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Bio-utilization of energy and protein content of Jack bean subjected to integrated processing techniques using Muscovy ducks

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ABSTRACT: The true metabolisable energy and protein contents of jackbean subjected to integrated processing techniques were evaluated using 18 mature muscovy ducks of average weight of 1.74 ± 0.17kg. The birds were subjected to five treatments, which include feeding of raw jackbeans, jackbeans soaked in 5% potash for 5 days and then boiled for 90 minutes, jackbeans soaked in 5% potash for 5 days and then toasted to browness, jackbeans soaked in 5% urea for 5 days and then boiled for 90 minutes, and jackbeans soaked in 5% urea for 5 days and then toasted to browness. Birds were starved for 24 hours and thereafter assigned to each of the diets in a completely randomized manner. Each of the birds were force-fed with 20g of the diet and allowed to stay for 24 hours for the collection of their feaces. Another set of 3 birds were starved for an additional 24 hours for the collection of endogenous feaces.

Feaces collected at the end of 24 hours and test feeding stuffs were analysed for both energy and nitrogen content. The TME and TMEn for raw jackbeans are significantly ($P < 0.05$) higher than that of processed beans. The raw jackbeans has TMP value of 234.97 ± 0.572 mg/gm which significantly ($P < 0.05$) lower than the urea soaked and boiled for 90 minutes but significantly ($P < 0.05$) higher than other processed beans. The TME and TMP of processed beans ranged from 2.829 ± 0.006 Kcal/g - 2.759 ± 0.005 kcal/g and 243.19 ± 0.021 mg/g - 175.64 ± 0.015mg/g respectively. Urea soaked and boiled beans has the highest TMP value of 243.19 ± 0.021 mg/g and appreciable energy value of 2.829 ± 0.006. It then becomes the effective method that can be conveniently practised at farm site.

Key Words: Bio-utilization; True metabolizable energy; Protein utilization; Jack bean; Muscovy ducks.

Introduction

The need to match the supply of animal products particularly meat and eggs with the protein requirements of Nigerian teaming population has necessitated the extension of hands to the promising though neglected species of poultry such as Duck, the yet untapped animal protein source (NRC, 1991). The duck has been found to adapt to wide range of environments. They utilize forages and cellulose - rich resources, tolerate wide array of diseases that could decimal other poultry species hence no routine vaccination like chicken (Thear & Froser, 1986). They show good feed efficiency and growth. Average muscovy ducks give more meat than a chicken of the same age. It has low fat content (Payne, 1990). Feed accounts for over 70% of the total production cost of livestock and poultry (Oluyemi, 1984) of which conventional protein source is the costliest due to competition between animal, man and industrial sector.

The need therefore arises to source for alternative protein source that are rarely edible by man, of less use in the industrial sector and that can meet the nutritional requirement of animals.

Jackbean is of such potential. It has excellent climatic adaptability, resistance to diseases and hence thrives where other legumes fails. It contain about 22 - 29% crude protein with the yield of about 4600kg of seed per hectare (N.A.S., 1979). Like other legumes, it contains anti-nutritional factor (Udedibie and Nwaiwu, 1988). Hence various processing techniques have been employed. Udedibie *et al* (1994) reported that toasting only resulted in partial detoxification. Also the use of urea alone was ineffective (Udedibie *et al*, 1996).

Heat treatment alone could not sufficiently improve the nutritive value of jackbeans beyond 10% dietary level. (Esonu *et al*, 1997). This may be due to the presence of both thermostable and thermolabile anti-nutritional factors in jackbeans (Jayne William, 1973 and Udedibie *et al*, 1996).
hence the need to combine more than one processing method (integrated) to detoxify the anti-nutritional factors in Jackbeans.

Its effect on bio utilization of energy and protein content of Jackbeans forms the objective of this experiment.

Materials and Methods

Jackbeans used were collected from Obi, Nassarawa State of Nigeria. Part of it was soaked in 5% potash for 5 days and then boiled for 90 minutes, soaked in 5% potash for 5 days and then toasted to browness, soaked in 5% urea for 5 days and then boiled for 90 minutes, and soaked in 5% urea for 5 days and then toasted to browness. The processed and rawbeans were oven dried to constant weight before usage.

Eighteen mature Muscovy Ducks of average weight of 1.74 ± 0.17kg were used for the experiment in a completely randomised design. A bird was thereafter randomly assigned to each of the 5 test feed stuffs. During the test period, each bird was transferred to individual metabolic cage where it was starved for 24 hours and thereafter force fed with 20g of the assigned feed stuff through a glass tube inserted into the crop. They were allowed to stay the nest 24 hours for quantitative collection of feaces. An additional bird was simultaneously starved for a total of 46 hours to collect feaces for endogenous energy and nitrogen. All birds were watered throughout that period. Feaces collected were dried in force drought oven at 60°C. All steps described above were repeated 3 times to provide the required of replications. Energy contents of ingested test feed stuffs and those of the feaces voided by both fed and starved birds were determined using a bomb calorimeter while their nitrogen contents were obtained using kjeidahl - procedure (A.O.A.C., 1984). The true metabolisable energy (TME) and true metabolisable protein (TMP) and true metabolisable emergy corrected for nitrogen (TMEn) were calculated by the method of Sibbald (1976) and Parsons *et al* (1987) respectively. Equation for (TME) calculation as given by Sibbald (1976).

$$\text{TME (kcal/g)} = \frac{(\text{G.E.F.} \times X) - (Yef - Yec)}{X}$$

G.E.F. = gross energy of the feed stuff (Kcal/g)
Yef = energy voided as excreta by feed birds
Yec = energy voided as excreta by unfed birds
X = weight of feeding stuffs fed (g)

Equation for TMEn as given by Parson *et al* (1982).

$$TMEn = \frac{FEE - (EEF + 22NF) + (EEU) + 8.22Nu)}{Fc}$$

FEF	= gross energy of the total feed consumed (Kcal/g)
EEF	= energy in excreta collected from fed birds (Kcal/g)
Ecu	= energy in excreta collected from fasted birds (Kcal/g)
Nf	= nitrogen retained by fed birds (g)
Nu	= nitrogen retained by fasted birds (g)
Fe	= dry feed consumed (g)

True metabolisable protein was calculated with the following equation adopted from the Sibbald (1976).

$$TMP\ (mg/g) = \frac{(GPF \times X) - (Ypf - Ypu)}{X}$$

GPF	= gross protein feed stuff (mg/g)
Ypf	= protein voided as excreta by fed birds
Ypu	= protein voided as excreta by fasted bird
X	= weight of feed stuff fed (g)

Statistical Analysis - All data were subjected to analysis of variance by the method of Steel and Torrie (1980).

Results and Discussion

The TME and TMEn for raw Jackbeans are significantly ($P < 0.05$) higher than that of processed beans (Table 1). This is in agreement with (Ologhobo and Fetuga, 1986) who reported that processing reduce the energy value of feeding stuffs.

For TMP, the raw jackbeans has TMP value of 234.97 ± 0.572mg/g which is significantly ($P < 0.05$) lower than the urea soaked and boiled for 90 minutes but significantly ($P < 0.05$) higher than other processed beans. This implies that processing has different effects on protein digestibility and this may probably be attributed to their varied effectiveness in reducing the anti-nutritional factor contained in them. For processed beans, the TME and TMP ranges from 2.798 ± 0.003 - 2.729 ± 0.003 Kcal/g and 243.19 ± 0.021 mg/g - 175.64 ± 0.015mg/g respectively. The urea soaked and cooked beans had the highest TMP value of 243.19 ± 0.021mg/g and appreciable energy value of 2.798 ± 0.003 Kcal/g.
This is in agreement with the findings of (Udedibie and Nwokocha, 1990 and Motilla *et al*, 1981) who reported that soaking jackbeans in urea solution for about a week prior to cooking for 60 minutes is the best method of dexoxifying jackbeans. It then becomes the effective method that can be conveniently praticed at farm site.

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Table 1: Processing Technique Parameters

		TME (Kcal/g)	TMEn (Kcal/g)	TMP (mg/g)
Raw		2.962 ± 0.001^{a}	2.933 ± 0.003^{a}	234.97 ± 0.572^{a}
Processed	T_1	2.813 ± 0.002^{b}	2.781 ± 0.002^{b}	192.35 ± 0.050^{b}
	T_2	2.809 ± 0.003^{b}	2.773 ± 0.001^{c}	175.64 ± 0.015^{c}
	T_3	2.829 ± 0.006^{c}	2.798 ± 0.003^{c}	243.19 ± 0.021^{d}
	T_4	2.759 ± 0.005^{d}	2.729 ± 0.003^{d}	188.38 ± 0.001

Values are mean ± standard error

abcefg = mean in the same column with different superscripts differ significantly ($P < 0.05$)

T1 = Jackbeans soaked in 5% potash solution for 5 days and boiled for 90 minutes
T2 = Jackbeans soaked in 5% potash solution for 5 days and toasted to browness
T3 = Jackbeans soaked in 5% solution for 5 days and boiled for 90 minutes
T4 = Jackbeans soaked in 5% urea solution for 5 days and toasted to browness
TME = True metabolizable energy
TMEn = Nitrogen corrected True metabolizable energy
TMP = True metabolizable protein.

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