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Phytochemical analysis and evaluation of the antioxidant and *in-vitro* anthelmintic activity of *Parkia biglobosa* fruit husk extracts

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Abstract

The fruit husks of *Parkia biglobosa* is used in folk medicine for the treatment of helminthiasis and other infectious diseases. This study determined the phytochemical contents, and evaluated the *in vitro* antioxidant and anthelminthic activities of *Parkia biglobosa* fruit husks extracts. Extraction was done by cold maceration method, using acetone, water and methanol, and the yield percentages were 15, 16 and 10%, respectively for each of the solvents. Determination of the phytochemical constituents of the different extracts revealed the presence in them of alkaloids, cardiac glycosides, flavonoids, saponins, phlobotannins, phenols, terpenoids, reducing sugar, volatile oil and tannins at varied levels. Total phenolic and total tannin contents were higher in acetone extract with the values of 87.2 ± 0.0 µg GAE/g and 88.0 ± 0.0 µg GAE/g, respectively while the total flavonoid content was higher in methanol extract with the value of 57.3 ± 00 µg QE/g. The antioxidant activity of the extracts was measured using DPPH, hydroxyl and superoxide scavenging assay. Acetone extract had the highest antioxidant activity in DPPH and superoxide assay, with the percentage level of 66.0 ± 0.0 and 56.0 ± 0.0 %, respectively. The *in vitro* anthelmintic activity of the acetone extract was highest at the concentration of 30 µg/ml, and larva paralysis and death occurred at 6.7 ± 1.7 and 16.7 ± 1.7 minutes, respectively, when compared to the albendazole (positive control), which had the time for larva paralysis and death of 16.7 ± 0.0 and 13.3 ± 1.6 minutes, respectively. The results of this study strongly suggest that the fruit husk of *Parkia biglobosa* is a source of natural antioxidants and anthelmintic.

Keywords: *Parkia biglobosa*; Fruit husk extracts; Phytochemical constituents; Antioxidant activity; Anthelmintic activity.

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Introduction

The use of herbs or plant products by man as medicine has been from time immemorial. Herbal preparations represent one of the important traditional therapies in the world, and it is still the main stay of ethnomedicine. It has been reported that 80% of the world's population rely on traditional medicine for their primary healthcare needs, especially in developing countries (Kamboj, 2000). In addition, an estimated 25% of modern medicines are made from plants, which were earlier used as traditional medicines for the treatment of diseases (Hamilton and Baskett, 2000).

Helminthiasis is a common animal health problem in livestock production throughout the tropics, especially in Nigeria. Most of the diseases caused by helminths are chronic and debilitating in nature; they cause more morbidity and greater economic and social deprivation among humans and animals than any single group of parasites (Hotez *et al*., 2008). Parasitic gastroenteritis (PGE), caused by mixed infection with several species of stomach and intestinal worms, results in weakness, loss of appetite, decreased feed efficiency, reduced weight gain and decreased productivity. Chemotherapy is the major strategy for control of helminth infections in Nigeria, as effective vaccines against helminths have not been developed so far (Vercruysse *et al*., 2018). Indiscriminate use of synthetic anthelmintics has been reported to lead to parasite resistance (Fissiha and Kinde, 2021).

There has been a shift from the use of synthetic medicines to the use of medicinal plants as a result of the reported adverse side effects of synthetic drugs and the prospects of development of resistance to synthetic drugs (Ekor, 2014). There are literally thousands of phytochemicals derived from plants that are relatively safe and effective with less adverse side effects in the treatment of diseases. Many beneficial biological activities of plant-derived medicines such as anti-cancer, antimicrobial, antioxidant, antidiarrheal, analgesic and wound healing activity had been reported as a result of studies conducted on medicinal plants (Sasidharan and Menon, 2011). In many cases, the health benefits of plant derived medicines had been claimed, but there is a need to scientifically study such plants in order to demonstrate and validate such claims and possibly isolate and characterize the bioactive components responsible for the therapeutic activity.

Medicinal plants have become the focus of intense study recently in terms of conservation and their traditional medicinal uses. The studies on plants have either supported the claims by the traditional healers or contradicted such folkloric claims (Cunningham, 1988; Jager *et al*, 1995; Locher *et al*., 1995; Williams, 1996). With the increased level of acceptance of traditional medicines as an alternative to solving healthcare problems, the screening of medicinal plants for active compounds became necessary. This involves a careful study of these plant materials from the extraction to the identification of the compounds present in them and their structural elucidation, which may eventually lead to the development of several drugs as well as other herbal remedies (UNESCO, 1998).

Parkia biglobosa is popularly known as African locust bean tree. It is also known as "Dorawa" in Hausa, "Irugba" in Yoruba, "Origili" in Ibo (Ajaiyeoba, 2003). The tree belongs to the genus Parkia in the family Fabaceae. It has a wide distribution across the Sudan and Guinea savanna ecological zones. It is found in 19 African countries (Hall *et al.,* 1997). The fruit husk of *Parkia biglobosa* is widely used in North Eastern part of Nigeria to treat a variety of microbial infections and anthelmintic infestations, but there are limited scientific

reports on the use of this plant part for these purposes. The aim of this present study was to determine the phytochemical constituents, and evaluate the antioxidant and anthelmintic activities of the extracts (acetone, water, methanol extracts) of fruit husk of *Parkia biglobosa*.

Materials and Methods

Plant collection, Identification and Preparation of Extracts: A branch of *Parkia biglobosa* tree (Figure 1) containing the leaves, stem and fruits was collected from Chibok town in Borno State, Nigeria and submitted for confirmation and authentication by a plant taxonomist; a voucher specimen was deposited in the Department of Veterinary Pharmacology and Toxicology, Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria. The fruit husks (Figure 2) used for the study were removed from the fruits, and air dried at room temperature and thereafter pulverized by grinding with pestle and mortar.

Figure 1. A picture of *Parkia biglobosa* tree.

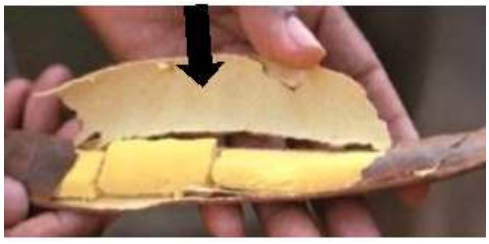

Figure 2. Fruit husk of *Parkia biglobosa* (arrowed).

The solvents used for the extraction were water, methanol and acetone. The cold maceration method as described by Umeh *et al*. (2005) was used for the extraction with the three solvents. One litre of each solvent was mixed with 200g of the dried pulverized fruit husk in separate conical flasks. The mixture was allowed to stay for four days, with intermittent shaking, and it was afterwards filtered using Whatman No. 1 filter paper. The extracts were recovered separately by evaporating the solvents in a water bath and the extraction yield of each of the extract was calculated and recorded. The extracts were then collected, labeled and stored at 4°C until used.

Qualitative Phytochemical Analysis: Freshly prepared *Parkia biglobosa* fruit husk extracts (water, methanol and acetone extracts) were dispensed into different test tubes for various phytochemical contents analyses based on the methods described by Harbone (1984), Evans (2002) and Sofowora (2008). The plant metabolites that were tested included alkaloids, anthraquinones, cardiac glycosides, flavonoids, saponins, steroids, phlobotannins, terpenoids, reducing sugar, phenolics, volatile lipid and tannins.

Determination of total phenolic content: The total phenolic content of the three extracts was evaluated following the Folin-Ciocalteu method (Lamuela-Raventos, 2018). The phenolic concentration of the extracts was estimated from a gallic acid calibration curve. To prepare a calibration curve, 0.5 ml aliquots of 10, 20, 30, 40, 50, 60, 70, 80 and 90 µg/ml methanolic gallic acid solution were mixed with 2.5 ml Folin-Ciocalteu reagent (diluted ten-fold) and 2.5 ml sodium carbonate (75 g/L). After incubation at 25°C for 30 minutes, the quantitative phenolic estimation was performed and the absorbance was measured at 765 nm against reagent blank using a spectrophotometer (Shimadzu, Japan). The calibration curve was constructed by plotting the value of absorbance against

concentration. All tests were performed in triplicate and the total phenolic content was recorded in milligramme of gallic acid equivalent (GAE) per gramme of extract.

Determination of total flavonoid content: The total flavonoid content was determined with aluminium chloride ($AlCl_3$), using quercetin as a standard (Zhishen *et al*., 1999). The plant extract (0.1 ml) was added to 0.3 ml distilled water followed by $NaNO_2$ (0.03 ml, 5%). After keeping for 5 minutes at 25°C, $AlCl_3$ (0.03 ml, 10%) was added. After a further 5 minutes, the reaction mixture was treated with 0.2 ml 1 mM NaOH. Finally, the reaction mixture was diluted to 1 ml with water and the absorbance was measured at 510 nm. The tests were performed in triplicate. The flavonoid content was calculated from the quercetin standard curve, and expressed as mg quercetin equivalent (QE) per g of extract.

Determination of total tannin content: The tannin content was determined using the Folin-Ciocalteu method, with minor modifications (Kavitha and Indira, 2016). The extract (0.1 ml) was added to a 10 ml capacity volumetric flask containing 7.5 ml of distilled water, 0.5 ml of Folin-Ciocalteu phenol reagent and 1 ml of 35% sodium carbonate solution, and was then made up to 10 mL with distilled water. The mixture was shaken well and kept at room temperature for 30 minutes. A set of reference standard solutions of tannic acid (10, 20, 30, 40, 50, 60, 70, 80, 90, 100 µg/mL) was prepared. The absorbance of the test and standard solutions was measured with a spectrophotometer (U-2900, Hitachi High-Tech Corporation, Tokyo, Japan) against the blank (distilled water) at 700 nm. The determination of the total tannin content (TTC) was carried out in triplicate. The tannin content was expressed in terms of µg/ml of tannic acid in the sample.

2, 2- Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity: The radical scavenging activity of the three extracts of *Parkia biglobosa* fruit husks was measured according to the method of Blois (1958). One millilitre of variable concentrations of the extracts (25 – 250 µg/ml of ethanol) was added to 1 ml of a DPPH solution (0.2 mM in ethanol) as the free radical source and kept for 30 minutes at room temperature. The decrease in the absorbance of the solution due to proton donating activity of the extracts, was measured at 517 nm. L-Ascorbic acid was used as the positive control. The percentage DPPH radical scavenging activity was calculated using the following formula: DPPH radical scavenging activity (%) = $\frac{A0-A1}{A0}$ x 100, where A_0 is the absorbance of the control and A_1 is the absorbance of the extract or the standard.

Hydroxyl radical scavenging activity assay: The scavenging activity for hydroxyl radicals was measured with Fenton reaction, as described by Yu *et al*. (2004). The reaction mixture contained 60 ml of 1.0 mM $FeCl_2$, 90 ml of 1 mM 1,10-phenanthroline, 2.4 ml of 0.2 M phosphate buffer (pH 7.8), 150 mL of 0.17 M H_2O_2, and 1.5 ml of the extracts at various concentrations. Adding H_2O_2 started the reaction. After incubating at room temperature for 5 minutes, the absorbance of the mixture was measured at 560 nm with a spectrophotometer. The hydroxyl radicals scavenging activity was calculated as: Hydroxyl radical scavenging activity (%) = $\frac{A0-A1}{A0}$ x 100, where A_0 is the absorbance of the control and A_1 is the absorbance of the extract or the standard.

Superoxide radical scavenging activity: The superoxide anion scavenging activity was measured based on the method described by Robak and Gryglewski (1988). The reaction mixture, containing PMS (0.1 mmol/L), NADH (1 mmol/L) and NBT (1 mmol/L) in phosphate buffer (0.1 mol/L, pH 7.4) with different concentrations of the extracts, was incubated at room temperature for 5 min and the color was read at 560 nm against a blank. The

scavenging effect was calculated using the following equation: Superoxide radical scavenging activity (%) = $\frac{A0-A1}{A0}$ x 100, where A0 is the absorbance of the control and A1 is the absorbance of the extract or the standard.

***In-vitro* anthelmintic activity of the extracts:** Rectal faecal samples were collected randomly from selected sheep and goats grazing on contaminated pasture and stored in plastic bags and taken to the laboratory. The faeces were pooled, mixed and incubated for 12 days at 27 ^{0}C. The samples were kept damped during the period of incubation. On day 12, larvae of *Haemonchus* were harvested and used to test for the anthelmintic activity of the different extracts. The evaluation of the larvicidal activity of the different extracts was conducted according to the method described by Wabo-Pone *et al.,* (2011). Albendazole was used as a positive control at the concentrations of 10, 20, and 30 µg/ml while distilled water was used as the negative control. The larvae of *Haemonchus* in 10 µl of suspension was added to each of the labelled 96-well flat-bottom microtitre plates. 10 µl of the different concentrations (10, 20, 30 µg/ml) of the extracts was added. Each test was done in triplicate. The content of each well was stirred and pipetted onto a clean glass slide and examined under a microscope at × 4 magnification to count the number of larvae that were dead or alive. The observation was repeatedly done at the interval of 20 minutes for 2 hours and the result was recorded as the time of paralysis of the larva and the time the larva died (in minutes). The movement of the larva from one point to the other indicates the parasite was alive, and the larva was considered dead when there was no observable motion after 5 – 10 seconds.

Statistical analysis: Data generated were subjected to descriptive statistics using IBM SPSS statistical package (Version 23), and presented as mean with standard error of mean (mean ± SEM).

Results

Extraction: The yield percentage of the extraction using the three solvents were: Acetone extract – 15%; Methanol extract – 10%; Water extract – 16%.

Qualitative Phytochemical Analysis: The results of the qualitative phytochemical analysis of the three different extracts (acetone, methanol and water) and their level of availability in the fruit husk of *Parkia biglobosa* is presented in Table 1. All the three extracts had high levels of flavonoids (Table 1). The acetone extract further had high levels of alkaloids, tannins and phenols, but moderate levels of glycosides, terpenoids, reducing sugars and volatile oils; while the methanol extract further also had high levels of alkaloids, tannins and phenols, with moderate levels of glycosides, phlobotannins, reducing sugars and volatile oils (Table 1). For the water extract, beyond the high levels of flavonoids, there were also high levels of terpenoids and moderate levels of alkaloids, glycosides, saponins, reducing sugars, tannins and phenols (Table 1).

Total phenolic content: The total phenolic contents of the extracts ranged from 85.0 ± 0.2 µg GAE/g recorded for the water extract, to 87.1 ± 0.0 and 87.2 ± 0.0 µg GAE/g recorded for the methanol and acetone extracts, respectively (Table 2).

Total flavonoid content: The total flavonoid contents of the water extract was relatively low (28.3 ± 0.0 µg QE/g) when compared to the 57.3 ± 0.0 and 57.0 ± 0.0 µg QE/g recorded for the methanol and acetone extracts, respectively (Table 2).

Total tannin content: The total tannin contents of the three extracts did not vary much; they ranged from 86.0 ± 0.0 µg/ml recorded for the water extract, to 88.0 ± 0.0 µg/ml recorded for both the methanol and acetone extracts (Table 2).

Table 1: Qualitative phytochemical constituents of crude acetone, methanol and water extracts of *Parkia biglobosa* fruit husk.

Constituents	Acetone extract	Methanol extract	Water Extract
Alkaloids	++	++	+
Anthraquinones	-	-	-
Cardiac glycosides	+	+	+
Flavonoids	++	++	++
Saponins	-	-	+
Steroids	-	-	-
Phlobotanins	-	+	-
Terpenoids	+	-	++
Reducing sugar	+	+	+
Volatile oil	+	+	-
Tannin	++	++	+
Phenol	++	++	+

Key: (-) = Negative, (+) = Positive, (++) = Highly positive

Table 2: Quantitative total phenolic, flavonoid and tannin contents of crude acetone, methanol and water extracts of *Parkia biglobosa* fruit husk.

Extracts	Total Phenolic content (µgGAE/g)	Total Flavonoid content (µgGAE/g)	Total Tannin content (µg/ml)
Acetone extract	87.2 ± 0.0	57.0 ± 0.0	88.0 ± 0.0
Water Extract	85.0 ± 0.0	28.3 ± 0.0	86.0 ± 0.0
Methanol extract	87.1 ± 0.0	57.3 ± 0.0	88.0 ± 0.0

Values are presented as mean ± SEM of triplicate determination of the contents of phenolic, flavonoid and tannin in the extracts.

Antioxidant activity of the extracts: The results of the evaluation of the antioxidant activity of the extracts for DPPH, hydroxyl and superoxide scavenging activities are presented in Table 3. The extracts were capable of neutralizing the DPPH free radicals via hydrogen donating activity by 66.3 % in acetone extract, 36.7 % in methanol extract and 48.7 % in water extract (Table 3). The hydroxyl scavenging activity was 21.7 % for acetone extract, 33.6 % for methanol extract and 9.1% for the water extract (Table 3). For superoxide, the scavenging activity was 56.0 % for acetone extract, 55.0 % for methanol extract and 37.0 % for water extract (Table 3).

***In vitro* Anthelmintic Activity:** Results of the *in vitro* anthelmintic activity of the three different extracts (acetone, water and methanol) of fruit husk of *Parkia biglobosa* are presented in Table 4. No paralysis or death of *Haemonchus* larvae was recorded for the

distilled water (negative control) and the methanol extract at 10 µg/ml concentration, but the acetone extract recorded the shortest time of paralysis and death of the *Haemonchus larvae* at all concentrations when compared with other extracts, though it was slightly higher than the time recorded for the Albendazole positive control (Table 4). Among the extracts, acetone extract effect on paralysis and death of the larvae was followed by that of water extract and then methanol extract. The half maximal effective concentration (EC_{50}) varied among the groups from the 15.8 (lowest) recorded for the albendazole positive control to the 22.9 recorded for acetone extract and the 25.9 and 27.5 recorded for the methanolic and water extracts, respectively (Table 4).

Table 3: *In vitro* anti-oxidant activity of crude acetone, methanol and water extracts of *Parkia biglobosa* fruit husk.

Extracts	DPPH scavenging activity (%)	Hydroxyl scavenging activity (%)	Superoxide scavenging activity (%)
Acetone extract	66.3 ± 0.0	21.7 ± 0.0	56.0 ± 0.0
Methanol Extract	36.7 ± 0.0	36.6 ± 0.0	55.0 ± 0.0
Water extract	48.7 ± 0.0	9.1 ± 0.0	37.0 ± 0.0

Values are presented as mean ± SEM of triplicate determinations.

Table 4: *In vitro* anthelmintic activity of crude acetone, methanol and water extracts of *Parkia biglobosa* fruit husk, indicating the time (in minutes) of paralysis and time of death of the *Haemonchus* larvae**.**

Extracts		Time taken for *Haemonchus* larvae to be paralyzed or to die (minutes)			
		10 µg/ml	**20 µg/ml**	**30 µg/ml**	**EC_{50}**
Acetone extract	Paralysis	15.0 ± 2.9	11.7±1.7	6.7±1.7	22.9
	Death	31.7 ± 1.7	21.7±1.7	16.7±1.7	
Water Extract	Paralysis	33.3 ± 1.7	25.0 ± 2.9	20.0 ± 5.9	27.5
	Death	38.3 ± 4.4	35.0 ± 2.9	35.0 ± 2.9	
Methanol extract	Paralysis	NP	55.0 ± 2.9	45.0 ± 2.4	25.9
	Death	ND	75.0 ± 2.9	58.3 ± 3.6	
Albendazole	Paralysis	11.7 ± 1.7	10.0 ± 0	6.7 ± 1.7	15.8
	Death	25.0 ± 2.9	16.7±1.7	13.3 ± 1.6	
Distilled water	Paralysis	NP	NP	NP	NA
	Death	ND	ND	ND	

Values are presented as mean ± SEM of triplicate determinations. [NP – No paralysis; ND – No death; NA – Not applicable]

Discussion

The different yields recorded for extraction using the different solvents in this study is believed to be due to the differences in polarity of the solvents. The solvents affected the extraction yield and the content of bioactive substances in each of the extracts, and it is thought that this might as well be responsible for the different effects noticed on the biological activity of the extracts (Mohd *et al*., 2012; Nihal *et al.*, 2005). In evaluating the anthelmintic activity, knowledge about the yield of extract is important because lower extract yielding plants are not commonly preferred by the pharmaceutical industries for drug development (Ishnava *et al*., 2015). Based on the results obtained for the extracts in this study, the percentage yields recorded may be considered as being high (Ishnava *et al*., 2015).

Among the varied phytochemicals recorded to be present in the extracts of the fruit husk of *Parkia biglobosa*, flavonoids were found to be in high levels in all the three extracts. Flavonoids had been reported to exert multiple bioactive properties such as anti-oxidant, anti-viral, anti-bacterial, anti-cancer, anti-inflammatory and cytotoxic properties (Teitan *et al*., 2013). Flavonoids acts as free radical scavengers and has been reported to be potential reducing agents that protect the body cells from oxidative damage. When compared, flavonoid concentration was higher in the methanol and acetone extracts, and lower in water extract. Alkaloids were found present in all the three extracts, though it was recorded to be relatively higher in the acetone and methanol extracts. The clinical importance of alkaloids includes muscle relaxation; they promote sleep in animals (Hussain *et al*., 2018). Alkaloids have also been reported to have anti-bacterial, anti-malarial, anti-hypertensive and anti-cancer activities (Deepak *et al*., 2016). Earlier reports showed that aporphine alkaloids possess anthelmintic activity (Sloan *et al*., 2007). Cardiac glycoside was also present in all the three extracts in moderate amounts. Clinically, glycosides increase the inotropic effect and rate of contraction of the heart. Cardiac glycosides have been utilized in the treatment of congestive heart failure. Additionally, glycosides with laxative, diuretic and antiseptic properties are being used in therapy (Robinson, 1967). Saponins were recorded to be present only in the water extract; they have expectorant property, and had been reported to be very effective in the treatment of upper respiratory tract inflammations (Irem and Somuncuaglu, 2021). Saponins had also been reported to possess anti-microbial property and can be used in the treatment of microbial infections (Birk and Petri, 1980). Terpenoids was present only in water and acetone extracts but was higher in water extract. Terpenoid had been reported to have medicinal properties such as anti-cancer, anti-ulcer, anti-malarial and diuretic activity (Langenheim, 1994). Reducing sugars was recorded to be present in all the extracts at moderate levels. Some reducing sugars can soothe the gastrointestinal tract and help in preventing diarrhea and gastroenteritis (Dharmanada, 1991). Volatile oil was present in acetone and methanol extracts, it can exert an antioxidant, antifungal, antimicrobial, antianxiety and pain reliving activities (Mohammed *et al*., 2019). Tannins and phenols were recorded to be present in all the extracts with higher concentrations in the acetone and methanol extracts followed by water extract. Tannins had been reported to possess anti-cancer and anti-mutagenic activities, which may be related to the fact that they also have anti-oxidative properties; this may be important in protecting against cellular oxidation (Chung *et al.*, 1998). Tannins also have been reported to possess anti-microbial activity; the growth of yeasts, fungi, bacteria and viruses has been reported to be inhibited by tannins. Phenols have been reported to have anti-oxidant, anti-bacterial, anthelmintic and anti-neoplastic activities

(Alan and Miller, 1996). The antioxidant capabilities of phenols are related to the hydroxyl groups and phenolic rings present in the phenolic compound structure. Phenols are also known to be powerful chain breaking anti-oxidants, which may contribute directly to oxidative action (Alam *et al*., 2013; Abdennacer *et al*., 2015; Aghraz *et al*., 2018). The results of the phytochemical analysis in this present study are in agreement with the reports of Ajaiyeoba (2003) and Udobi and Onaolapo, (2009) on the leave, stem bark and the root extracts of *P. biglobosa*.

Results of the evaluation of the antioxidant activities of the extracts investigated in the present study showed that the extracts were capable of neutralizing the DPPH free radicals via hydrogen donating activity. The hydroxyl scavenging activities was higher in methanol extract and lower in water extract. For superoxide, the scavenging activity of the acetone extract was higher, followed by the methanol then water extracts. These results show that the fruit husk of *Parkia biglobosa* has antioxidant activity in all the extracts. The present study also agrees with the reports of Komolafe and Oyelade (2015) which revealed that the aqueous-methanolic extract of the leaves of *Parkia biglobosa* has radical scavenging activity. Kayode *et al*., (2014) also made a similar report on the aqueous-methanolic extract of *Parkia biglobosa* stem bark; they observed that the extract exhibits considerable antioxidant activity by scavenging cation radicals.

The *in vitro* anthelmintic study showed that the extracts of the fruit husk of *P. biglobosa* have anthelmintic activity against *Haemonchus* larval stages. The extracts induced paralysis and death of the larval stages of *Haemonchus* parasites. The *in vitro* anthelmintic activity of acetone extract at 30 µg/ml produced a near similar effect as that of albendazole at the same concentration; this may be an indication that the extract may have acted in similar way as albendazole.

The finding in this present study that the EC_{50} of the acetone, water and methanol extracts of *P. biglobosa* were 22.9 µg/ml, 25.9 µg/ml and 27.5 µg/ml respectively while that of albendazole was 15.8 µg/ml, implies that the acetone extract with 22.9 µg/ml EC_{50} exhibited highest anthelmintic efficacy against the larval stages of *Haemonchus* larvae. Some of the phytochemicals present in the extracts such as tannins, flavonoids and saponins may be responsible for the anthelmintic activity observed in the study (Cho-Ngwa *et al*, 2010; Ndjonka *et al*., 2011 and 2014; Samje *et al*, 2014). Earlier reports have shown that condensed tannin contained in Nigerian plants has been proven to have anthelmintic activity, by inhibiting nematode glutathione-s-transferase *in-vitro* (Fakae *et al*, 2000). The findings in the present study agrees and concurs with a previous report by Soetan *et al.* (2011) in which the aqueous extracts of both the seeds and the leaves of *Parkia biglobosa* exhibited anthelmintic activity, with the seeds having more anthelmintic activity than the leaves. Josiah *et al*. (2022) also reported on the anthelmintic efficacy of the extract of stem bark of *P. biglobosa*.

Conclusion: Based on the results of the study, it was concluded the crude acetone, methanol and water extracts of the fruit husk of *Parkia biglobosa* contains very useful elements and bioactive constituents as phytochemicals. The extracts induced paralysis and death of the larval stages of *Haemonchus* parasites, which is an indication of its anthelmintic activity. Extracts of the fruit husk of *P, biglobosa* also showed a strong antioxidant activity. These results validate the folkloric usage of this plant as an anthelmintic agent in the North-Eastern Nigeria, and also, that the fruit husk of *Parkia biglobosa* is a prospective source of natural antioxidants.

Conflict of Interest

The authors declare that they have no affiliations with or involvement in any organisation or entity with any financial interest (such as honoraria, educational grants, participation in speakers' bureaus, membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licencing arrangements), or non-financial interest (such as personal or professional relationships affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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