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Proximate Analysis of seed and pulp of *Parkia biglobosa* (Jacq.) Benth from different provenances in sub Sahara Region of Africa.

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ABSTRACT

The socio-economic importance and cultural values of *Parkia biglobosa* fruits among local people within the parkland system necessitate the need to study the provenances of *Parkia biglobosa* plantation located in Saki, Oyo State. Proximate analysis of the seeds and pulp of *Parkia biglobosa* were assessed for protein, carbohydrate, ether extract (fat), moisture content and ash. The data collected were analysed using descriptive (mean, standard error) and Analysis of Variance. The results obtained shows that there were significant difference in the level of the proximate composition in the seeds and pulp of *Parkia biglobosa* from different provenances. The mean moisture content in the seeds from Cameroun provenance with the value 4.133% was the highest. The seeds of Cameroun provenance also had the highest crude fibre of 4.733% and the least mean value in the seeds from Senegal with 4.467% was recorded. The maximum carbohydrate (CHO) content was recorded in the seeds from Senegal with 31.233%, while the minimum mean value of CHO was found in the seed from Guinea with 28.200%. The seed sourced from Guinea provenance had the highest percentage of protein content (32.533%), the least mean value was associated with seeds from Cameroun (29.433%). The highest mean value for fat and ash were found in seeds from Burkina Faso Provenances which are 18.733% and 4.3% respectively. The carbohydrate content of the pulp is characterised with high values ranging from 67.000 to 70.257%. While the protein, fat, ash and crude fibre were low. The moisture content ranged from 18.133%. to 21.433% It was concluded that there were variation in the proximate analysis of *Parkia biglobosa* seeds and pulp from different locations. Also, based on the management objective, the proximate composition which is of great interest to food industry and nutritionist, will dictate the choice of provenance.

Keywords: Provenances, Moisture, Protein, Carbohydrate, Crude fibre and Ether extract

Introduction

Provenance study has gone a long way in choice of selection for plantation establishment. It is a known fact that not only foresters are interested in provenance or location study. The nutritionist, end users and consumers are concern in source of seeds in one way or the other. The findings from germplasm of forest trees and its products is of great interest as attention is now on fruit, seed, and nut from non timber forest product in which *Parkia biglobosa* is one of them. African locust bean (*Parkia biglobosa*) a leguminous plant is one of the economic trees in the sub Sahara region. The most important product of the tree is the fruit, out of which a fermented paste is made from the dried seeds, the pulp which is been licked up by the children and pod used for local tiles (Adama and Jimoh, 2011).

The trees of the Parkia species are usually and carefully preserved by the inhabitant of the area where they grow because they are valuable sources of reliable food, wood production, supply of timbers, firewood, pulp and fibre through fodder, gum, drugs and dyes are well as restoration of soil

fertility (Okafor, 1980). The seeds have been confirmed to be rich in protein, lipids, Carbohydrate, Vitamin B_2, when fermented also rich in lysine according to the findings of (Auta *et al.*, 2014 and Ademola *et al.*, 2011). Also, fruit pulp of the African locust bean is sweet to the taste, which indicates the presence of natural sugars and thus a potential energy source. The attractive yellow colour indicates the presence of phytonutrients, possibly carotenoids, which are important precursors of retinol (vitamin A) (Auta *et al.*, 2014). The sour taste of the pulp suggest the presence of ascorbic acids (vitamin C) (Akoma *et al.*, 2001) However, the Carbohydrate content of the pulp was found to be much higher than the seeds (Uwaegbute, 1996). The African locust bean fruit pulp is a potential good source of energy given the recommended daily energy intake, (Muller,1988) this could be process into energy food drink or toddler food if there are basic information on the nutrient status based on their locations. *P. biglobosa* seeds and pulp are used in many dishes in Nigeria and across West Africa, the seed is a major protein supplement in Africa diets contributing some minerals and essential vitamins and the flowers and immature pods are eaten by children (Aja *et al*., 2015).

The pulp that envelope the seeds is could be prepared when by processing into pure dough or mixed with millet flour and eaten, especially by children on farms (Olujobi 2012). The pulp with other mixture is also used to produce other foods such as couscous, porridge, local drink, fritters and cakes (Gernah *et al*., 2007) The potentials of the seeds and pulp of *P. biglobosa* is under utilised as it remain a local diet among West African Countries (Somefun, 2017). Having known the importance of this multipurpose tree species the legume could certainly be employed more intensively. The variation in the level of the nutrient in seed and pulp *P. biglobosa* from different seed source has not been harnessed which could be a pointer to food industrialists and nutritionist. African locust bean is one of the comparatively few tropical plant species which has been subject to thorough studies concerning its biology and utilisation.

Although, it's weakly organised local use of its products deserves more attention, as well as initiatives to improve on products since it has remain a local diet whereby it can compete with other international dishes if given adequate consideration. However, it has been established that the location of a particular plant species has influence on the genetic traits (Ouedraogo, 2012). This has necessitated the need to study the proximate composition of the seeds and pulp of *P. biglobosa* pod in order to ascertain the provenance with best nutritional value that will suit the management objectives. This will also provide background information that could be useful for tree breeders in selection of provenance or provenances with high quality fruits. Nutritionist can harnessed the best nutritional level of *P. biglobosa* from different location.

Materials and Methods

Sample Preparation:

The matured cluster pods of *P. biglobosa* were harvested from plantation of *Parkia biglobosa* in Saki West Local Government, Oyo State. The plantation of *Parkia biglobosa* comprises different provenances which include Nigeria, Senegal, Republic of Benin, Mali, Burkina Faso, Cameroun, Guinea and Ghana. Three replicate of matured bunches were harvested from each provenance. The harvested bunches were broken into pods, the pods were carefully labelled and kept in a black polythene bag and transferred to the laboratory. The dried sample of the pulp were removed and turned into a fine and homogenous powdery form. The fine sample was then kept in a container. The shell was discarded and the

remaining seeds were grinded using a small pestle mortar to reduce the large seeds into smaller particles and consequently grounded using a manual blender into a fine powder. Sterilised equipments were used to separate the bark from the pulp and the pulp from the seed. Samples of *P. biglobosa* seeds and pulp were kept in white cellophane paper for assessment.

Determination of protein content

Protein was determined by Kjedahl procedure using a protein factor of 6.25. A sample of about 1.2g was weighed into a digestion tube and concentrated Tetraoxosulphate (VI) acid (H_2SO_4) was added using a dispenser. The tube was placed in a pre-heated digester at 42°C for about 30 minutes until a clear solution was obtained. The tube was removed from the digester, cooled and diluted with water and placed in the distillation unit. A conical flask containing 25ml of Boric acid (indicator) was placed under the condenser outlet. 25ml of 40% Sodium hydroxide (NaOH) was dispensed in the flask and distillation carried out for 5 minutes. The Ammonium borate solution formed was titrated with 0.1M H_2SO_4 to purplish-grey end. Percentage nitrogen (percentage N_2) was calculated.

Determination of fat content

Fat analysis was carried out using Soxhlet extraction method. About 25g of ground sample was mixed with about 100ml of n-hexane. The mixture was vigorously shaken with the separation flask knob opened at intervals to release the accumulated air pressure, which could burst the flask if left there. The fat in the spirit was evaporated to dryness over a Soxhlet extraction, which extracts n-hexane from its solution of fat. The fat left behind in the flask was placed in the oven to dry at 105°C for 1½ hours. The round bottom flask was cooled in desiccators and weighed. Percentage of fat in sample was calculated.

Determination of fibre content

Fibre content of the sample was measured using the enzyme-modified, Neutral Detergent Fibre (NDF) method of analysis. Dried samples whose fat content were extracted using Soxhlet extraction were treated with standard NDF procedures up to the point that fibre-containing residues were filtered and washed with water. The filtered residues were incubated with a porcine *a* – amylase solution at 37°C overnight. The residues was filtered after incubation, washed very well, and dried. The NDF was calculated as filtered residual.

Determination of ash content

Ash content of the samples was determined by putting about 25g of sample in a dish of known weight (W4) and dried in an oven for 4 hours at 105°C. It was removed, cooled in desiccators and weighed (W5). The sample in dish was ash in a muffle furnace at 550°C until white or grey ash resulted. It was cooled and reweighed (W6). The percentage ash content was calculated.

Determination of moisture content

Moisture content was determined by weighing 25g of sample into cans of known weights (W1). The samples in cans (W2) were placed in an oven for 6 hours at 105°C and then cooled in desiccators and reweighed (W3). Difference in weight was moisture loss.

Statistical analysis

One way analysis of variance (ANOVA) was conducted for the data obtained using Completely Randomised Design (CRD). The data obtained were expressed as mean plus or minus standard error of the means (mean $\pm$SEM). Duncan Multiple Range Test was used as a follow up test for means that were significant. The value of $p<0.05$

was regarded as significant for statistical comparison in all cases.

Result and discussion

Proximate analysis

The analysis of variance below revealed that there is significant difference in the nutrient composition of the seeds and pulp from all the provenances. The proximate analysis of the seeds and pulp from all these provenances is significantly different as shown in the table 1 and 2. The proximate analysis variables include the moisture content, carbohydrate, crude fibre, protein, ash and ether (fat). According to Afolayan *et al.*, (2014), it confirms that there are variations in the proximate composition of the *P. biglobosa* seed and pulp. However, this was revealed in the result on the proximate analysis of the seed and pulp of *P. biglobosa* from Senegal, Benin, Nigeria, Burkina Faso, Ghana, Guinea, Cameroun and Mali. Duncan Multiple Range Test was carried out as follow up test to show the level of significance at 0.05% (Table 1 and 2). Comparing the difference in the proximate analysis of pulp and seeds of *P. biglobosa* was shown in Fig. 1, 2, 3, 4, 5 and 6.

Moisture Content

The Table 1 and 2 show the mean moisture content of seeds and pulp of *Parkia biglobosa* from different provenances in West Africa. The result revealed that there are significant differences in all the proximate variables measured at 5% level of significance. The moisture content of the seeds from different locations shows that seeds from Cameroun provenance have the highest Moisture Content level with 14.133%. Generally the moisture content is invariably low which suggest that *Parkia biglobosa* seeds could be store for a long period of time if properly packaged against external conditions (Eka, 1987, Bello *et al.*, 2009). The pulp of Benin Republic provenance has the highest moisture content 21.433%. This indicates that the mean percentage of moisture content in pulp of *Parkia biglobosa* is higher than the seeds. (Fig.1) This result support the findings of Marcel *et al.(* 2015), that confirms the potential of *P. biglobosa* fruit pulp as a thickener due to the high moisture level and an effective pharmaceutical binder. Therefore, the *P. biglobosa* fruit pulp could be a good binder for the manufacture of solid dosage forms. Also this could proffers the use of Parkia pulp powder as beef sausage which impacts a characteristic flavour, and juiciness on the sausage

as reported by (Teye *et al*., 2015). However, the pulp of *Parkia biglobosa* from Benin Republic and Burkina Faso could be of higher preference.

Table 1: The Mean of Proximate Composition of *Parkia biglobosa* Seeds from Different Provenances in West Africa

	Moisture Content(%)	Crude Protein (%)	Ether Extract (Fat) (%)	Ash (%)	Crude Fibre (%)	CHO (%)
Senegal	13.53^{bc} ±0.05	29.53^{g} ±0.15	17.70^{d} ±0.10	3.73^{c} ±0.21	4.27^{c} ±0.15	31.23^{a} ±0.25
Benin Republic	12.47^{e} ±0.15	30.43^{e} ±0.15	18.37^{c} ±0.15	4.10^{ab} ±0.10	4.50^{bc} ±0.10	30.13^{b} ±0.21
Nigeria	13.73^{b} ±0.15	30.77^{d} ±0.15	17.67^{d} ±0.15	3.47^{d} ±0.15	4.30^{c} ±0.10	30.07^{b} ±0.29
B. Faso	11.63^{d} ±0.15	32.20^{b} ±0.10	18.73^{a} ±0.15	4.30^{a} ±0.10	4.47^{c} ±0.15	28.67^{c} ±0.15

Ghana	12.7^{d} ±0.15	31.63^{c} ±0.11	18.23^{c} ±0. 15	4.07^{ab} ±0.06	4.70^{ab} ±0.10	28.60^{c} ±0.56
Guinea	12.37^{e} ±0.15	32.53^{a} ±0.15	18.67^{ab} ±0.15	3.93^{bc} ±0.15	4.30^{c} ±0.10	28.20^{c} ±0.36
Cameroun	14.13^{a} ±0.15	29.43^{g} ±0.15	17.37^{e} ±0.15	4.27^{a} ±0.06	4.73^{a} ±0.10	30.07^{b} ±0.35
Mali	13.40^{c} ±0.10	29.83^{f} ±0.15	18.43^{bc} ±0.15	3.87^{bc} ±0.15	4.40^{c} ±0.15	30.07^{b} ±0.31

*Means± Standard error of mean of 4 replicate samples. *Se= Senegal, Be= Benin Republic, Ng=Nigeria, BF=Burkina Faso, GH=Ghana, G=Guinea, CM=Cameroun and ML= Mali. Values with the same alphabet in each column are not significantly different at a = 0.05 using Duncan Multiple Range Test.

Table 2: The Mean of Proximate Composition of *Parkia biglobosa* pulpfrom Different Provenances in West Africa

Provenance	Moisture content (%)	Protein (%)	Ether extract (fat)(%)	Ash (%)	Crude fibre (%)	CHO by diff (%)
Senegal	18.133 ±0.153f	4.133 ±0.153^{b}	1.133 ±0.058^{bc}	4.667 ±0.153^{c}	2.133 ±0.153^{a}	70.267 ±0.208^{a}
Benin	21.433 ±0.208^{a}	4.133 ±0.153^{b}	1.300 ±0.100^{ab}	3.867 ±0.153^{cd}	1.733 ±0.058^{cde}	67.533 ±0.252^{d}
Nigeria	20.767 ±0.153^{bc}	4.400± 0.100^{a}	0.933 ±0.153^{cd}	3.633 ±0.153^{d}	2.000 ±0.100^{ab}	68.267 ±0.058^{c}
Burkina Faso	19.467 ±0.153^{d}	3.367 ±0.153^{e}	1.100 ±0.100^{bc}	4.300± 0.100^{b}	1.667 ±0.058^{de}	70.100 ±0.100^{a}
Ghana	19.100± 0.100^{e}	3.767 ±0.153^{cd}	0.867± 0.058^{d}	4.033 ±0.153^{bc}	1.900 ±0.100^{bc}	70.333 ±0.058^{a}
Guinea	20.533 ±0.208^{c}	3.867 ±0.153^{c}	1.467 ±0.153^{a}	4.233 ±0.153^{b}	1.600 ±0.100^{e}	68.300 ±0.173^{c}
Cameroun	20.867 ±0.153^{b}	3.567 ±0.115^{de}	0.933± 0.153^{cd}	3.733 ±0.158^{d}	2.100 ±0.100^{a}	68.800 ±0.300^{b}
Mali	21.167 ±0.153^{a}	4.467 ±0.153^{a}	1.267 ±0.058^{ab}	3.767 ±0.153^{cd}	1.833 ±0.058^{bcd}	67.500 ±0.519^{d}
Total	20.183 ±1.113	3.900 ±0.396	1.125 ±0.224	4.029 ±0.357	1.871 ±0.205	68.888± 1.159

*Means± Standard error of mean of 4 replicate samples. Values with the same alphabet in each column are not significantly different at a = 0.05 using Duncan Multiple Range Test.

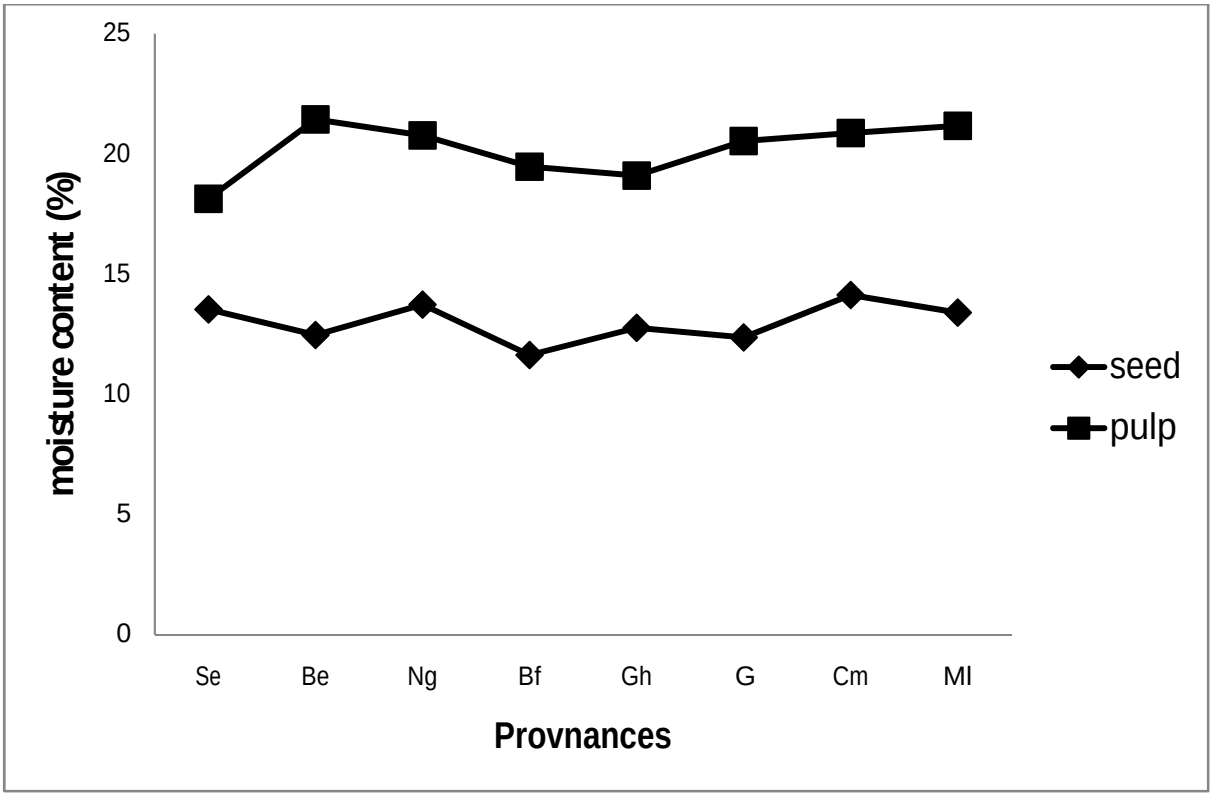

Fig. 1: Variation in moisture content of seeds and pulp of Parkia biglobosa from different provenances

Note: Se – Senegal, Be – Benin, Ng – Nigeria, Gh – Ghana, G- Guinea, Cm – Cameroun, and Ml - Mali

Carbohydrate

The mean values of Carbohydrate from all provenances shows that the carbohydrate content of *Parkia biglobosa* seeds and pulp varies among sources. The seed source from Senegal has the highest mean content of Carbohydrate of 31.233%. The mean content of Carbohydrate from Nigeria, Cameroun and Mali has the same mean values of 30.067%. This is followed by Benin seeds source with the value mean 30.133%. The last three mean values of Carbohydrate content decrease across Burkina Faso, Ghana and Guinea provenances, with 28.667%, 28.600% and 28.200% values respectively. These results correspond with the findings of (Boateng *et al*., 2014). The highest mean value 70.333% of Carbohydrate content in the pulp of *Parkia biglobosa* is associated with the pulp from Ghana. Mali has the least mean value of 67.500% present in the pulp of *Parkia biglobosa*. This showed that the fruits of *Parkia biglobosa* could be used as a good source of energy because of its high carbohydrates contents (Aja *et al*., 2015).

The pulp with high carbohydrate especially seeds sourced from Ghana could be a raw material for energy food drink industries. In comparison with the carbohydrate content of the seeds and the pulp, carbohydrate content in the pulp is much higher as it is being reported by (Fetuga *et al.*, 1974 and Gernah, 2007). (Fig 2)

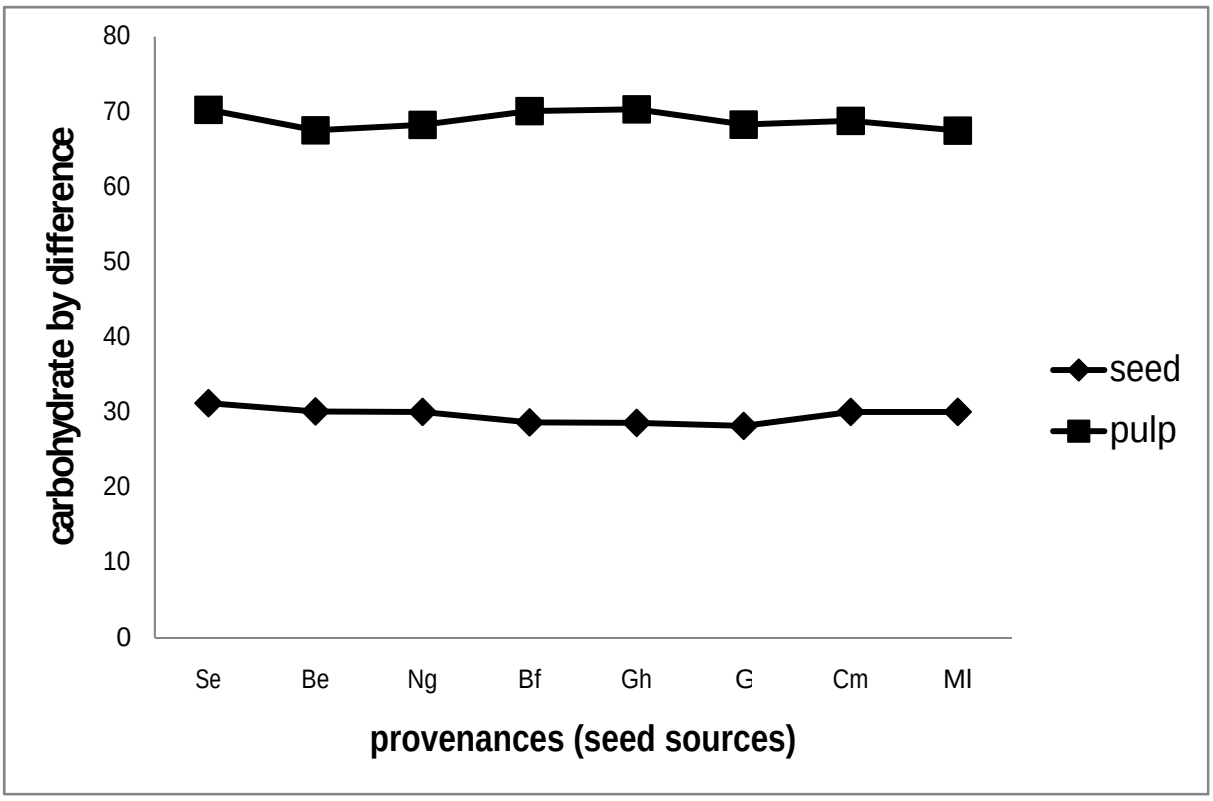

Fig. 2: Carbohydrate content of seed and pulp of *Parkia biglobosa* from different provenances

Crude fibre

The result obtained for crude fibre in the proximate analysis of *Parkia biglobosa* seeds shows that Cameroun seeds have the highest mean crude fibre content with 4.733% at 0.05% level of significance. This was closely followed by seed provenance from Ghana and Benin with 4.700% and 4.500% respectively. The Crude fibre mean decreases as recorded in Table 2 from Burkina Faso, Guinea, Nigeria and Senegal with 4.467%, 4.300%, 4.300% and 4.267% respectively. The result from Table 2 shows that the highest mean value of the of Crude fibre in the pulp of *Parkia biglobosa* is present Senegal provenance. While the lowest mean value of Crude fibre in the pulp of *Parkia biglobosa* is present in the pulp of Guinea provenance.

The result of the Crude fibre obtained shows that, shaft of the seeds probably add to the crude level in the seed. There is reduction in the Crude fibre level of the pulp from various locations; this could probably due to the solubility and absorbability of the pulp materials which dissolved when taken. Although Crude fibre does not contribute nutrients or energy to the body, it is essential for easy digestion. Gernah, (2007) reported that it is a source of dietary fibre which is essential for good bowel movement and helps in preventing obesity, diabetes, cancer of the colon and other ailments of the gastro-intestinal tract of man. The crude fibre obtained for the fruit pulp is less than that of the seeds as reported by Uwaegbute, (1996). This also correspond with other legumes, like kidney beans (Ihekoronye and Ngoddy, 1985). This makes the African locust beans seed a potential good source of dietary fibre.

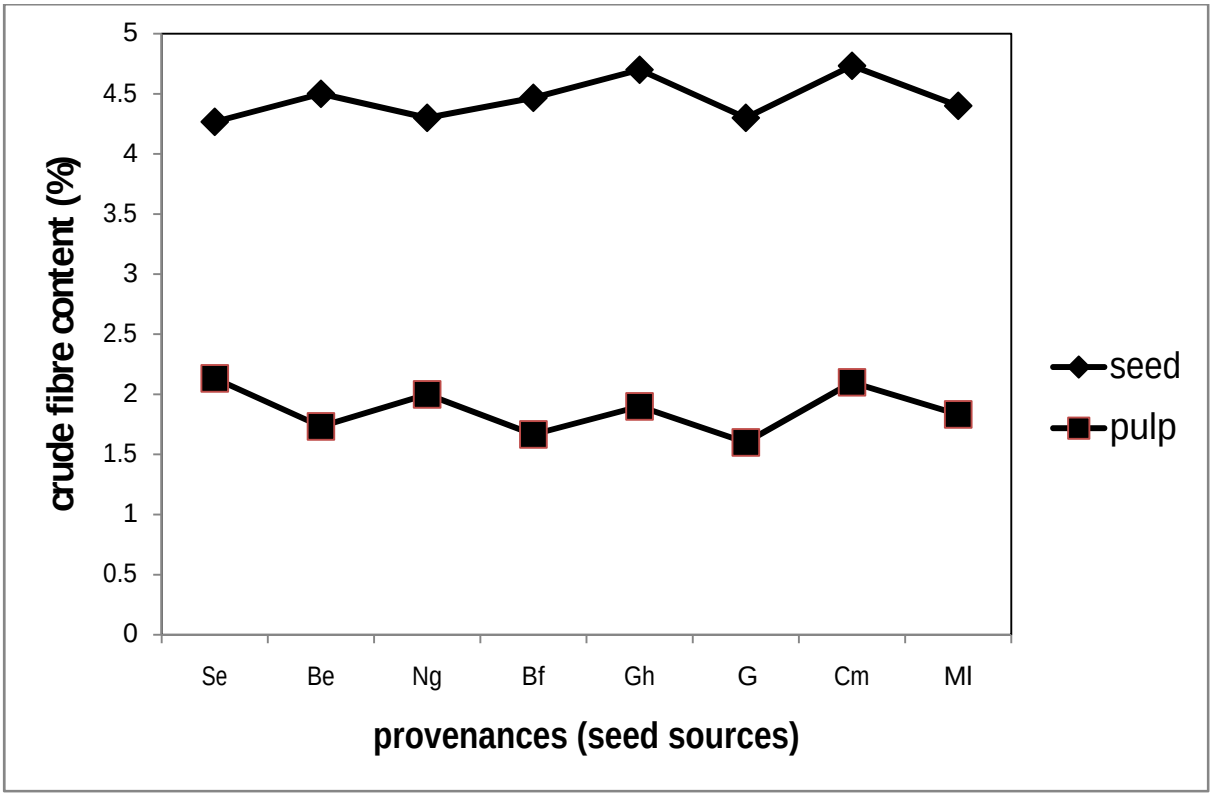

Fig. 3 : Comparison of Crude fibre present in seeds and pulp of *Parkia biglobosa* from different provenances

Protein

The protein content of the seeds is generally high but significantly different among the provenances. Seeds from Guinea with mean value 32.533% contain the highest protein level. This is followed by seed sourced from Burkina Faso with mean 32.200%. Ghana has 31.633% followed by Nigeria seeds source with 30.767% value. Benin and Cameroun are with 30.433% and 29.833% values respectively. The lowest protein content is observed in seeds from Cameroun and Senegal provenance with the same of mean value 29.533%. Consequently, the highest mean value of protein is 4.467% which is found in the pulp from Mali presented in Table 2. The lowest mean value of protein content in pulp of *P. biglobosa* is observed in the pulp from Burkina Faso The result obtained by Hassan *et al.* (2007) was in correlation to the observed low protein content in *Parkia biglobosa* fruit pulp.

The protein content of the seeds and pulps of *P. biglobosa* from different provenances are significantly different from the presentation of Fig. 4, it is clearly shown that the protein content is significantly different from each other. Protein is an essential component of diet which supplies adequate amounts of amino acid (Pugalenthi *et al.*, 2004). This result also corresponds favourably with the report of Ogundele and Oshodi, (2010) on three varieties of *Lagenaria siceraria* with protein content of (27.71, 32.72 and 34.64%). Hence, the seeds of *P. biglobosa* could provide safe, nutritious, and wholesome food for poor and under nourished populations which has been a major challenge for the developing world.

The seeds can also be processed into cakes and preserved for use in the preparation of some indigenous drinks that are more than adequate to meet the FAO/WHO recommended daily allowance of protein of

0.5 g/kg body weight for an average healthy individual and 0.88 g/kg body weight for children aged 1-10 years (Akoma *et al*., 2001)

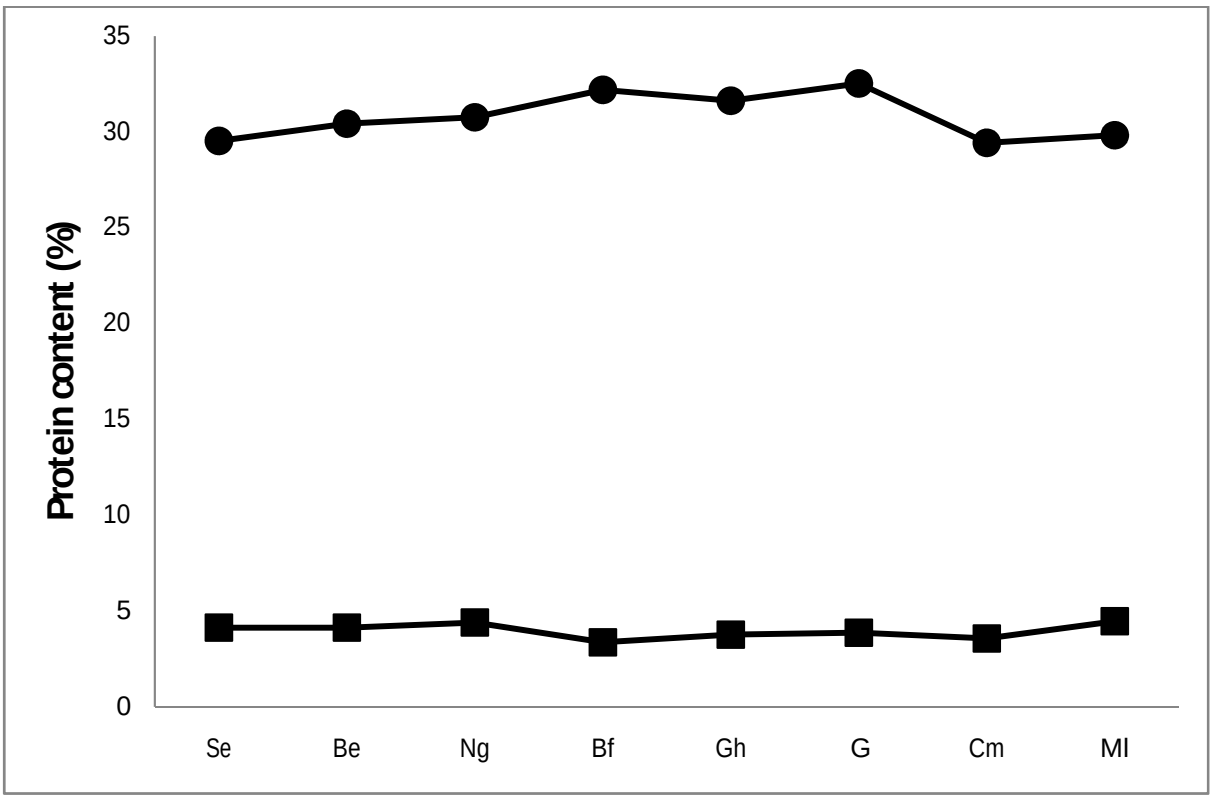

Fig. 4 : Protein content present in seed and pulp of *Parkia biglobosa*

Ash

The mean Ash content in seeds of *P. biglobosa* with highest level which are 4.300% and 4.267% are found in Burkina Faso and Cameroun provenances. The difference in the mean values of the Ash content is close. In that, provenances of Benin, Guinea, Mali, Senegal and Nigeria have these corresponding values accordingly which are 4.100%, 3.933%, 3.867%, 3,733% and 3.467% (Table 1). These are values of the means Ash content in the pulp of *P. biglobosa* ranging from Mali, Nigeria Benin, Guinea, Burkina Faso, Ghana and Senegal are respectively. More so, the mean Table 1 presents the significant difference in the ash content of the seeds. However the significant difference in the level of the Ash content across the provenance is close with the least value from Senegal seeds. The higher amount of Crude fibre obtained from the seed and the pulp may be due to tough texture, especially at maturity and probably due to presence of waxy substances (Olujobi 2012). This may also be responsible for the high Ash and cellulose contents of the pulp and testa.

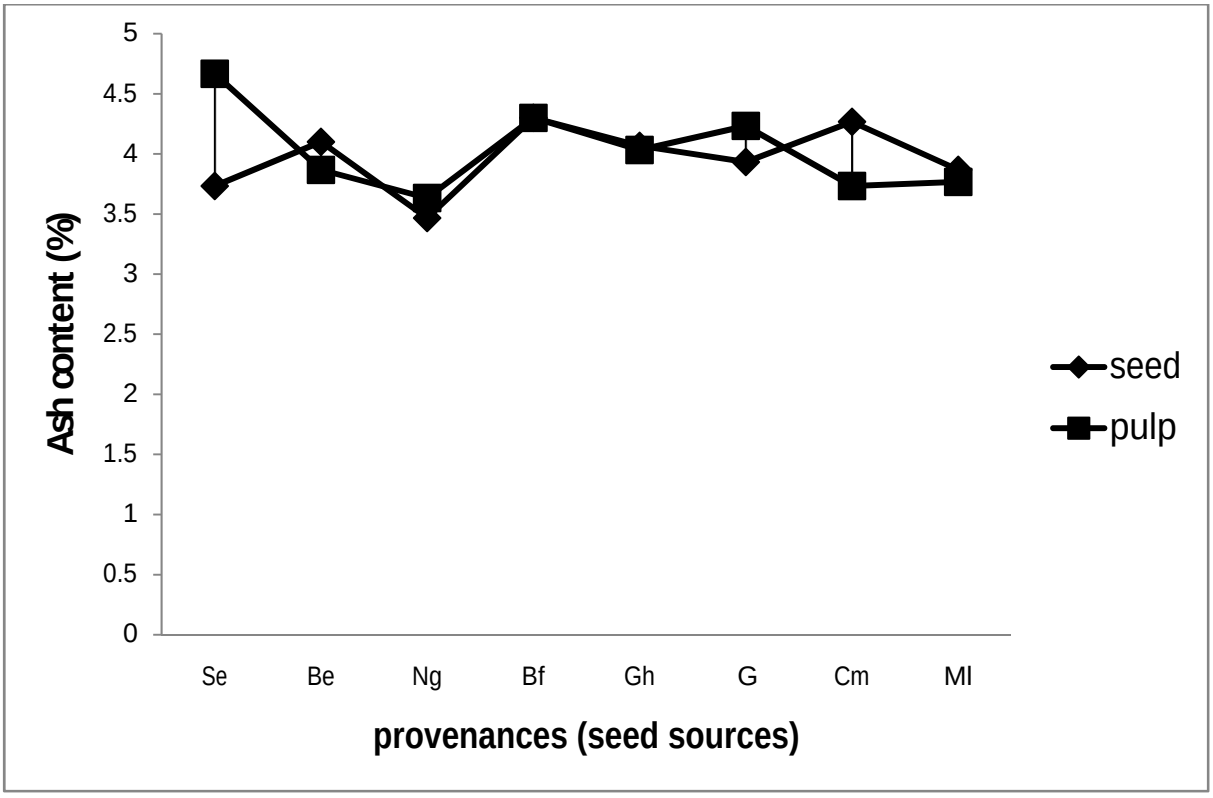

Fig. 5: Variation in the ash content of seed and pulp of Parkia biglobosa

Ether Extracts (fat)

The mean Table 1 and 2 records that seeds of *P. biglobosa* from Burkina Faso provenance have the highest level of ether extract (fat) which is 18.733%. This is followed by Guinea has the mean value of fat content to be 18.667% at 0.05 significance level. The ether extract mean values of seeds from Mali and Ghana are with 18.4333% and 18.233% respectively. The mean value for Nigeria and Senegal are the same with 17.700%, while the lowest value is gotten from Cameroun seeds (17.367%). The values of the ether extract are all significant as reported in Table 1 and 2.. The ether extract from Ghana, Benin and Mali are not significantly different but are significant to ether extract from Senegal and Ghana. The low fat content is an indication that the fruit pulp can store for long periods at the room temperature and moisture content below 12% without spoilage by rancidity, which is characteristic of many legumes (Omafuvbe *et al.*, 2004)

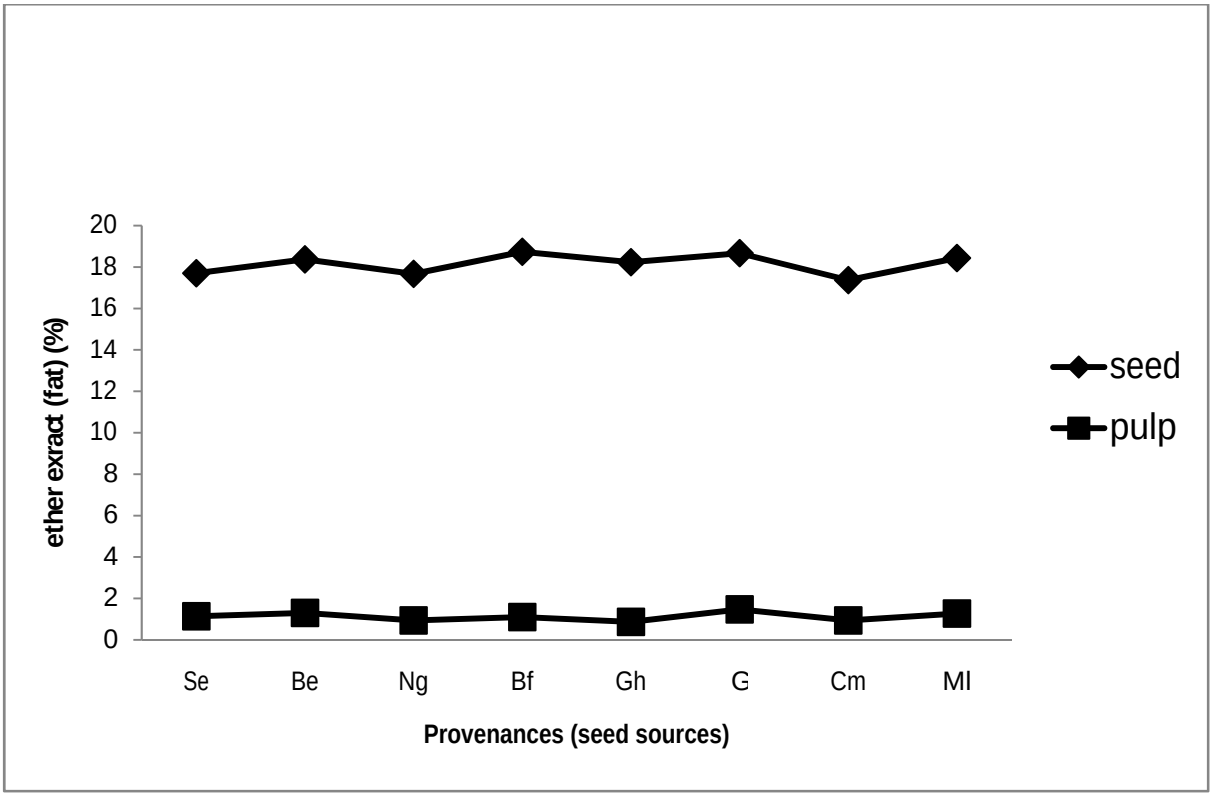

Fig. 6: Status of ether extract (fat) in seed and pulp of *Parkia biglobosa* from different provenances

Conclusion and Recommendations

This study confirms the nutritional status (proximate composition) of *Parkia biglobosa* from different provenances in West Africa in the plantation located in Wasangare, Saki West Local Government, Oyo State of Nigeria. The proximate composition of the seeds and pulp of *Parkia biglobosa* from different provenances varies across the provenances investigated. However, it was concluded that the carbohydrate content in the pulp of the *Parkia biglobosa* was very high in relation to their provenances.

This could dictate the use of the pulp for energy drink and toddlers food. More so, the low moisture content of the seeds of *Parkia biglobosa* enhance long storage provided it is protected from rodent. The result obtained from this study could proffer basic information for tree breeders and nutritionist on choice of seed sources selection of *P. biglobosa* from different provenances across West Africa in the plantation located in Wasangare, Saki, Oyo State. Hence, further research study could be carried out on mineral content, phytochemical analysis of the *P. biglobosa* in relation to their seed sources.

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