EFFECT OF DURATION OF FERMENTATION ON THE PROXIMATE COMPOSITION AND PHYTOCHEMICAL PROFILE OF BAOBAB (*Adansonia digitata*) SEED

[1]*Gyang, I.Y., [1]Damang, P. J. [1]Ashom, S.A., [2]Damter, S.A. [2]Magaji, S.T., [2]Gofwan P. G., and [3]Kuttu, J. M.
[1]Department of Animal Production Technology, Plateau State College of Agriculture, Garkawa [2]Department of Animal Health Technology, Plateau State College of Agriculture Garkawa
[3]Department of Agricultural Education, Federal College of Education (Tech.) Bichi Kano State
*Corresponding author: mapakiliya123@gmail.com; 08065822835

ABSTRACT
Samples of Baobab Seed (BS) were collected from Lur, Kanke Local Government Area of Plateau State, to determine its Proximate Composition and Phytochemical Profile. The seeds were washed to remove pulp on the seed coat, sun dried until crisp, then winnowed to remove debris. They sun-dried seeds were divided into four equal parts. The first part was left unprocessed as Unfermented Baobab Seed (UFBS) at 0hr of fermentation; the 2nd, 3rd and 4th parts were soaked for 24 hr, and then fermented for 48, 72 and 96hr as Fermented Baobab Seed (FBS), respectively. After fermentation the seeds were washed to remove fungus or leached anti nutrients, Sun-dried until crisp and then ground for chemical analysis. Baobab Seed (BS) Fermentation for 48hr increased Crude Fibre (CF), Ash, Ether Extract (EE) and Nitrogen Free Extract (NFE). Fermentation of BS for 72hr increased its Dry Matter (DM) while 96hr fermentation improved Crude Protein (CP) and Metabolizable Energy (ME). Oxalate, Saponin and Phytate were significantly (P<0.05) destroyed at 72hr. BS Fermented for 96hr significantly (P<0.05) reduced levels of Alkaloid and Hydrocyanide. Tannin was significantly (P<0.05) reduced at 48hr. Therefore, fermentation for 96hr can be recommended to improve the nutrient value of BS, since protein and energy are the most expensive and critical nutrients required for growth and development in farm animal.
Keywords: Baobab Seed (BS), Fermentation, Nutrients, Anti-nutrients

INTRODUCTION

The livestock industry has recorded a significant setback due to high cost of conventional feed ingredients (maize, soybeans, groundnut etc) and this has led to insufficient supply of livestock products [Include the name, and not numbers (Adebayo et al., 2019). Therefore, there is need for alternative provision of feed ingredients to bridge this gap. Research has shown that baobab seed is classified as a nonconventional feedstuff which has basic nutrient potentials for livestock growth and development (Adeyinka et al., 2018). The seed contain energy, protein, minerals and vitamins (Makokha & Mwangi 2017). Yusuf et al. (2017) reported that the proximate composition of raw baobab seed contained Dry Matter (92.02 %), Crude Protein (21.36 %), Crude Fibre (6.04 %), Ether Extract (12.29 %), Ash (4.34 %), Nitrogen Free Extract (55.97 %), and Metabolizable Energy (3772.74 kcal/k ME). These nutrients (Carbohydrate, Amino-acids, Vit.C, Ca, P, Mg, k etc) in the seeds are not readily available to the animal during digestion due to the presence of anti-nutritional factors such as phytate, saponin, tannin, oxalate which hinders their digestion and bioavailability, thereby affecting animal performance (Adeola et al., 2018). Therefore, the seeds need some forms of food processing such as soaking, boiling, toasting, sprouting, fermentation to destroy these anti-nutrients and improve on the nutrient bioavailability (Selle et al., 2017). Ezekiel et al. (2020) described the importance of fermentation to crop plants (Baobab seed), it reduces the level of anti-nutritional factors; improving protein digestion and increase nutrient bioavailability to animals. The objective of this study was to determine the effect of different duration of fermentation on the proximate composition and anti-nutritional factors in baobab (*Adansonia digitata*) seed.

MATERIALS AND METHODS

Baobab seeds used for the experiment were purchased from Lur village in Kabwir District of Kanke Local Government Area of Plateau State, Nigeria.

Processing of Baobab Seed

The seeds were washed to remove pulp on the seed coat, sun dried until crisp. The seeds were divided into four equal parts. The first part was left unprocessed (unfermented); the 2nd, 3rd and 4th parts were soaked for 24hr, before they were fermented for: 48hr, 72hr and 96hr (FBS) respectively. After fermentation they were sun-dried until crisp and then ground for analysis.

Chemical Analysis

Proximate Composition

Samples were determined by procedures recommended by (AOAC, 2006). The Metabolizable Energy (ME): *ME (kcal/kg) = 37 x % CP + 81.1 x % EE + 35.5 x % NFE* (Pauzen, 1985).

Phytochemical Screening Saponin was determined by (Harborne, 1973). Phytate was determined according to method outlined by Makkar et al., 1975. Tannin determined using methods described by (AOAC, 1980).

Oxalate was determined by the modified method of (Abeza et al., 1968). Alkaloid was determined by Gravimetric Method of Harborne (1973). Cyanogenic Glycosides was determined by AOAC, 2006).

Table 1: Effect of Different Duration of Fermentation on Proximate Composition and Metabolizable Energy of Baobab Seed (BS)

Nutrient (%)	0hr FBS	48hr FBS	72hr FBS	96hr FBS
DM	96.86	97.36	97.82	97.28
CP	25.51^{b}	20.65^{d}	24.01^{c}	29.93^{a}
CF	10.74^{d}	11.48^{a}	10.91^{c}	11.23^{b}
EE	10.88^{c}	12.12^{a}	09.93^{d}	11.88^{b}
Ash	06.84^{c}	08.25^{a}	07.67^{b}	06.78^{c}
NFE	46.03^{c}	47.50^{b}	47.48^{a}	40.18^{d}
ME Kcal/kg	3460.30^{b}	3433.23^{c}	3379.23^{d}	3497.27^{a}

^{a,b,c,d} Means with different super scripts are significantly different (P<0.05) different across rows, *(P<0.05), SEM = Standard error of means, FBS = Fermented baobab seed, hr = Hours, DM = Dry matter, CP = Crude protein, EE = Ether extract, CF = Crude fibre, NFE = Nitrogen free extract, ME= Metabolizable energy, ME (kcal/kg) = 37 x %CP + 81.1 x % EE + 35.5 x % NFE by (Pauzenga, 1985).

Table 2: Effect of Fermentation of Baobab Seed on the Levels of Anti-Nutritional Factors

Anti-nutrient	Duration of Fermentation of Experimental Materials				P-value	SEM
	0hrFBS	48hr FBS (%)	72hr FBS (%)	96hrFBS (%)		
Oxalate (g/100g)	0.35^{a}	0.29^{b} (17.14)	0.25^{c} (28.57)	0.20^{d} (42.86)	0.00	0.03*
Saponin (g/100g)	2.31^{a}	0.87^{c} (62.34)	0.71^{d} (69.26)	1.33^{b} (42.42)	0.00	0.18*
Alkaloid (g/100g)	4.96^{a}	4.55^{b} (08.27)	4.44^{c} (10.48)	4.25^{d} (14.32)	0.00	0.42*
Tannin (mg/100g)	18.64^{a}	6.15^{d} (67.01)	12.45^{b} (33.21)	9.14^{c} (50.97)	0.00	1.43*
HCN (mg/100g)	6.16^{a}	5.91^{b} (04.06)	5.30^{c} (13.96)	3.47^{d} (43.67)	0.00	0.53*
Phytate (mg/100g)	83.59^{a}	67.10^{b} (19.73)	29.33^{d} (64.91)	47.56^{c} (43.10)	0.00	6.70*

a,b,c,d Means with different super scripts are significantly different (P<0.05)different across rows, *(P<0.05), SEM = Standard error of means, FBS =Fermented baobab seed, hr = Hours, HCN = Hydrocyanic acid. Values in brackets are Percent level of destruction BS: Calculated as A-B/A x 100 by (Nalle, 2009) E.g : Oxalate at 48hr fermentation 0.35-0.29/0.35 x 100 = 17.14%

DISCUSSION

Proximate Composition

Table: 1 Show the effect of fermentation on Proximate Composition of Baobab Seed (BS). Fermentation for 48hr significantly (P<0.05) reduced crude protein (CP) to 20.65% level. This agrees with the reports of (Nnam & Obiako, 2003) who reported a reduction in protein content of baobab seeds fermented at 48hr. The decreased in protein content could result from the microbial mass in the fermentation medium, utilizing hydrolyzed protein to build their structural cell protein. BS Fermented for 96hr significantly (P<0.05) increased crude protein (29.93%)

level. This study agrees with (Damang et al., 2017) who reported that 72hr fermentation increased protein content (24.75%) of kidney bean seed. This increased in protein content could be attributed to the increase in microbial mass during fermentation (Abang & Shittu, 2015). Fermentation increased CF, EE and NFE of BS within the first 48hr and decreased at 72hr but later improved at 96hr. This irregular change agrees with the reports of Agblemango et al. (2017) who observed an increase in nutrient fractions of African Locust Beans fermented for 48hr but later decreased at 72hr. Ash (minerals) content of BS fermented for 48hr (8.25%) is significantly higher than other treatment groups. This study agrees with Chikwendu et al. (2014) who reported that 48hr fermentation increase ash (minerals) content of African yam beans. The decreased in ash could be as a result of leaching of solute inorganic salt into the fermentation medium. Carbohydrate content was reduced to 37.46% at 96hr of fermentation, lower than 42.90% of unfermented seeds. This study agrees with the reports of Nnam & Obiako (2003) who observed a decrease in carbohydrate level when fermentation of BS exceeds 48hr. This could be attributed to the activities of amylolytic enzymes which hydrolyzed complex carbohydrate to soluble carbohydrate for their energy and carbon skeleton.

Phytochemical Analysis

Table: 2 shows effect of different duration of fermentation on anti-nutritional factors of BS. Oxalate content of BS fermented for 96hr was reduced to 0.2mg/100g (42.86%) compared to 0.35mg/100g of unfermented BS. This study agrees with Damang et al. (2017) who reported that less than 50% oxalate content of kidney beans was reduced by 72hr fermentation. This could result due to leaching of bivalent cations into the fermentation medium (Tuleun, 2008). Baobab seeds fermented for 72hr significant ($P<0.05$) reduced Saponin level to 0.71g/100g (69.26%) less than 2.31g/100g of unfermented BS. This study corroborates the findings of Obiokor, (2009) who reported that 72hr fermentation reduced Saponin content of Lima Beans much more than those fermented for 120hr. Fermentation for 96hr slightly reduced alkaloid to 4.25g/100g (14.32%) compared to 4.96g/100g of unfermented BSM. The result of this study is lower than the findings of Sulaiman, (2019) who reported 21.45% alkaloid reduction in calabash seed meal (*Crescentia cujete*) when fermented beyond 96hr. This slight reduction could result from inability of *Lactobacilli plantarum* and *L. fermentum*) to inhibit the growth of *Sphacelia sorghi* (fungus) which utilized free amino acid to form alkaloids (Mantle, 1973). Hydrocyanide (HCN) content of BS was significantly ($P<0.05$) reduced to 3.47mg/100g (43.67%) at 96hr fermentation than other treatments.

The result in this study is more than half the average value obtained by the findings of Damang et al. (2017) who reported that fermentation of kidney beans fermented 72hr significantly ($P<0.05$) destroyed HCN to 81.45%. Variations could occur due to crop variety difference. Maximum reduction (67.01%) of tannin content in this study occurs at 48hr (6.15 mg/100g) of fermentation than other treatments. This study agrees with Felix & Francis (2019) who reported decrease in tannin content of African locust bean seed fermented at 48hr. BS fermented for 72hr (33.21%) increased the level of tannin, this could be attributed to the reaction of tannin enzyme acyl hydrolase which can chelate with hydrolyzed protein to form insoluble tannin complex (Ojha et al., 2018) Fermentation of BS for 72hr in this study significantly ($P<0.05$) reduced Phytic Acid to 29.33mg/100g at (64.91%) compare to 83.59mg/100g of unfermented BSM. The value obtained in this study is similar to the value (64.3%) reported by Rasha et al. (2011) on Mung Beans fermented for 72hr. Prolonging fermentation for 96hr increased (47.56mg/100g) level of phytate, this could be attributed to re-chelating activity of myoinositol haxaphosphoric acid (Phytate) which have high affinity for free metal ions to form complex compound (Osagie, 1998).

CONCLUSION

Fermentation of BS for 48hr increased CF, Ash, EE and NFE. However, 72hr of fermentation increased Dry Matter (DM) while 96hr fermentation improved Crude Protein and Metabolizable Energy. Oxalate, Saponin and Phytate were destroyed at 72hr of fermentation. BS Fermented for 96hr significantly reduced levels of Alkaloids and Hydrocyanide. However, tannin had maximum level of destruction at 48hr of fermentation. Therefore, fermentation for 96hr can be recommended, since protein and energy are the most expensive and critical nutrients required for growth and development in farm animal.

REFERENCE

Abang, F.B.P and Shittu, H.A. (2015). Effect of fermentation on the chemical composition of peeled taro cocoyam (*Colocasia esculenta var esculenta*). *Journal of Agriculture and Veterinary Science, 8(3): 23.*

Abeza, R.H., Blake, J.T. and Fisher, E.J. (1968). Oxalate determination: Analytical problems encountered with certain plants species. *Journal of the Association of Official Agricultural Chemists, 51: 963-965.*

Adebayo, S. E., Ojo, M. A., and Adewumi, M. K. (2019). Analysis of the Nigerian livestock feed industry. *Journal of Agricultural and Food Economics, 3(1), 1-12.*

Adeola, O., Aderibigbe, A. O., andAkinmutimi, A. H. (2018). Effects of phytase on growth performance and nutrient digestibility in broilers. *Journal of Animal Science, 96(10), 3811-3821.*

Adeyinka, A. A., & Ojewole, J. A. (2018). Effect of fermentation on the nutritional quality of baobab seed meal. *Journal of Food Science and Technology, 55(4), 1220-1228.*

Agblemanyo, A. K., Obodai, M., and Adjei, B. O. (2017). Effects of fermentation on the nutritional and anti-nutritional contents of African locust beans (Parkia biglobosa). *Journal of Science and Technology, 54(4), 1020-1028.*

AOAC (1980). Official Method of Analysis of the association of analytical chemist. USA, Washington DC, Pp. 76 – 86.

AOAC (2006). Official Method of Analysis of the AOAC, W. Horwitz Editor. (18th ed). USA Washington D.C., pp 132.

Chikwendu, J.N., Obiakor- Okeke, P. N., and Maduforo, A.N. (2014). Effect of fermentation on the nutrient and anti-nutrient composition of African yam bean (*Sphenostylis stenocarpa*) seeds and pearl millet (*Pennisetum glaucum*) grains. *The International Journal of Science & Technology, 2(12): 169-176.*

Damang, P.J., Tuleun, C. D. Oluremi, O. I. A. and Carew, S. N. (2017). Evaluation of raw and processed kidney bean (*Phaseolus vulgaris L.*) seed for mono-gastric animal feed production. *Journal of Animal Production Research, 29(1): 301-311.*

Ezekiel, O. O., and Abotuge, D. C. (2020). Fermentation and anti-nutritional factors of baobab seed meal. *Journal of Food Processing and Preservation, 44(6).*

Felix, E.A. and Francis, K.A (2019). Effect of traditional fermentation process on the nutrient and anti-nutrients content of maize and African locust beans. *Journal of Food Science and Nutrition Research, 2(2): 065-075.*

Harborne, J.B. (1973). Phytochemical methods: A guide to modern technology of plant analysis, (2nd ed), New York, Chapman and Hall, pp185.

Makkar, H. P. S., Singh, B., & Negi, S. S. (1975). Determination of phytic acid in feedstuffs. *Journal of Science of Food and Agriculture, (26)10, 1323-1328.*

Makokha, A. O., & Mwangi, D. M. (2017). Fermentation and nutritional quality of baobab seed meal. *Journal of Animal Science and Technology, 59(2), 53-62.*

Mantle, P. G. (1973). Production of ergot alkaloids in vitro by (*Sphacezia sorghi*) Department of biochemistry, Imperial College of Science and Technology, London, S. W. 7 Printed in Great Britain. *Journal of General Microbiology, (75): 275-281.*

Nalle, C. L. (2009). Nutritional Evaluation of Grain Legumes for Poultry. A thesis presented in partial fulfillment of the requirements for the degree of Doctor of Philosophy. In: Poultry Nutrition at Massey University, Palmerston North, New Zealand, Pp. 6-9.

Nnam, N.M. and Obiakor, P.N. (2003). Effect of fermentation on the nutrient and anti-nutrient composition of baobab (*Adansonia digitata*) seeds and rice (*Oryza sativa*) grains. *Journal of Ecology of Food and Nutrition, 42: 265-277.*

Obiokor, S. T. (2009). Effect of fermentation on the anti-nutritional factors of Lima beans (*Phaseolus lunatus*). *Journal of Food Science and Technology, 46(4), 1010-1015.*

Ojha, P., Adhikari, R., Karki, R., Mishra, A., Subedi, U. and Karki, T.B. (2018). Malting and fermentation effects on anti-nutritional components and functional characteristics of sorghum flour. *Journal of Food Sciences and Nutrition, 6: 47–53*.

Osagie, A.U. (1998). Anti-nutritional factors and nutritional quality of plant food. Eds. University of Benin City. Published by the Post-harvest Research Unit, Biochemistry Department, Nigeria. Pp. 221-224.

Pauzenga, U. (1985). A new equation for calculating the metabolizable energy of poultry feeds. *Journal of Nutrition, 115(11), 1575-1584.*

Rasha, M.K., Esmat, A.A., Gibriel, A.Y., Nagwa, R.M.H. and Ferial, M.A. (2011). Effect of legume processing treatments individually or in combination on their phytic acid content. *African Journal of Food Science and Technology, 2(2): 036-046.*

Selle, P. H., Ravindran, V., and Partridge, G. G. (2017). Phytase and phytate in animal nutrition: A review. *Journal of Animal Science, 95(10), 3811-3821.*

Sulaiman, R. B. (2019). Effect of fermentation on the nutritional and anti-nutritional factors of calabash seed meal (*Lageria siceraria*). *Journal of Food Science and Technology, 56(2), 831-838.*

Tuleun, C.D., Carew, S.N. and Patrick, J.A. (2008). Fruit characteristics and chemical composition of some varieties of velvet beans (*Mucuna* spp) found in Benue State of Nigeria. *Livestock Research for Rural Development, 20:10.*

Yusuf, Z. S., Wafar, J.R. and Abdullahi, J.A. (2017). Evaluation of raw baobab (*Adansonia digitata)* seed meal on the performance of weaned rabbits. *Journal of Advances in Biology and Biotechnology, 12(2): 1-8.*