = 5 ppm, C_4 = 1 ppm and C_5 = 0.1 ppm, where:
C = concentration, V = volume.

The above obtained concentrations (extracts of the different parts with different solvents) were separately spread on a three layers of cellulose pads with dimensions of 0.50 cm x 10 cm x 10 cm till moistened. Pads moistened with distilled water only were used as control. The moistened pads were left to evaporate till drying and then labeled. Three replicas were used for each treatment. All the labeled pads were weighed before being buried at the testing site using the grave yard method (ASTM, 1989). The test was carried out at the experimental farm of the Gezira University in a site well known with termite infestation. The test pads were distributed randomly in a completely randomized design (C R D), and designated with vertical labels (Gary, 1979). The grave yard test lasted for 72 hours.

Statistical analysis

Data of experiment for assay of anti-termite activity of extracts, were statistically analyzed using analysis of variance (ANOVA) M. STAT. Program, and presented as average, standard error. Means were obtained using Duncan's multiple range test (DMRT) (Duncan, 1955). Data were transformed to $\sqrt{x+1}$ when necessary.

RESULT AND DISCUSSION

Plant material and extraction

The highest amount of extractive (9.56 g) was obtained from the bark when directly extracted by soaking in water only, followed by root (8.65 g) and leaf (4.46 g) extracts when also extracted with water only. It was also observed that succession with water after the solvent gave higher extractive content from leaves, root and bark (3.29 g, 2.98 g and 2.97 g respectively) than extraction with other solvents. The lowest amount (0.37 g) was obtained from the bark when using ethyl acetate as a solvent. There was variation on the extractive when using different solvents with different parts of the plant. The amount of the extractive does not necessary mean the efficiency of the solvent in this stage, but the fractionation and qualitative analysis would be of great value to determine the contents of the extractive. The basic parameters influencing the quality of an extract are: a) the plant part used as starting material, b) the solvent used for extraction and c) the extraction technology (Lijun and Curtis, 2006).

Preliminary assay for anti-termite activity

The idea behind the method and procedures developed during this research was to estimate the efficiency of various extractives. Results represented in Table (1) showed percentage of damage that took place after direct treatment with extractives without adjustment of the concentration. The initial exploration of the data showed that change in weight was common in the untreated and there was variation in weight loss among the different treatments. It was observed that all ethyl acetate extracts of leaves, bark and root have significantly reduced termite's infestation as compared to other extracts. The performance of ethyl acetate extract of leaf and bark were significantly better than that of root, and there were no significant differences between them. While the response to the water extractives was the least. Figure (1) was illustrated the different levels of damage in the cellulose pads caused by termites.

In further analysis (Table 2, 3 and 4), the results showed that all concentrations for different extract solvents significantly reduced termite attack compared to the untreated control. The pattern of differences in weight loss among medians and means are similar across all treatment depending on the concentrations which gave an indicative correlation between the concentrations type of solvent and the part of the plant. The pattern of decrease in weight was significantly high at water extracts treatments rather than when using solvent for extraction. The ethyl acetate extract had significantly higher anti-termite activity compared to the control and other test solvents. A tendency of decreased infestation was observed at extracts from all parts of the plant. The least susceptibility to termite destruction was in extracts from leaves as compared to the other parts of the plant. In general, ethanol and petroleum extracts from root, had good repellant activity of termite attack, while superior activity was observed by the ethyl acetate extracts either from leaf, bark or root. The study proved the suitability of leaves ethyl acetate extract of Gumbail for controlling termites, and represents a good environmental and alternative method for synthetic insecticides of termites. Further studies were attempted to isolate the bioactive compound from the crude extract using chromatography methods.

Table 1: Damage in cellulose pads treated with extracts obtained from different parts of *C. africana* extracted with different solvents

Plant Parts	Termite damage (%)				
	Petroleum ether	Ethyl acetate	Ethanol	Water after solvents	Water only
Leaf	45.72 (6.15) [a]	17.26 (3.43) [b]	53.58 (6.96) [a]	59.70 (7.27) [a]	65.00 (7.70) [a]
Bark	44.08 (5.71) [a]	15.48 (3.37) [b]	58.00 (7.18) [a]	60.97 (7.13) [a]	58.44 (7.01) [b]
Root	26.84 (4.35) [b]	25.23 (4.47) [a]	38.67 (5.17) [b]	56.21 (6.86) [a]	58.40 (7.37) [ab]
SE ±	0.185	0.169	0.201	0.177	0.168
C.V. %	48.32	57.86	47.99	33.57	29.27

*Means in a cross and rows followed by the same letter (s) are not significantly different at $P \leq 0.05 P \leq 0.05$; according to Duncan's multiple Range Test.
* Means between parentheses are transformed to $\sqrt{x+1}$
* SE ±: Standard error.
* C.V.% : Coefficient variance

Table 2: Effect of the extractive concentrations as extracted with petroleum ether from different parts of *C. africana* on termite damage %.

Solvent con. (ppm)	Termite damage (%)		
	Leaf	Bark	Root
0	51.13 (6.27) bcd	51.13 (6.27) bcd	51.13 (6.27) bcd
0.1	54.97 (7.46) bc	100.00 (10.05) a	69.13 (8.36) ab
1	12.23 (2.93) fgh	37.17 (5.00) def	1.37 (1.53) h
5	60.13 (6.91) bcd	30.03 (4.78) defg	1.90 (1.69) h
10	60.80 (7.82) bc	7.23 (2.56) gh	13.40 (3.68) efgh
15	35.07 (5.49) cde	38.90 (5.61) cde	24.10 (4.55) defg
SE ±	0.709		
C.V. %	48.32		

*Means in a cross and rows followed by the same letter (s) are not significantly different at $P \leq 0.05$; according to Duncan's multiple Range Test.
* Means between parentheses are transformed to $\sqrt{x+1}$
* SE ±: Standard error.
* C.V. %: Coefficient variance

Table 3: Effect of the extractive concentrations as extracted with ethanol from different parts of C. africana on termite damage %.

Solvent con. (ppm)	Termite damage (%)		
	Leaves	Bark	Root
0	79.87 (8.93) a	79.87 (8.93) a	79.87 (8.93) a
0.1	52.43 (6.64) abc	67.03 (8.24) ab	46.77 (5.94) bcde
1	50.43 (7.13) abc	34.76 (5.33) cde	8.53 (2.39) f
5	42.13 (5.93) bcde	47.53 (6.14) bcde	51.20 (6.21) bcd
10	37.73 (5.44) cde	48.83 (6.08) bcde	25.40 (3.60) ef
15	58.90 (7.68) abc	70.00 (8.37) ab	20.27 (3.98) def
SE ±	0.771		
C.V. %	47.99		

*Means in a cross and rows followed by the same letter (s) are not significantly different at $P \leq 0.05$; according to Duncan's multiple Range Test.
* means between parentheses are transformed to $\sqrt{x+1}$
* SE ±: Standard error.
* C.V.% : Coefficient variance

Table 4: Effect of the extractive concentrations as extracted with ethyl acetate from different parts of C. africana on termite damage %.

Solvent con. (ppm)	Termite damage (%)		
	Leaf	Bark	Root
0	39.70 (5.58) ab	39.70 (5.58) ab	39.70 (5.58) ab
0.1	0.33 (1.15) f	20.87 (4.14) bcd	42.20 (6.40) a
1	10.27 (2.92) cdef	23.13 (4.85) abc	11.97 (3.24) cdef
5	1.50 (1.56) ef	2.70 (1.81) ef	39.13 (5.74) ab
10	27.70 (4.63) abc	3.16 (2.02) ef	14.10 (3.69) bcde
15	24.07 (4.75) abc	3.33 (1.86) ef	4.33 (2.23) def
SE ±	0.647		
C.V. %	57.86		

*Means in a cross and rows followed by the same letter (s) are not significantly different at $P \leq 0.05$; according to Duncan's multiple Range Test.

* means between parentheses are transformed to $\sqrt{x+1}$

* SE ±: Standard error.

* C.V.% : Coefficient variance

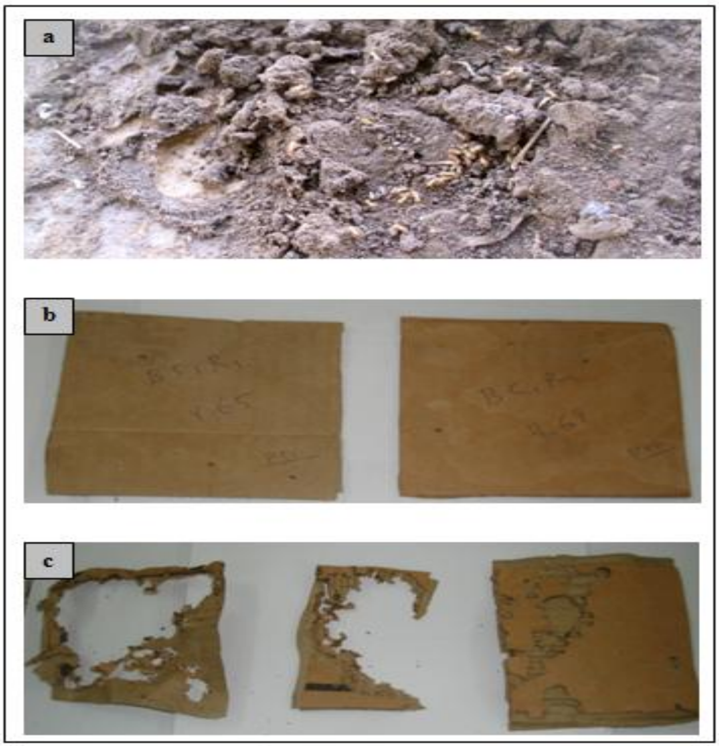

Figure 1: Bio-assay of anti-termite activity of the extracts of *C. africana* parts

a) Termites infested experimental site
b) Treated cellulose pads before being buried
c) Signs of termite damages

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