BAP -21

Effects of Different Fermentation Media on the Chemical Composition of Jackfruit (*Arthocarpus heterophyllus*) Seed Meal

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Abstract
The effect of different fermentation media on the chemical composition of jackfruit seed (Arthocarpus heterophyllus) meal was investigated. Bunches of jackfruits were cracked and the seed subjected to different fermentation media. The fermented samples were rinsed, sundried, milled with 2mm mesh hammer mill and stored alongside with the raw sample in properly labeled individual containers for chemical analyses. The result showed that all the fermentation media reduced ($p<0.05$) dry matter, crude fibre and nitrogen free extract (NFE) contents of jackfruit seed meal, while the crude protein and ash contents were increased ($p<0.05$) by rumen digester filtrate. Rumen digesta filtrate reduced ($p<0.05$) the phytates, oxalates and tannins, but caused an increase ($p<0.05$) in calcium and magnesium concentrations, whose values were reduced by maize cob solution medium. Levels of sodium, potassium, phosphorus and iron were reduced by all the fermentation media. It was concluded that rumen digesta filtrate fermentation was a preferred method of improving the nutritional quality of jackfruit seed meal.

Keywords: Rumen digesta filtrate, maize cob, fermentation, chemical composition, anti-nutrients.

Introduction

Livestock is currently one of the growing agricultural subsectors in developing countries with its share of agricultural GDP of 33 per cent (Delgado, 2005). This is as a result of the increasing demand for livestock products which is driven by population growth, urbanization and increasing income in developing countries. Population grows rapidly and constitutes an important hindrance in achieving improvements in food security in some countries; therefore the need to increase livestock production to meet the rapid growth of the populace is inevitable. To ascertain this improvement, livestock will demand efficient use of adequate feed resources; therefore provision of feeding stuffs of adequate nutritional quality is likely to be the most limiting factor towards the achievement of efficient livestock production in the third-world countries including Nigeria.

With the present trend of rising prices of animal feedstuffs all over the world, considerable attention has been placed on research for non-conventional feedstuffs (Esmail, 2002). One such non-conventional feedstuff of economic importance is Jackfruit (*Arthocarpus heterophyllus*) meal. The flour from jackfruit seed has been reported to contain 11per cent crude protein, 82 per cent nitrogen free extract and starch (Ndyomugyeni *et al.,* 2014). According to Ndyomugyeni *et al.* (2014), the seeds have been reported to contain 13.4MJ/kg (3200.59kcal/kg) of metabolisable energy.

However, the major factor limiting the utilization of jackfruit seed as a feed resource is the presence of anti-nutrients (Ndyomugyeni *et al*., 2014). To reduce these anti-nutritional factors, methods such as soaking, boiling, roasting or combination of all or any of these methods have been used in processing the bean with minimal success. It was therefore imperative to utilize other alternative processing methods with the aim of improving the feeding value of the jackfruit seed meal.

The study was designed to compare changes in the chemical composition of jackfruit seed meal fermented with plain water, maize cob ash solution and rumen digesta filtrate.

Materials and Methods

Sources and Processing of jackfruit seed

Bunches of jackfruit were harvested from home garden in Calabar municipality and opened up, using sharp knife to expose the beans. The beans were separated from the pulp and divided into four groups of 300 grams for fermentation. The maize cobs were gathered from Akim market, while the rumen digesta was obtained immediately the cattle was slaughtered from the Akim abattoir in Calabar and conveyed to the laboratory in an air tight polyethene bag.

Preparation of the fermentation media

The maize cob ash solution was prepared by setting maize cob on fire and allowing it to burn completely into ash. One hundred (100) grams of the ash was weighed using electronic weighing balance and transferred into a plastic bucket containing one litre of distilled water. The mixture was centrifuged, using glass rod to obtain maize cob solution.

The rumen filtrate was prepared by rapidly submerging the rumen digesta into distilled water in a capped plastic container at the rate of 1kg of digesta /litre of water. The mixture was vigorously centrifuged using a metal rod to dislodge the microbes. The residue was filtered out and the filtrate incubated for 48 hours under room temperature (26^0C), in a capped plastic bucket.

Fermentation process

The maize cob solution was added to the first capped plastic bowel, into which 300 grams of cracked jackfruit seeds had been previously weighed into, while the rumen filtrate was added into the second capped plastic bowel containing 300 grams of jackfruit seed. Plain water was added to the jackfruit seed in the third bucket. Each sample was fermented at room temperature for 48hours, with limited air penetration. At the end of fermentation process, samples were drained, rinsed with fresh clean water, sun-dried, milled using hammer mill with 2mm mesh and stored alongside with the raw sample in properly labeled individual containers, prior to chemical analyses.

Chemical analyses of the raw and fermented jackfruit seed meal

The proximate analysis of raw and fermented jackfruit seed meals were carried out using the standard procedures of AOAC (2010), while the gross energy was determined using bomb calorimeter (AOAC, 2010). Atomic Absorption spectrophotometer (Unicam-939) was used to determined calcium, manganese, magnesium, zinc, iron and copper, while potassium and sodium were determined, using flame photometer. The molybdovanadate method (AOAC 2010) was used to determine the total phosphorus. Concentrations of some important anti-nutritional factors present in the raw and fermented jackfruit bean meals were determined. Phytic acid content was determined by the method described by Eskin and Latta (1980). Quantitative estimation of tannins was carried out using method of Joslyn (1970). Oxalates were determined by method out lined by Nwinuka *et al*. (2005) and Saponins by methods outlined by AOAC (2010).

Statistical analysis

The experimental design employed was completely randomized design (CRD). Data were subjected to analysis of variance procedures and significant means separated using Duncan's multiple range test (Duncan, 1956).

Results and discussion

Proximate composition of differently fermented jackfruit bean meals

Table 1 shows the proximate composition of differently fermented jackfruit seed meal. The three fermentation media caused a significant ($p<0.05$) decrease in dry matter and NFE contents of the seed meal, while rumen digesta filtrate significantly increase its crude protein and ash levels. A significant reduction in the crude fibre content was observed in the rumen digesta filtrate fermented jackfruit seed meal, while maize cob ash and rumen digesta filtrate media increase ($p<0.05$) the ether extract contents.

Significant increase in the protein content of fermented jackfruit seed meal, particularly in rumen digesta filtrate medium maybe as attributed to the hydrolysis of protein enzyme-tannin complexes to release free amino acids for new protein synthesis. Effiong *et al.* (2016) noted that, increase in the growth and proliferation of the fungi and bacteria complex in the form of single cell proteins in 72 hours cultured rumen digesta filtrate accounted for the apparent increase in the protein content of the *Icacinia manni* meal. The significant reduction in the fibre content of the fermented jackfruit seed meal may be attributed to the actions of the fibre digester micro-organisms such as fungi present in the fermentation media. Decrease in the nitrogen free extract of fermented jackfruit seed meals was attributed to the high utilization of energy by micro flora during fermentation, as observed in earlier studies (Obiakor and Nwanekezi, 2008). Increase in gross energy composition of fermented jackfruit seed meal suggests the presence of high energy.

Anti-nutritional factors composition of the fermented jackfruit seed meals

Result of the anti-nutritional factors profile of jackfruit seed meal (Table 2) showed that the anti-nutrients present in raw sample were significantly ($p<0.05$) reduced by fermentation. Significant reduction in the levels of anti-nutritional factors of fermented jackfruit seed meal may be attributed to the degradation of the products through the secretion of enzymes such as phytase, tannase and non-starch polysaccharides by the micro-organisms.

Mineral composition of the fermented jackfruit seed meals

The result of mineral composition (Table 3) showed that fermenting jackfruit seed with rumen digesta filtrate increased ($p<0.05$) the concentrations of calcium and magnesium, while plain water and rumen digesta filtrate media caused substantial loss of sodium and potassium. The phosphorus and iron contents were significantly reduced by the three fermentation media, with rumen digesta filtrate fermentation medium causing the highest loss of phosphorus, while plain water medium caused the highest reduction of iron. Maize cob ash solution significantly increased copper and zinc concentrations of jackfruit bean meal. Minerals concentration reported in this experiment were higher than the levels reported for maize and water fermented jack fruit (Okafor *et al*., 2015).

Conclusion

It was concluded from the study that the nutritional quality of jackfruit bean meal can be improved by fermentation. The rumen digesta filtrate was the best medium of fermentation, followed by maize cob ash solution.

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Table 1: Proximate composition of fermented jack fruit meal

Parameters (%)	RAW	PWFJ	MCAFJ	RDFFJ	SEM
Dry matter	91.05[a]	74.85[c]	83.85[b]	85.85[b]	1.30
Crude protein	5.34[b]	5.00[b]	5.13[b]	7.10[a]	0.49
Crude fibre	4.21[a]	3.21[b]	3.15[b]	3.11[b]	0.36
Ether extract	2.56[c]	2.43[c]	3.01[b]	5.74[a]	0.32
Ash	4.45[b]	4.01[b]	4.23[b]	5.61[a]	0.42
NFE	74.50[a]	59.71[c]	68.34[b]	64.30[b]	1.25
Gross energy(kcal/100g)	3.687	3.876	3.521	3.858	0.19

[a,b,c,d,] means on the same row with different superscripts are significantly different (p<0.05); means are values of triplicates determinations. PWFJ = Plain water fermented jackfruits, MCAFJ = Maize cob ash fermented jackfruits. RDFFJ = Rumen digesta filtrate fermented jackfruits± SEM = Standard error of mean

Table 2: Anti- nutritional factors of fermented jackfruit bean meal.

Parameters	RAW	PWFJ	MCAFJ	RDFFJ	SEM
Phytates (mg/100g)	11.28[a]	7.95[b]	7.94[b]	3.17[c]	0.92
Oxalates(mg/100g)	80.07[a]	50.11[c]	75.53[b]	34.10[d]	2.33
Tannins (mg/100g)	8.14[a]	4.72[b]	2.06[c]	1.64[d]	0.87
Saponins (mg/100g)	2.68[a]	0.01[b]	N/D	N/D	0.58

[a,b,c,d,] means on the same row with different superscripts are significantly different (p<0.05); means are values of triplicates determinations; PWFJ = Plain water fermented jackfruits; MCAFJ = Maize cob ash fermented jackfruits; RDFFJ = Rumen digesta filtrate fermented jackfruits, SEM = Standard error of mean

Table 3: Mineral composition of fermented jackfruit bean meals

PARAMETERS	RAW	PWFJ	MCAFJ	RDFFJ	SEM
Calcium	48.00[c]	56.00[b]	40.00[c]	120.00[a]	3.02
Magnesium	19.00[b]	22.40[b]	16.00[c]	48.00[a]	1.92
Sodium	51.92[a]	32.12[c]	57.64[a]	48.04[b]	1.70
Potassium	118.90[a]	63.74[c]	112.92[a]	73.20[b]	2.63
Phosphorus	39.79[a]	23.87[b]	20.00[b]	16.99[c]	0.22
Copper	0.58[c]	0.55[c]	0.99[a]	0.75[b]	0.41
Zinc	2.78[c]	2.77[c]	4.71[a]	3.46[b]	0.15
Manganese	0.63[c]	0.81[a]	0.71[b]	0.61[c]	0.15
Iron	0.32[a]	0.10[d]	0.17[c]	0.22[b]	1.59

[a,b,c,d,] means on the same row with different superscripts are significantly different (P<0.05), PWFJ = Plain water fermented jackfruits; MCAFJ = Maize cob ash fermented jackfruits; RDFFJ = Rumen digesta filtrate fermented jackfruits, SEM = Standard error of mean