TRUE METABOLIZABLE ENERGY (TME), TRUE METABOLIZABLE ENERGY CORRECTED TO NITROGEN EQUILIBRIUM (TMEn) AND TRUE METABOLIZABLE PROTEIN (TMP) OF RAW AND VARIOUSLY PROCESSED AFRICAN YAM BEANS (*SPHENOSTYLIS STENOCARPA*)

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Abstract
Studies were carried out to determine the effect of processing on metabolizable energy and protein of African yam beans (AYB). Eighteen and 8 weeks old broilers were selected randomly out of 100 broiler chicken. They were allotted into 5 dietary treatments having 3 replicate of 1 bird per replicate in a completely randomized design (3 of the 18 birds served as control). They were forced fed 30g each of relevant diet except the control. Diet I was raw AYB, diet 2 was boiled AYB, diet 3 was toasted while diets 4 and 5 were cracked and boiled and toasted and dehulled respectively. There was no significant difference ($P>0.05$) in the values of TME. Values of TMEn compared favourably with one another and are significantly ($P<0.05$) higher than that of raw AYB. Considering numerical values boiled AYB has superior numerical value of TMEn than other processing methods. The TMP value of boiled AYB is significantly ($P<0.05$) higher than those of raw and other processing methods. Boiled AYB is therefore recommended.

Key words: African Yam Beans. True Metabolizable Energy (TME), True Metabolizable Energy

Introduction

Knowledge of the available energy and protein of feedstuffs is essential if the least cost poultry rations are to be formulated. There are many feedstuffs of interest that require evaluation. Such feedstuffs will be better utilized when their available energy and protein values are known (Okah *et al.*, 2006).

Metabolizable energy and digestible protein are a measure of available energy and protein in feedstuff. These estimates the ability of the test feedstuff to provide energy and protein needed for maintenance and production by the animals (Vohar, 1972, Agunbiade *et al.*, Akinmutimi *et al.*, 2009).

Anti-nutritional factors are present in most feeding stuffs. These anti-nutritional factors pose physiological effect and decrease or reduce the bio-availability of protein and energy (Gatel, 1994). Lectins for example combine with receptor of epithelial cells of intestinal mucosa and disturb the digestive processes (Gatel, 1994), tannin forms insoluble complexes with protein and interferes with digestion (Kakade *et al.*, 1982).

Processing methods such as the heat treatments (boiling, cooking, testing etc) and cold treatment (fermentation, cracking, soaking etc) reduce the effect of anti nutritional factors and increase bio-availability of energy and protein (Akanji *et al.*, 2003, Akinmutimi, 2004, Akinmutimi *et al.*, 2006).

Processing methods such as boiling, dehulling, toasting and cracking are common and acceptable detoxification methods among Nigerians. They therefore attract attention in this study.

Materials and Methods

Location of the experiment

The experiment was carried out at the poultry unit of the Research and Training Farm of the Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

Procurement and processing of African Yam Bean (AYB)

AYB (speckeld, the more available one) was purchased from Umuosu market in Isialangwa Local Government Area of Abia State of Nigeria. The following methods were used for processing of AYB.

a. Toasting to browness (for 15 min)
b. Boiling in water (30 min at 100-105^{0}c)
c. Dehulling after toasting
d. Cracked and boiled using the same method as in b.

The broiled, cracked and boiled AYB were sun-dried, and together with toasted/toasted dehulled, and raw AYB were separately ground to fine (100 mesh screen) powder and then stored until required.

Chemical Analysis

The proximate composition of processed AYB were determined using the procedure described by the association of official analytical chemists

(AOAC, 1990) while the gross energy was determined using Gallenkamp Ballistic bomb calorimeter(A.O.A.C., 1990).

Anti-Nutrient Determination

The methods of Maga (1982), Lucas and Markaka (1975), Kakade *et al.*, (1969), Knowled and Montgomery (1980) and Brunner (1985) were used to determine Tannic acid, phytic acid, trypsin inhibitors, hydrocyanic acid and saponin content of processed AYB meal respectively.

Experimental Diet

The diet consists of raw and variously processed AYB.

Experimental birds, management and design

A total of one hundred unsexed broilers of Anak strain were bought from Zion Farms Nigeria Limited, Owerri, Imo state. The birds were brooded with kerosene stove in a deep litter house for 2 weeks s. All the birds were watered and fed *ad-libitum* through out the period of the experiment (8wks). Vaccination programme was observed and anti stress formula given throughout the period.

At 8 weeks of the experiment, 18 birds of equal weights were randomly selected. 15 out of the 18 were allotted to each of the test ingredients (i.e raw AYB, boiled AYB, toasted AYB, toasted and dehulled AYB and cracked and boiled AYB) while the remaining 3 of the birds were used as control. There were 3replicate/treatment and 1 bird/replicate. All the birds were starved for one day to empty their alimentary canal of feed residues. The birds were kept in individual metabolic cages over an excreta collection tray.

The birds (except control) were fed with 30g of the relevant test ingredient and the time noted. Exactly 24hrs after putting the birds in cages the excreta of both fed and unfed birds were collected quantitatively, dried and weighed. The dried faeces were analyzed for endogenous faecal energy and nitrogen. Energy was determined using Adiabatic Bomb calorimeter while the nitrogen content of the test ingredient and faeces were determined using the method of AOAC (1990).

True Metabolizable Energy (TME) and True Metabolizable Protein (TMP) were calculated using Sibbald's (1976) method while True Metabolizable Energy corrected to Nitrogen Equilibrium (TMEn) were calculated using the method of Passons *et al.*, (1982).

Experimental design and statistical analysis

Experimental design was completely randomized design. Data collections were subjected to analysis of variance (ANOVA) (Steel and Torrie, 1980). Means separation were carried out as described by Duncan's Multiple Range Test (Duncan, 1955).

Results and Discussion

$$\text{TME (kcal/g)} = \frac{F_i \times GEF - Y_f - Y_o}{F_i}$$

Where:

F_i = feed input
GEF = gross energy of feedstuff (kcal/g)
Y_f = energy excreted by fed bird
Y_o = energy excreted by unfed bird

$$\text{TMP}\left(\frac{mg}{g}\right) = \frac{Gpf \times X - (Yfp - Ypu)}{X}$$

Where:

Gpf = gross protein of feedstuff (mg/g)
Ypf = protein voided as excreta by fed birds
Ypf = protein voided as excreta by starved birds
X = weight of feedstuff fed (g)

$$\text{TMEn} = FEf - \frac{(FEf \times 8.22Ne \times EEu)}{FC}$$

Where:

FEf = gross energy of the total feed consumed (kcal/g)
EEF = energy in excreta collected from fed birds (kcal/g)
EEu = energy in excreta collected from fasted bird (kcal/g)
NF = Nitrogen retained by fed bird
FC = dry feed consumed

Table 1 reveals the metabolic energy and protein of 8 weeeks old broiler chicken fed raw and variously processed AYB. Although there were no significant (P>0.05) differences in the valves of TME, processed seeds had higher numerical values than the raw seeds. This agrees with the work of Akinmutimi (2004) who reported same in determination of TME for both raw and processed sword bean meal . He attributed it to increased digestibility and better utilization of nutrients as a result of removal of anti-nutritional factors that hinder energy metabolism. The range of value of TME 12.13 kg/g (for raw) to 13.14kJ/g (for cracked and boiled) compared favourably with conventional energy sources such as maize (12.71kJ/g), millet (10.65 kJ/g), wheat (12.79 kJ/g), rice bran (8.78 kJ/g) (Olomu, 1995). This suggests that its usage will reduce the quantity of conventional energy thereby reducing the cost of production. TMEn showed the same pattern as in TME, but that of processed seeds have values that compared favourably with one another and these values were significantly (P<0.05) higher than that of raw meal. This is probably due to reason given earlier for TME. The True Metabolizable Protein (TMP) followed similar pattern as in TMEn. Significantly higher values were got from boiled AYB seed and cracked and boiled. This may be due to bio-availability and better utilization of nutrients as a result of boiling.

Conclusion

Considering the fact that boiled seeds of AYB had highest values of TMEn and TMP, it shows that the nutrients in boiled AYB seeds are better available and better utilized. Boiling is therefore recommended as processing method. The values of TME, TMEn and TMP also suggest that AYB can reduce the quantity of conventional energy sources and replace protein sources to a certain

extent.

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Table 1: Metabolism of Energy and Protein of 8 weeks old broiler chicken fed Raw and Variously Processed AYB

	Raw	Boiled	Toasted	Cracked & Boiled	Toasted & Dehulled	SEM
TME kJ/g	12.13	12.80	12.30	13.14	12.43	0.10
TMEn (kcal/g)	10.88^{b}	12.38^{a}	11.76^{a}	12.34^{a}	11.76^{a}	0.05
TMP (mg/g)	18.42^{d}	20.90^{a}	18.41^{d}	20.33^{b}	19.52^{d}	0.12

Means within the same raw bearing different superscripts (a-d) are significantly ($p<0.05$ different) SEM-standard error of mean.