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NUTRITIONAL POTENTIALS OF TOASTED *Afzeliaafricana* SEED MEAL IN NON-RUMINANTS

Oko, Emmanuel Chukwuma[1], Obinna, Vincent Oko[2], Ikpe, Juliana Nnenna[1]
[1]Department of Agricultural Technology, Akanu Ibiam Federal Polytechnic, Unwana Ebonyi State South East Nigeria
[2]Department of Food Technology, Akanu Ibiam Federal Polytechnic, Unwana Ebonyi State South East Nigeria
Email: oe.chukwuma@gmail.com, vinoko43@gmail.com, juliananikpe@gmail.com

ABSTRACT
Nutritional potentials of toasted *Afzeliaafricana* seed meal as feed ingredient on performance of broiler finishers was evaluated. The proximate Analysis and amino acid profiles of the toasted *Afzeliaafricana* were carried out and the seed meal was used to formulate four experimental diets at levels of 0%, 5%, 10% and 15% for treatments 1,2,3 and 4 respectively on a 35 day feeding trials. One hundred and twenty brooded four weeks old broiler chicks were assigned to each treatment diets at 30 broiler chicks per treatment and were replicated three times to 10 broilers per replicate in a completely randomized design. The proximate results indicated a moisture level of 6.2%, the crude protein content was 28.7%, crude fibre 5.3%, Ether Extractive 12.5%, Ash 2.9% and Nitrogen free extractive 50.6% on dry matter basis. The phytochemical components were Tannin 8.01%, saponins 5.4%, alkaloids 1.3%, flavonoids 11.8%, cardiac glycosides 2.4%, oxalate 8100mg/ 100g, phytate 0.157 % and no level of phenol recorded on dry matter basis indicating toxic levels of these components. The amino acid profiles revealed the presence of all the amino acids. The performance of the broilers showed a drop in the average final weight of the broilers by 2448.6g, 2073.33g, 1930g and 1477g for

treatments 1, 2, 3 and 4 respectively. The feed intakes were reduced to 181.3 g, 200 g, 154.67 g and 116.67 g per bird per day for treatments 1, 2, 3 and 4 respectively. Average daily weight gain were 44.10, 33.41, 29.43 and 16.31 grams per day for broilers in treatments 1,2,3 and 4, respectively and the feed conversion rate decreased as the levels of the toasted *Afzeliaafricana* seed meal increased in the experimental diets. It was therefore concluded that *Afzeliaafricana* resulted to extensive deleterious effect on the broilers and suggests that it should not be used broilers' diet unless further studies on the detoxification of the toxic phytochemical components were effected.
Keywords: *Afzeliaafricana,* proximate, phytochemicals, haemorrhage, broiler finisher, detoxification

INTRODUCTION

The West African rain forest areas are endowed with wonderful vegetation unequalled by any other continents of the world. Most of the vegetative species are either underutilized or are not utilized at all. Some of these plant species are used as vegetables, wooden species and as browse to livestock species and the seeds or nuts used only as less value to human utilization. These vast species have added wide range of animal feed resources for which the West African rain forest areas are blessed with in the form of grains, oil seeds and agro-industrial products and by- products which could be used in the formulation of good quality livestock feeds.

Some of these plant products (seeds, leaves and barks) are allowed to waste and are underutilized or unharnessed. These seeds are often times toxic to animals and are fibrous or

contain anti-nutritional factors as could be the case with *Albiziasaman, Mucuna*species, *Canavalia* species and some leaf species (D'Mello, 1992, Udedibie and Opara, 1998, Esonu et al., 2004, Okorie, 2006).

The efforts to determine the biosafety status of some of these plant species have attracted the attentions and interests of Nutritionists and
Biochemists on possible treatments such as, heat treatment (cooking, roasting and toasting), the use of enzymes and probiotic to inactivate some anti-nutritional substances to enhance their utilization.

Despite all these efforts, there is still low capacity feed resources utilization which could be linked to inadequate information based on location and localization of feed resources, processing, preservation or storage and quality assessment or enhancement. This is associated with long time dependence on conventional and imported feed resources by key players in livestock industry while potentially affordable, available unconventional local feed resources suffer a great neglect and low patronage resulting to the wide gap on the animal protein intake of Nigerians short of the WHO's average protein intake requirement(WHO, 1991).

To sustain the livestock and poultry industries, it is very urgent to look for readily available plant protein-energy source that are affordable and has low human value that can replace either totally or partially the conventional feed resources like Soya bean or maize for continued and consistent production of meat, milk, egg and other animal products and by-products for mankind(Ortega, 2012).

Forage trees and shrub-like legumes are inexhaustible nutrient sources contributing feeds of good quality, that improve the animal diet and reduce the use of concentrates in agricultural exploitations (De Andrade et al., 2004).

Legume and oil seeds used in preparation of diets abound in Nigeria. Seeds of castor, coconut, dikanut, groundnut, melon, African oil bean, palm kernel, soya bean, *vigna* and *phaseolus* bean cultivars and a wide variety of seeds in the *Leguminoceae family* are used in the preparation of diets and for humans and livestocks to improve diets(Onweluzo et al., 1994, Akpanabiatu et al., 2001, Onyeike and Achene, 2002, Onwuliri and Obu, 2002).

Cereals and Legumes in the developing countries supply the energy and vegetable proteins requirement of both humans and livestocks (Okorie 2015). Also, leaves of *Alchorniacordifolio* and *Azachirchtaindica* could be of value to poultry diets(Udediebie et *al*, 1998). Legumes are important ingredients in human diets in many parts of the world due to their high protein and starch contents (Czuchajowska et al., 1998).

The scarcity and high cost of feed ingredients despite efforts by livestock industry stake-holders has resulted to high cost of finished poultry products. The quest for high quality but affordable animal feed ingredients has continued to be the concern of nutritionists, government and bodies charged with the responsibilities of food and nutrition in different parts of developing economies.

This problem has been blamed more on lack of information on the composition and utilization of many of the various sources of feed ingredients indigenous to the tropical/sub Saharan Africa.

The unavailability of animal protein origin, inadequate quantities makes the use of protein rich legumes to be essential alternatives in poultry nutrition (Akanji, 2002).

Groundnut cake (GNC) and soya bean meal (SBM) which used to play major and significant roles in poultry nutrition have suddenly become scares in view of their high demand resulting to the closure of most poultry farms. Perhaps, that is why (Ndubuisi, 2011, Madubuike, 2012) reported that in Nigeria, poultry industry has been facing a lot of challenges due to numerous constraints among which is high cost of poultry feed. Feed alone accounts for over 70% of the total cost of production out of which 50% is expended on protein and energy source. They further observed that the unprecedented cost of feed ingredients has made the cost of poultry products very high. The industry is becoming unattractive and hence unable to supply the much needed animal protein on the table of an average Nigerian. The situation is worsened by the competition between man and livestock industries for the major feed ingredients such as maize and soya beans. Also high cost of conventional protein feedstuffs such as groundnut cake, fish meal, soya bean meal, etc, has led to the closure of most poultry farms.

This situation calls for the obvious need to exploit and expand the production and utilization of other relatively unknown non-conventional and cheaper legumes as sources of protein in

poultry feeds. Legume pastures have been projected as economically viable alternative for proteins and calories in developing countries (Famurewa and Raji, 2005). Few substitutions with native legumes is viable and provides additional proteins, minerals and energy in dry seasons and improves the overall nutritional status of developing countries(Guillon and Champ, 1996).

Legumes are plant-based proteins for humans and livestock. The underutilized ones are inexpensive and attractive sources of protein than conventional sources such as soya bean (*Glycine Max*), groundnut (*Arachishypogea*) and animal-based proteins (Guillon and Champ, 1996). It has become necessary therefore, to investigate into some of the wild leguminous plants, to enable us harness their food and nutrient potentials, reduce the demand for and the high cost of conventional protein concentrates, increase concentrate availability and hence increase supply of poultry products to man.

Some underutilized wild leguminous plants have been explored for their nutritional values and *Afzeliaafricana* is one of such legumes whose potentials has not been fully harnessed by nutritionists and livestock industries. It can be grown in all parts of the country. Presently it has only attracted local recognitions in areas it is used as soup thickening ingredient and the leaves and bark as medicinal materials for various ailments.

The tree is known in the major Nigerian languages of Igbo, Hausa and Yoruba as "Akparata" or "Akpalata", "Kawo" and "Apa", respectively. *Afzeliaafricana* belongs to the family

Leguminoceae and sub family *Caesalpinaceae*(Keay et al., 1964, Enwere, 1998). The tree is a semi deciduous wild plant, abundant in the savanna, fringing forest and the drier parts of the forest regions of Africa. Its fruiting period is between December and March every year. It is one of the most widely distributed species in Africa. It is found in Senegal and predominantly in the Eastern part of Nigeria West Africa; Sudan, Uganda and Tanzania in the East. Very small quantities of the seeds are traditionally used as condiment (soup thickening ingredient) by few Nigerian communities, while large quantities are allowed to waste in the fields. The use of the leguminous seed (*Afzeliaafricana*) as protein source in livestock feeds is not widely reported in the literature to the knowledge of the researchers, there is little or no information on *Afzeliaafricana* seed meal as a diet ingredient for poultry (monogastric) production.

The un-affordability and unavailability of the conventional protein sources (groundnut cake (GNC), soya bean meal (SBM)) for poultry feeds production to enhance increased poultry products has necessitated the need for conducting this study. This study therefore, evaluates nutritional potentials of toasted Afzeliaafricana seed in broiler diet as to ascertain the general performance of finisher broilers fed varying levels of toasted *Afzeliaafricana*seed meal (TAASM).

Objectives of the Study

The objectives of this study include:

1. To determine the proximate and phyto-chemical composition and amino acid profile of Toasted *Afzeliaafricana* seed meal.

2. To determine the effects of graded levels of Toasted *Afzeliaafricana* seed meal on performance of finisher broiler birds.

To determine the effects of Toasted *Afzeliaafricana* seed meal on carcass yield.

Justification

This study will uncover the true value of *Afzeliaafricana* seed as feed ingredients in broiler diets. The findings may enable poultry farmers (producers) to start using Afzelia*africana* seed meal as feed ingredient or not.

If positive result is achieved, it is believed it will prompt scientists to research into indigenous leguminous plant seeds that are considered not useful now. It may also attract agro-allied industries, other industries, nutritionists and government agencies to release grants for further researches, on not only *Afzeliaafricana* but other indigenous legumes. The positive outcome of this research if publicized, will boost morale, arouse and ginger interest in crop farmers going into the cultivation of *Afzeliaafricana* on a controlled large scale.

More importantly, it will forestall the tendency of the plant going into extinction and in so doing it will help increase the supply of the seeds and consequently further force down the market price of poultry feed for increased productivity.

MATERIALS AND METHOD

Experimental Site

The experiment was carried out in the Teaching and Research Farm of Imo State University, Owerri and also in the Food

Chemistry/Analysis Laboratory of the Department of Food Technology of Akanu Ibiam Federal Polytechnic, Unwana Ebonyi State both in South East Nigeria.

Sources, Preparation and Processing Of Experimental Diet

The matured raw seed of *Afzeliaafricana* were bought from Eke Market in Afikpo North LGA and Ọnueke Market in Ezza Local Government Area, Ebonyi State, Nigeria.

After purchase and collection, the seeds were inspected and the defective ones discarded. The seeds with the waxy orange cup like structure at the base of the seed were traditionally processed by being toasted at a temperature of 100°C for about 25 minutes until they started to crack open and the white endosperm turned crispy brown. The toasted seeds were cracked/decorticated manually with the use of wooden pestle.

The toasted endosperm were hammer milled to particle size, which can pass through 0.02mm sieve in order to obtain the toasted *Afzeliaafricana* Seed Meal (TAASM) that were used for the formulation of the experimental diets. This method was adopted by (Anyanwale and Aya, 2006).

The Toasted *Afzeliaafricana* Seed Meal (TAASM) sample so produced was taken to the laboratory for phyto-chemcial analysis, amino acid profile test and proximate analysis prior to ration formulation according to Association of Official Analytical Chemist (A.O.A.C., 2000) to determine the crude protein, Ether Extract, Crude Fibre, Ash content, Moisture and carbohydrate.

Experimental Diets

The TAASM was used to formulate four (4) broiler finisher diets at inclusion levels of 0.00%, 5.00%, 10.00% and 15.00% representing T_I (control) conventional diet which did not contain the *Afzeliaafricana* seed meal while diets T_2,T_3 and T_4 contained 5.00%, 10.00% and 15.00% of toasted *Afzeliaafricana* seed meal (AASM) in partial replacement of soya bean meal respectively. The ingredient compositions of the diets are shown in Table 1

Table 1: Ingredient Composition of the Experimental Diets

INGREDIENTS	T_1 (0.00%)	T_2 (5.00%)	T_3 (10.00%)	T_4 (15.00%)
Maize (yellow maize)	55	55	55	55
AfzeliaAfricana	0.00	5.00	10.00	15.00
Soya bean	15.00	10.00	5.00	0.00
Groundnut cake	10.00	10.00	10.00	10.00
Palm kernel cake	3.00	3.00	3.00	3.00
Brewers dried grain	3.00	3.00	3.00	3.00
Wheat bran	3.00	3.00	3.00	3.00
Fish meal	4.00	4.00	4.00	4.00
Bone meal	3.00	3.00	3.00	3.00
Blood meal	3.00	3.00	3.00	3.00
Vitamin mineral premix	0.25	0.25	0.25	0.25
Common Salt	0.25	0.25	0.25	0.25
DL-Methionine	0.25	0.25	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25
TOTAL	100	100	100	100

Experimental Birds and Design

A total of one hundred and twenty (120) Marshal strain, finisher broilers, 28 days old with an average weight of 904g were used for the experiment. The birds were placed in deep litter pens. Prior to the commencement of the experiment, the birds were fed commercial finisher diet (*Afzeliaafricana* free diet) for 7 days.

On the 8th day, the broilers were randomly divided into four (4) experimental groups of thirty (30) broiler birds and each group was randomly assigned to one of the experimental diets in a completely randomized design (CRD).

Subsequently, each group was further replicated into three (3), consisting of ten (10) birds per replicate. Each replicate was kept in a compartment measuring 2m x 2m. Feed and water was provided ad-li-bitum throughout the experimental period. Prophylactic treatments against Newcastle disease, fowl pox and Gumboro were given to the birds. The birds were also given drugs against coccidiosis as they were also dewormed. The feeding trial lasted for 35 days. The broilers were weighed at the commencement of the experiment and weekly thereafter. Routine washing of drinkers, cleaning and proper litter management to prevent infection and spread of diseases were observed. Multivitamins stress reducers were given.

Data Collection

The data collection commenced as soon as treatment diets were introduced. Feed intake was recorded daily and the birds weighed weekly after the initial body weight was taken. Feed intake was determined by weighing the feed offered and the left over the following day. The difference between the two values was taken as the feed consumed. Feed conversion ratio was determined by dividing average feed intake by average daily body weight.

STANDARD ANALYTICAL PROCEDURE FOR PROXIMATE ANALYSIS

Determination of moisture content/total solids

Several methods are available for the determination of moisture content/total solids. But the most commonly used method is the Indirect Distillation method employing drying oven.

Porcelain/Silica crucibles are used. Weigh 5g – 10g of the sample into a pre – weighed, Pre – dried and cooled crucible or dish and dry in the oven at 70 - 80^{0}c for two (2) hours and at 100 - 110^{0}C (usually at 105^{0}C) until a constant weight is obtained. Cool the crucible and its content of dried sample in a desiccator before weighing. The percentage moisture content/total solids are calculated using the equation below:

$$\% \text{ Moisture Content} = \frac{W_2 - W_3}{W_2 - W_1} \times \frac{100}{1}$$

$$\% \text{ Total Solid} = \frac{W_3 - W_1}{W_2 - W_1} \times \frac{100}{1}$$

Where w_1 = Initial weight of empty crucible

W_2 = Weight of empty crucible + sample before drying

W_3 = Weight of empty crucible + sample after drying

Determination of ash content

Crucibles are thoroughly washed, cleaned and placed in a hot air – circulation oven for 2 hours and cooled to room temperature in desiccator. The empty crucible are then transferred to the muffle furnace to burn off all organic matter and also to stabilize the weight of the crucible at the temperature range 550^{0}c – 600^{0}c, before cooling at room temperature in a desiccator.

The pre – weighed crucibles with 5 – 10g of sample was then transferred into a preheated furnace and ashed for 3 – 5 hours at 600^0c. The crucible and its content (ash) were cooled in a desiccator and reweighed. The percentage ash content was calculated as:

$$\% \text{ Ash Content} = \frac{\text{weight of ash}}{\text{Weight of sample}} \times \frac{100}{1}$$

$$\frac{W_3 - W_1}{W_2 - W_1} \times \frac{100}{1}$$

Where W_1 = Weight crucible

W_2 = Weight of empty crucible + sample before ashing

W_3 = Weight of empty crucible + Ash

Determination of fibre content

The sample (2g) was weighed accurately in the fibre flash and 100ml of 0.25N H_2SO_4 was used to dissolve the mixture and heated for one hour with the heating mantle. The hot mixture was filtered through a fibre sieve cloth. The filtrate obtained was thrown off and the residue was returned to the fibre flash to which 100ml 0.3N NaOH was added and heated under reflux for another 1 hour. The mixture was filtered through a fiber sieve cloth and 10ml of acetone was added to dissolve any organic constituent. The residue was washed with about 50ml hot water twice on the sieve cloth before it was finally transferred into the crucible. The crucible and residue was oven dried at 105^0C overnight to drive off moisture. The oven dried crucible containing the residue was cooled in a desiccator and later weighed to obtain the weight (W_1), which

was transferred to the muffle furnace for ashing at 550^{OC} for 4 hours. The crucible containing white or grey ash (free of carbonaceous material) was cooled in the desiccator and weighed to obtain W_2. The difference $W_1 - W_2$ gives the weight of fibre(A.O.A.C., 2000). The percentage fibre was obtained by the formula:

$$\% \text{ Fibre Content} = \frac{w_1 - w_2}{\text{Weight of sample}} \times \frac{100}{1}$$

Determination of crude fat/lipids

Using the *AOAC* (2000) method, weigh 2 -5g of finely ground dried sample into a thimble and place into a Soxhlet apparatus containing a glass wool. Attach a dried pre – weighed 500ml round bottom flask (containing few crystals of anti – bumping chips) to the base of the extractor and clamp to retort stand. Pour about 300ml of petroleum ether into the barrel containing the thimble and place the assembled unit on an electro-thermal heater with the top of the extractor connected to a reflux condenser and source heater to enable the solvent in the flash to boil and extract the lipids in the sample for about 3 – 6 hours on completion, remove the thimble and reclaim either by distillation. Place the flask and the extracted lipid in an oven at 70^0C for a few minutes to completely remove all the ether residues and cool in a desiccator before reweighing. The process of drying and cooling were continued until a constant weight was obtained. The percentage lipid was calculated thus:

$$\text{Crude Lipid (\%)} = \frac{\text{Weight of lipid } (W_1)}{\text{Weight of sample}} \times \frac{100}{1}$$

Where W_1 = Weight of flask and content after extraction – weight flask before extraction

Determination of crude protein content

Kjeldahl method was used for the determination of crude protein. Exactly 8g of the sample and 3g of copper sulphate catalyst and 25mls of concentrated sulphuric acid was heated over Bunsen flame in a fume cupboard to expel any poisonous gas. It was then heated with shaking at intervals for 1hr until the mixture became clear. 400ml of distilled water was added followed by the addition of 50ml of 2% boric acid with 1ml of methyl red indicator.75ml of 50% NaOH was added to make the solution alkaline. The ammonia was distilled into the boric acid solution. 250mls of the distillate was collected after washing the walls of the receiver and condensed. The distillate was titrated with 0.1N Sulphuric acid. The percentage protein was calculated from the percentage nitrogen of the sample as follows:

$$\% \text{ Nitrogen} = \frac{\text{ml Acid- (N acid x 1.4)}}{\text{Weight of sample}}$$

Therefore, % Crude Protein = %Nitrogen x 6.25

Determination of total carbohydrates (by difference)

By this, the total carbohydrate content of sample is the percentage remaining after the moisture ash, lipid, fibre and protein contents have been removed.

Mathematically, it is given as:

%Total Carbohydrate =100% - %(Protein + lipids + Fibre +Ash Content +Moisture Content)

Data Analysis

The data collected from the study were subjected to analysis of variance (ANOVA) by Steel and Torrie (1980) while

significant treatment means were separated using Duncan's New Multiple Range Test (DUNMRT) as outlined by Obi, (2002).

RESULTS

The result of the proximate composition of toasted *Afzeliaafricana* is presented in Table 2. The result revealed that moisture content was 6.2% without browning effect and ether extractive 12.5%. The crude protein content was 28.7%. This level of protein could appreciate if the lipid content of the seed is extracted .The crude fibre content and the total ash which is the mineral content is 5.3% and 2.9% respectively and the nitrogen free extractive is 50.6%. The proximate analysis was done on dry matter basis.

Table 2: Proximate composition of Toasted *Afzeliaafricana* seed meal

Nutrient	Amount (%Dm)
Moisture	6.2
Crude protein	28.7
Crude fibre	5.3
Ether extractive	12.5
Ash	2.9
Nitrogen-free extractive	50.6

Dm = Dry matter basis

At 6.2% moisture content, he toasted *Afzeliaafricana* seeds can store very well and over a very long period of time and this can ensure storability and availability even at the off season period.

Amino acid profile of toasted *Afzeliaafricana* seed meal

Table 3: The result of the amino acid profile of Toasted *Afzeliaafricana* Seed meal.

S/N	Group name	Amount(g/100g protein)
1.	Glycine	3.81966
2.	Alanine	4.24524
3.	Serine	2.66257
4.	Proline	2.74162
5.	Valine	3.47853
6.	Threonine	3.42590
7.	Isoleucine	3.26236
8.	Leucine	6.26319
9.	Aspartate	8.95398
10.	Lysine	4.07628
11.	Methionine	1.47835
12.	Glutamate	11.33029
13.	Phenylalanine	4.24347
14.	Histidine	2.49853
15.	Arginine	6.75032
16.	Tyrosine	2.51570
17.	Tryptophan	6.79751
18.	Cystine	1.24996
	Total	**72.99602**

The result of the amino acid profile revealed that toasted *Afzeliaafricana* has a high level of glutamate, leucine aspartate, arginine and tryptophan with other amino acids in moderate and low levels. The result revealed that the seed when toasted has almost all the amino acids and importantly, it has all the eight essential amino acids, which therefore makes it a very good source of protein.

CONCLUSION

The nutritional potentials of *Afzeliaafricana* make the seeds attractive for use as a source of protein both for human consumption and animal production and should therefore be exploited for more extensive use in human nutrition as well as for the production of livestock, especially broiler birds.

RECOMMENDATION

It is strongly recommended that studies on the toxicological potentials of *Afzeliaafricana* be investigated before incorporating it fully into the feed for the broiler birds.

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