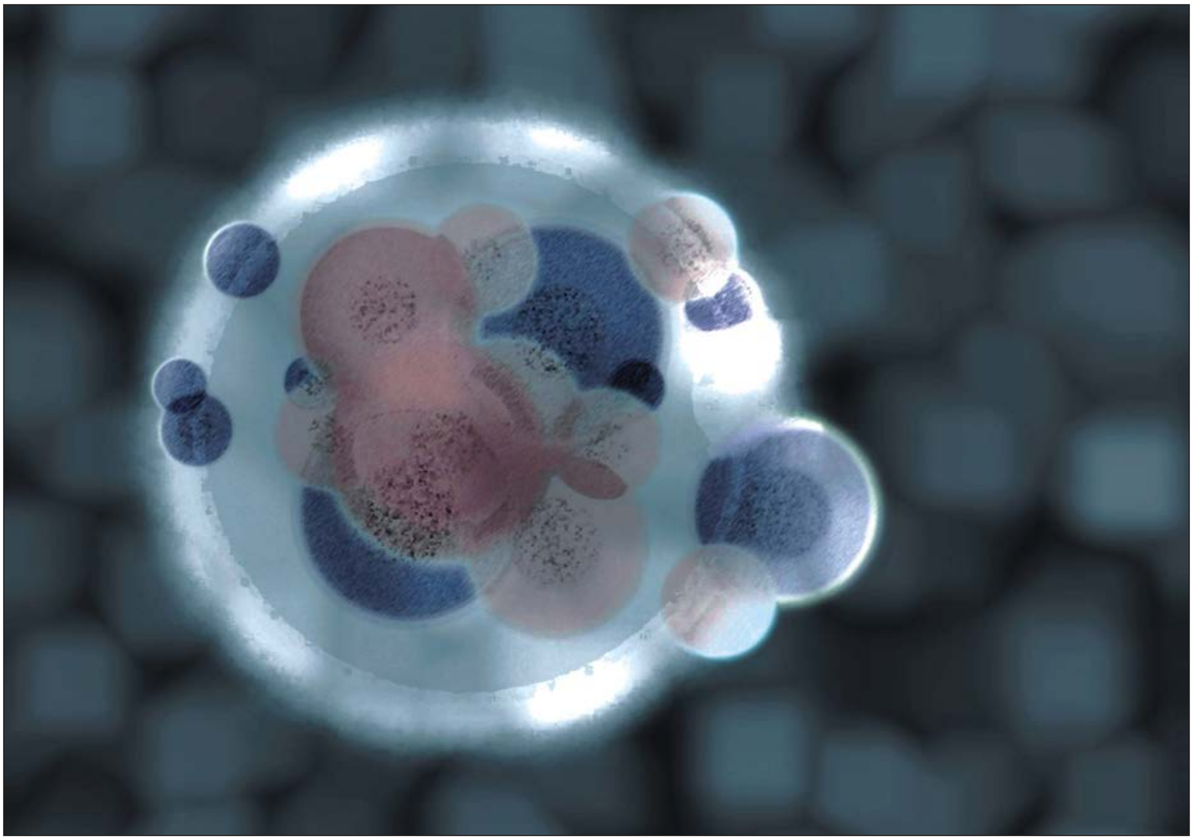

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Chemical Composition and Termicidal Properties of *Parkia biglobosa* (Jacq) Benth

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Abstract: The proximate and mineral composition of raw and boiled African locust bean (*Parkia biglobosa*) was determined. The termicidal properties of the aqueous and acetone extracts of the beans were also investigated. There were variations in the proximate and chemical composition of the raw and boiled samples. Cadmium, nickel, lead, cobalt and copper were leached out of the seed during boiling. The aqueous and acetone extracts of boiled *P. biglobosa* had no effect on termites, while they were affected by extracts of raw *P. biglobosa*. The aqueous and acetone extracts exhibited concentration dependent termicidal activity. However the aqueous extract was more active than the acetone extract. Termites died within 40 and 110 min when exposed to paper pads treated with 0.4 g mL^{-1} of aqueous and acetone extracts, respectively.

Key words: Locust bean, extract, proximate, mineral composition, termites

INTRODUCTION

Termites are the most destructive insect pests all over the world (Malaka, 1996). They derive their nutrition from wood and other materials containing cellulose such as paper, cotton and other plant products. Termites are attracted to odors of wood decay fungi that make the wood easy to penetrate (Roger *et al*., 2006). There are several approaches to control of termites. The main focus of past research was on chemical methods of control with an obvious lack of concern over side effects caused by the use of these chemicals. Many researches are now focused towards alternative non toxic and biological methods of control. These methods include baiting, asphyxiant gases, extreme temperatures, barriers of various types and biological control organisms (Malaka, 1996; Peralta *et al*., 2004). Naturally resistive woods and extractives have great promise for prevention of termite attack (Nakayama *et al*., 2000; Peralta *et al*., 2004). These extractives in form of phenolic compounds like terpenes and flavonoids have insecticidal activities (Nagnan and Clement, 1990; Morisawa *et al*., 2002; Coelho *et al*., 2006). Some of these substances may also act as feeding deterrents (Scheffrahn, 1991; Chen *et al*., 2004; Taylor *et al*., 2006).

The African locust bean tree, *Parkia biglobosa* (Jacq) Benth is a perennial tree legume which belongs to the subfamily Mimosideae and family Leguminosae. The fermented seeds of *P. biglobosa* are used in all parts of Nigeria for seasoning traditional soups. *Parkia* has found use as foods, medicinal agents and are of high commercial value (Ajayeoba, 2002). One of the local methods used in the controlling termite infestation is the application of water used in boiling *P. biglobosa* seeds during the fermentation of Iru a local condiment on termite infested wood. There is dearth of information on the various factors that could be responsible for the termicidal activity of the aqueous extract obtained after boiling, prior to the fermentation of the locust beans. This research was therefore designed to determine the proximate and chemical compositions of *P. biglobosa* seed extracts and examine their effects on termites.

MATERIALS AND METHODS

Parkia biglobosa were bought at the King's market in Ado-Ekiti, South Western Nigeria. Wood-eating termites were collected from decayed planks on the campus of the University of Ado-Ekiti, Nigeria, during the wet season (April to November).

Preparation of seed extract: Twenty grams of the dried powdered sample of *P. biglobosa* seeds (boiled and raw samples) were extracted with 100 mL of acetone and deionised water, respectively for 12 h. The extract was filtered and the filtrate allowed evaporating to dryness at 27±2°C.

Proximate analysis: The moisture, ash, crude fiber and fat contents of *P. biglobosa* (raw and/or boiled) seeds were

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determined by the methods of the Association of Official Analytical Chemists (AOAC, 1990). Nitrogen was determined by the micro-Kjeldahl method reported by Pearson (1976). The percentage nitrogen was converted to crude protein by multiplying with 6.25. The carbohydrate was calculated by difference.

Mineral analysis: The mineral components of the seeds were analyzed by dry-ashing 1 g of the sample at 550°C in a furnace. The ash obtained was dissolved in 10% hydrochloric acid, filtered and made up to standard volume with deionised water. The elements (Na, K, Ca, Mg, Fe, Cu, Pb, Mn, Cd, Co, Ni and P) were determined using the atomic absorption spectrophotometer (Buck model 200-A).

Determination of termicidal activity: Externally undifferentiated termites (workers) beyond the third instars were selected from colonies of *Amitermes evuncifer* Silvestri on a decayed wood. Extracts of *P. biglobosa* seeds were applied to absorbent paper pads and allowed to air dry. One milliliter aliquots of different concentrations ranging from 0.1 to 0.4 g mL^{-1} of the extract was applied to each pad and placed at the bottom of a disposable Petri plate (Carter *et al*., 1978). Forty termites were then placed on the pad and the conditions of the termites were monitored over a period of 3 h.

RESULTS AND DISCUSSION

There were variations in the composition, while the moisture and ash contents of the raw sample were higher than those of boiled *P. biglobosa* seeds (Table 1). The crude protein, fat, fiber and carbohydrate contents of the boiled seed were higher than in the raw seeds. Elements like cadmium, cobalt, nickel, lead and copper were present in the raw samples and absent in the boiled seeds of *P. biglobosa*. There was an increase in the concentration of sodium, potassium, magnesium, zinc, iron and phosphorus (Table 2). It was observed that the higher the concentration of the extract the faster the killing rate. All the termites died within 40 min when exposed to paper pads treated with 0.4 g mL^{-1} of the aqueous extract of raw *P. biglobosa* seed (Fig. 1). However, all the termites died within 1 h when exposed to paper pads treated with 0.1 g mL^{-1} of the same extract (Fig. 1). The effect of the acetone extract of the raw *P. biglobosa* seeds (Fig. 1) was less pronounced when compared to that of the aqueous extract. The acetone extract was only active at concentrations of 0.3 and 0.4 g mL^{-1}. All the termites died within 110 and 90 min when exposed to paper pads treated with 0.3 and 0.4 g mL^{-1} acetone extract of raw *P. biglobosa* seeds, respectively (Fig. 2). It was also observed that termites survived well on paper pads treated with either aqueous or acetone extracts of boiled *P. biglobosa* seeds. No death of termites was recorded.

There were variations in the proximate and mineral composition of the raw and boiled samples of *P. biglobosa*. This may be due to the effect of heat

Table 1: Proximate composition of *Parkia biglobosa* seeds

	Percentage	
Chemical components	Raw	Boiled
Moisture	13.49±0.01*	11.22±0.01*
Protein	25.57±0.00	30.12±0.00
Crude fat	6.63±0.01	18.21±0.00
Crude fiber	8.83±0.01	7.53±0.01
Ash	4.82±0.01	3.63±0.01
Carbohydrate	40.66±0.01	35.22±0.01
Nitrogen	4.09±0.02	4.82±0.01

*: Mean±SD of triplicate determinations

Table 2: Mineral composition of *Parkia biglobosa* seeds

	Level (mg mL^{-1})	
Minerals	Raw	Boiled
Sodium	167.08±0.01	299.60±0.00
Potassium	121.31±0.11	453.00±0.00
Calcium	548.68±0.01	271.07±0.02
Magnesium	62.71±0.10	426.90±0.01
Zinc	16.32±0.01	20.00±0.01
Iron	7.85±0.02	9.00±0.00
Lead	2.46±0.01	ND
Manganese	0.98±0.01	0.67±0.01
Cadmium	40.14±0.11	ND
Cobalt	4.20±0.01	ND
Nickel	3.96±0.02	ND
Phosphorus	54.40±0.01	65.70±0.05
Copper	6.99±0.01	ND

Mean±SD of triplicate determinations, ND: Not Detected

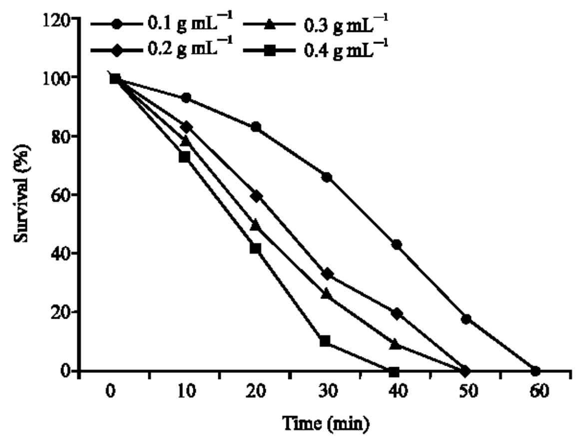

Fig. 1: Antitermic activity of aqueous extracts of *Parkia biglobosa*

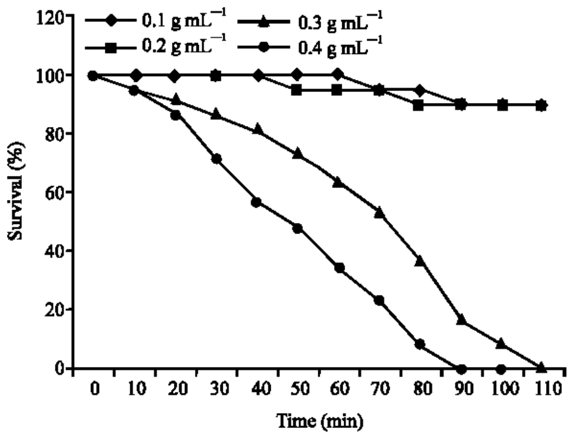

Fig. 2: Antitermic activity of acetone extracts of *Parkia biglobosa*

treatment on the boiled sample. Omafuvbe *et al.* (2004) had reported that boiling, soaking in water and dehulling of African locust bean (*P. biglobosa*) led to the reduction of ash, crude fiber and mineral contents of the seeds. It has been suggested that a large percentage of the mineral constituent may reside in the hull of the seed and are leached out during processing (Alabi *et al.*, 2005). Raw *P. biglobosa* contained some heavy metals such as cadmium, cobalt, nickel, lead and copper which are natural components of the earth crust and are toxic at low concentration (Cheng, 1990).

The aqueous extract of boiled seed did not have any termicidal effect on the termites, while they were affected by aqueous extract of the raw *P. biglobosa* seed. Extracts from several plants have been reported to have biocidal effects or acting as feeding deterrents to insects such as termites (Morisawa *et al.*, 2002; Chen *et al.*, 2004; Neya *et al.*, 2004; Coelho *et al.*, 2006; Taylor *et al.*, 2006). The biocidal activity of the raw seeds may be due to the presence of heavy metals (Cu, Cd, Co, Ni and Pb) which were absent in the boiled samples. The elements may have been leached during the boiling process as earlier suggested by Omafuvbe *et al.* (2004). This may explain why the boil water obtained during the processing of African locust bean for Iru fermentation is effectively used traditionally in the control of termite infestation (Malaka, 1996). It has been well established that certain extractives found in plant material acted as a natural repellent for termites (Grace, 1997; Nakayama *et al.*, 2000; Verena-Ulrike and Horst, 2001; Neya *et al.*, 2004).

CONCLUSION

This study has confirmed that African locust bean (*Parkia biglobosa*) seed extract could be used in the alternative control of wood infestation by termites. Further research is being carried out to determine the active components of *P. biglobosa* seed coat that may be responsible for its termicidal activity. Even though elements that could be poisonous were found in the extracts of the raw seeds, the biocidal activity of these elements on termites needs to be ascertained.

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