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Effects of Different Processing Methods on Nutrient and Anti-Nutrient Compositions of *Entada aricana* Seed

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Abstract
Entada africana belongs to the family Fabaceae which is popularly known as Legumes and third largest order of seed-plants. The study investigated the effects of different processing methods on the nutritional and anti-nutritional properties of *Entada africana*. *Entada africana* seed were collected from New-Bussa in Borgu Local Government Area of Niger State, Nigeria. *Entada africana* were subjected to different processing methods; boiling and toasting, the processed seed were milled into powdered for proximate and photochemical analysis. All determinations were done in triplicates. All data collected was subjected to analysis of variance (ANOVA), while significant means was separated using Duncan multiple range test. The results of the finding indicate that all the processed seed reduced the contents of phytochemicals; tannin was reduced by 62.12%, saponin 76.67%, phytate 60.69%, oxalate 76.40% and trypsin inhibitor by 29.79%. The study concludes that the processing methods have a significant effect on the nutrient and anti-nutrient composition of *Entada africana* seed by increasing the nutrient content and reducing the anti-nutrient composition of the seed. The study therefore, recommends that *Etanda africana* seed should be boiled before roasting in order to reduce anti-nutritional factors to a tolerable level before being used as animal feed.

Keywords:Entada africana, Seed, Processing, Nutrient, Anti-nutrient

Introduction
Grain legumes are major sources of dietary proteins in the developing countries, as animal proteins are expensive (Shimelis *et al.*, 2006). In addition to their protein contributions, legumes are also rich in other nutrients such as starch, dietary fibre, phytochemicals, vitamins and mineral. Indigenous legumes are used as an alternative to protein to people in many tropical countries especially in Africa where they are predominantly consumed. However, the use of legumes as protein source is limited by the presence of anti-nutrients or toxic substances which interfere with digestive processes and prevent efficient utilization of their proteins (Okoye and Ene, 2018). Anti-nutrients are those natural or synthetic substances which by themselves or through their metabolic products arising in living systems interfere with food utilization, causes certain physiological responses and affect the health and productivity of man and animal (Okoye and Ene, *ibid*).

The utilization of raw *Entada africana* as animal feed is limited by the presence of naturally occurring anti-nutritional factors such as phytic acid (phytate), tannins, cyanogenicglucoside (cyanide), oxalate and gossypol. These factors negatively affect the nutritive value of the seeds through direct and indirect reactions by inhibiting proteins and carbohydrate digestibility (Bello and Udo, 2017). Anti-nutritional compounds like phytate, tannin, saponin, alkaloid, flavonoids etc., reduce food intake and nutrient utilization in animals and lower the nutrient value of grain legumes (D'Mello, 2005). According to Duke (2002), the major anti-nutritional compound in *Entada Africana* is a non-protein amino acid, 3, 4-dihydroxy-Lphenylalanine (L-Dopa). Increased serum level of L-Dopa from consumption of *Entada africana* leads to high concentration of dopamine in peripheral tissue inducing anti-physiological effects such as nausea, vomiting, anorexia, paranoid delusions, hallucinations, delirium, severe depression and unmasking dementia (Josephine and Janardhanan, 2007).

Anti-nutritional factors such as phytate, tannin, saponin, etc., are known to hamper the absorption of nutrient by livestock. These anti-nutritional factors can be reduced to a tolerable level using different processing methods. It is of paramount importance and worthwhile to carry out a study that would reveal the effect of different processing methods on nutrients and anti-nutritional composition of *Entada africana* seed in order to provide preliminary information towards effective utilization of this legumes in various food applications in Nigeria and other parts of the world.

Methodology

Seed Collection

Exactly 20 kg of matured Seeds of *Entada africana* were sourced for within and around New-Bussa Niger-State, Nigeria.

Sample preparation

The pods of *Entada africana* were opened to release the seeds. The seeds were boiled at 100°C. Water ratio 1:10 W/V for 30 minutes in an aluminium pot on a Gallenkamp thermostat hot plate to moderate the boiling temperature at 100°C, after which the water was drained and the boiled seeds were air dried for three (3) days. After three (3) days of air drying, the seeds were subjected to toasting for fifteen (15) minutes using sand at 35°C. The samples were hammer milled, sieved through standard sieve (BSS 20) into polyethylene bag packaged in air tight container for analysis.

Untreated seeds

The seed were cracked, dried and grounded with Kenwood food blender, the flours of the seed sample was kept in a refrigerator at –4°C prior to use, for preservation of the nutrition content.

Boiled seeds

Entada africana seed were boiled for 30 minutes and the seeds dehulled. After dehulling, the seeds were grinded into fine particle size using mortar and pestle before taking for laboratory analysis.

Toasted seeds

After boiling in water and proper washing of the seed, it was toasted in the Oven at 35°C and ground with Kenwood food blender. The sample flours were kept in a refrigerator at -4°C prior to use.

Proximate analysis

The *Entada africana* seed samples were analyzed for their proximate composition, according to the methods of AOAC (1990) for determination of moisture, crude fibre, nitrogen free extract, crude fat and Ash content. All determinations were done in triplicates.

Phytochemical analysis and anti-nutrients

The methods of Sofowora (1993) were used for the quantitative phytochemical and anti-nutrients analysis of the *Entadaafricana* seed samples. All determinations were done in triplicates.

Statistical Analysis

All data collected was subjected to analysis of variance (ANOVA) while significant means was separated using Duncan multiple range test.

Results and Discussion

Table 1 shows the nutrient composition of the raw and processed *Etanda africana* seed. There were significant differences ($P<0.05$) in all the anti-nutritional factors determined. Generally, processing methods significantly reduced the anti-nutrient contents of the seed. The higher percentage reduction of all parameters observed in the processed seed in this study confirms earlier report by other authors (Ajibade *et al.*, 2018; Makinde *et al.*, 2019) that heat treatment of seed was effective against saponin, tannins, phytate and oxalate. All the parameters observed in this study differ from what was earlier reported by Gidado *et al*. (2013) that *Etanda africana* seed contains 0.184% tannin, 0.131% saponin and 0.002% alkaloids.

The variation could be due to reasons reported by Ann and Neena (1982) that species may vary not only in composition of nutrient but in type and amount of toxins, thus results obtained with one species of legume may not necessarily be applicable to another. Even the length of storage time will also affect certain characteristics (Ann and Neena, *ibid*). This reason may also be responsible for the difference between the result of this and that of Akinmutimi (2004) who observed a poor reduction of the anti-nutritional factors in sword beans, even when subjected to different processing techniques.

The higher percentage reduction of tannin in the processed seed could be attributed to the ability of the processing techniques to break the linkages formed by tannic acid like other phenol compounds with protein and other macro molecules and to overcome the intra-molecular force existing within the tannin structure (Abdu, 2012). This may mean better digestibility of protein if these processed seeds are fed to animals. This is because tannic acid is known to adversely affect protein digestibility (Makinde *et al*., 2017).

The observed reduction of phytate (60.69%) in the processed seeds during heat treatment may be partly due to the heat labile nature of phytic acid and the formation of insoluble complexes between phytate and other components (Udensi *et al*., 2007). Phytates can reduce bioavailability of minerals; impaired protein digestibility caused by formation of phytate- protein complexes and depressed absorption of nutrients due to damage to the pyloric caeca region of the intestine (Francis *et al*., 2001).

A similar trend was observed with respect to oxalate content of *Etanda africana* seed which reduced (76.40%) drastically in the processed seed. Our result agrees with the work of Olajide *et al*. (2011) who reported a significant decrease in oxalate content of processed wild Cocoyam (*Colocassia esculenta L. Schott*) Corm. Oxalates bind with calcium and magnesium, and interfere with their metabolism, cause muscular weakness and paralysis (Soetan and Oyewole, 2009). The generally low concentration of Anti-nutrient factors (ANFs) in the processed seed is indicative of the possibility of utilizing the seed meal as a feedstuff without affecting the health of animals consuming such feed.

Conclusion

This study determined the anti-nutritive factors of raw and processed *Etandaafricana* seed. It was observed that all the processing methods significantly ($p<0.05$) reduced the contents of phytochemicals; tannin was reduced by 62.12%, saponin 76.67%, phytate 60.69%, oxalate 76.40% and trypsin inhibitor by 29.79%. It is therefore, recommended that *Etanda africana* seed should be boiled before roasting in order to reduce anti-nutritional factors to a tolerable level before being used as animal feed. Further research should be conducted on other processing methods such as fermentation, malting, soaking etc that can also ameliorate anti-nutritional factors to a tolerable level before being used as animal feed.

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Table 1: Nutrients composition of raw and processed *Entada africana* seed

Parameters, %	Raw	Processed	SEM[1]	P-value
Dry matter	91.30	92.00	0.41	0.004
Crude Protein	40.18^a	34.86^b	1.06	0.003
Crude fibre	13.50^a	9.00^b	0.90	0.0001
Ash	3.50^a	2.00^b	0.18	0.0001
Ether extract	4.75^a	3.50^b	0.31	0.0001
NFE	29.37^b	42.64^a	2.65	0.003
Metabolizable energy (Kcal/kg)	2917.85^b	3089.84^a	28.67	0.001

All values are means of triplicate determinations expressed in dry weight basis. ab= means with different superscripts on the same row are significantly different (P<0.05), SEM[1]= Standard error of mean, P = Probability value. NFE= Nitrogen Free Extract =100-(%CP+%CF+%EE+%Ash)

Table 2: Anti-nutrient composition of raw and processed *Entandaafricana* seed meal

Parameters, mg/100g	Raw	Processed	% Reduction	SEM[1]	P-value
Tannin	1.98^a	0.75^b	62.12	0.15	<.0001
Saponin	2.10^a	0.49^b	76.67	0.09	<.0001
Phytate	5.47^a	2.15^b	60.69	0.42	0.0489
Oxalate	3.56^a	0.84^b	76.40	0.14	0.0050
Trypsin Inhibitor (TIU/g)	550.00^a	386.16^b	29.79	18.20	<.0001

All values are means of triplicate determinations expressed in dry weight basis. abc= means withdifferent superscripts on the same row are significantly different (P<0.05), SEM[1]= Standard error of mean, P = Probability value