Nutritional assessment of soaked-boiled-fermented Jackfruit (Artocarpus heterophyllus) seed meal for broiler chickens

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Abstract

Chemical analysis and one feeding trial (0 - 5 weeks) were conducted to assess the nutritional value of Jackfruit seeds (JS) that had been subjected to a combination of soaking, boiling, and fermentation (SBF). Five diets were formulated with the processed Jackfruit seed meal (JSM) representing 0, 8, 16, 24, and 32% of the diet DM.

Processing reduced tannins and oxalates in raw JS by over 80%. However, inclusion of increasing levels of the processed JSM in broiler diets depressed growth and feed conversion. Soaking-boiling-fermentation treatment does not appear to be an effective method to improve the nutritional value of Jackfruit seeds for broiler chickens.

Key words: *alternative feedstuffs, anti-nutrients, growth rate, poultry, processing*

Introduction

Poultry production plays an important role, providing meat and eggs in the diets of people, and income from sales. Poultry population in Uganda has steadily increased over the years. The population of poultry increased from 37.4 million in 2008 to 43.4 million in 2013, representing 13.8% (UBOS 2014). Out of 43.4 million poultry in 2013, 38.1 and 5.3 million were indigenous and exotic, respectively (UBOS 2014). Among poultry species, chicken population outnumbers other species put together. In 2008, for instance, the population of chickens, turkeys and ducks in Kampala and Mbale districts was 1,053,031; 5,675; 28,148 and 459,868; 26,162; 13,100, respectively (MAAIF 2011). Currently, commercialization of chicken production is being promoted for resource-poor and peri-urban producers who raise chickens on small scale. However, farmers usually find it costly to feed their chickens on commercial concentrates. Additionally, farmers are susceptible to changes in the feed prices and lose money when the prices of conventional feedstuffs such as maize increase.

The high prices of conventional feedstuffs result into costly poultry feeds and consequently low poultry production, high cost of meat and eggs, and protein malnutrition in rural households.

This implies that there is an urgent need to search for alternative feed resources to reduce feed costs. However, the use of alternative feed resources (such as Jack fruit seeds - JS) in poultry diets has resulted in growth depression and high mortalities of the birds due to presence of anti-nutrients (Akinmutimi 2006; Ravindran et al 1996). The seeds are produced from trees adapted to tropical climates (Morton 1987) and therefore have the potential to be widely produced in Uganda. The annual yield can be as high as 150 - 500 fruits per Jackfruit tree (Morton 1987; Rosengarten 1984). The JS are readily available in Uganda because they are usually discarded as waste after consumption of the fruit pulp (Ndyomugyenyi et al 2014a). In urban and peri-urban markets, the discarded seeds have an undesirable/offensive smell and attract flies. The use of seeds as feedstuff would reduce the cost of poultry feed and also contribute to improving the environment by reduction of quantities of waste to be disposed-off. The seeds have an advantage of being less costly than maize. Inclusion of the Jackfruit seed meal (JSM) in poultry diets would reduce feed costs and competition for maize.

Some anti-nutrients in JS have been identified (Ndyomugyenyi et al 2014b; Akinmutimi 2006; Ravindran et al 1996), but limited work has been done to quantify and eliminate them. Effective utilization of JS as feed for poultry would therefore depend on treatment methods that remove anti-nutrients from the seeds. Additionally, little research has been conducted to include the properly processed JSM in poultry diets. Consequently, the optimum inclusion levels of different treated JSM in poultry diets have not yet been fully studied. Thus, this study was conducted to assess the nutritional value of soaked-boiled-fermented (SBF) JSM for broiler chickens.

Materials and methods

Source, treatment and chemical analysis of Jackfruit seeds (JS)

The JS were obtained from an urban market in Kampala district, Uganda. The seeds were sun-dried and stored in gunny bags on wooden stands until used. The dried seeds were soaked in water at room temperature for 12 h, drained and rinsed once with fresh water, boiled in water at 100°C for 2 h, cooled under shade for 12 h, mixed with fresh water (1 kg of seeds in 65 ml of water), placed in gunny bags, well covered, allowed to ferment for one week and then sun-dried. Proximate and mineral composition were determined using procedures of AOAC (1990). Total oxalates were determined using the method of Day and Underwood (1986) and tannins by the method of Price et al (1978).

Feeding trial

A feeding experiment that lasted five weeks was conducted to assess the response of 150 broilers fed graded levels of the SBF JSM. Day-old, Ross strain broiler chicks were randomly distributed into fifteen cages each measuring 1.0 m^2. Five diets (Table 1) were formulated with processed JSM at dietary levels of 0, 8, 16, 24, and 32% in DM. Heat was provided using charcoal in clay pots and 24 h lighting was ensured using kerosene lanterns.

Data collection

Body weights of chicks were taken at the beginning of the experiment and at the end of each week for five weeks. Feed intake (FI) was determined weekly for each replicate. The weekly body weight gain and feed measurements were used to compute feed conversion ratio (FCR). Mortality was recorded.

Experimental design and statistical analysis:

A Completely Randomized Design was used with three replicates. Each treatment/replicate contained ten broiler chicks. Data obtained were analyzed using the General Linear Model Option in the ANOVA program of the Minitab Software (Minitab 2000). Sources of variation were: replicates, levels of JFM and error. Regression analysis was done with the Microsoft Excel software to relate performance traits to levels of dietary JSM.

Table 1. Composition of broiler diets used in the feeding trial (% air-dry basis)

Diets	**JSM0**	**JSM8**	**JSM16**	**JSM24**	**JSM32**
Jackfruit seed meal	0	8	16	24	32
Maize	55.0	47.0	40.0	33.0	25.0
Fishmeal (55% CP)	10.0	10.0	9.0	8.0	8.0
Soybean meal (roasted, full fat)	31.0	31.0	31.0	31.0	31.0
DL-Methionine	0.50	0.50	0.50	0.50	0.50
Lake shells	0.50	0.50	0.50	0.50	0.50
Bone ash	2.0	2.0	2.0	2.0	2.0
Salt	0.50	0.50	0.50	0.50	0.50
Vitamin-trace mineral premix[1]	0.50	0.50	0.50	0.50	0.50
Total	**100**	**100**	**100**	**100**	**100**
Composition of diets (% unless otherwise stated)					
Dry matter	88.3	88.4	88.4	88.6	88.5
Metabolizable energy (MJ/kg)	13.4	13.0	12.6	12.2	11.8
Crude protein	21.6	21.9	21.7	21.5	21.8
Crude fat	8.8	8.7	8.4	8.2	8.0
Crude fibre	3.00	3.10	3.30	3.50	3.64
Calcium	1.21	1.25	1.26	1.27	1.31
Phosphorus	0.84	0.83	0.79	0.76	0.75
ME (MJ): CP (%) ratio	620:1	594:1	581:1	567:1	541:1

[1] *Premix provided per kg diet: Vitamin A 15,000 I. U., Vitamin D_3 3,000 I. U., Vitamin E 15 I.U., B_{12} 0.013 mg, Vitamin K 4 mg, Riboflavin 10 mg, Folic acid 2 mg, Nicotinic acid 44 mg, Pantothenic acid 13 mg, Biotin 0.064 mg, Vitamin B_1 2.2 mg, Vitamin B6 5.5 mg, Choline Chloride 350 mg, Copper 6.25 mg, Iodine 1.5 mg, Zinc 62.5 mg, Manganese 62.5 mg, Selenium 0.1 mg, BHT (Antioxidant) 100 mg, Zinc Bacitracin 10 mg.*
Supplied by: *UNGA Farm Care (East Africa) Limited with technical assistance from Frank Wright Limited, part of BASF Group.*

Results and Discussion

Composition of Jackfruit seed meal

Processing had major effects on the presence of condensed tannins and oxalates which were reduced by more than 80% (Table 2).

Table 2. Composition of raw and soaked-boiled-fermented JSM (% DM, except DM which is on air-dry basis)

Composition	Raw JSM	SBF JSM
Dry matter	92.5±0.55	87.8±0.65
Crude protein	15.1±0.25	14.0±0.30
Ether extract	0.983±0.09	1.42±0.04
Crude fibre	4.20±0.08	4.63±0.05
Ash	3.78±0.74	2.25±0.034
Nitrogen free extract	74.0±0.50	74.7±0.64
Condensed tannins#	1.11±0.015	0.103±0.01
Total oxalates	1.00±0.012	0.147±0.003

 # Catechin Equivalent

Growth performance

Inclusion of the processed JSM in the diets depressed broiler growth rate and feed conversion with respective linear and curvilinear trends (Table 3; Figures 1 and 2) .

Table 3. Mean values for changes in live weight, feed intake (FI) and feed conversion in broilers fed fermented jackfruit meal as replacement for maize

	Content of JSM, %					SEM	***p***
	0	**8**	**16**	**24**	**32**		
Live weight, g							
Initial	414	440	415	427	429	8.31	0.25
Final	10878	10456	9525	8706	6979	469	0.002
Daily gain	32.1	29.6	26.9	25.3	19.4	1.26	<0.001
FI, g/d	710	680	696	717	649	29.2	0.52
Conversion#	2.21	2.29	2.58	2.86	3.36	0.14	<0.002

 # Air-dry basis

Figure 1. Effect of increasing dietary levels of processed JSM on growth rate of broilers

Figure 2. Effect of increasing die on air-dry feed conve

Growth depression of birds at levels as low as 8% JSM inclusion was least expected considering that Ravindran et al (1996) reported improved growth performance at inclusion levels as high as 25% when the seeds were only boiled for 10 minutes. The reason for the disparity could not readily be established. Since tannins and oxalates were greatly reduced (>85%) after processing, there may be other anti-nutrients in the seeds that appeared to depress growth performance when JSM was included in the diets. Other anti-nutrients in JS such as saponins, alkaloids, phytic acid, and triterpenes (Ndyomugyenyi et al 2014b; Akinmutimi 2006; Ravindran et al 1996) could have played a role in depressing growth of the broilers. Saponins, for instance, significantly affect growth, and reproduction of animals; they impair digestion of protein and uptake of vitamins and minerals in the gut (Francis et al 2002). Phytic acid is known to affect protein and lipid utilization (Kumar et al 2010), because it inhibits enzymes such as pepsin, amylases and trypsin, needed to digest food (Coulibaly et al 2011; Ramakrishna et al 2006).

Conclusions

- Processing Jackfruit seeds by soaking, boiling and fermentation reduced the content of tannin and oxalate but apparently did not improve the nutritive value as growth and feed conversion were depressed as the level of the treated seeds in the diet of broilers was increased.

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