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Evaluation Of The Proximate Composition, Amino Acid Profile And The Level Of Anti-Nutritional Factors Of Raw And Differently Processed Senna Obtusifolia Seed Meal.

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Abstract
This study was conducted to determined the chemical composition of raw and differently processed Senna obtusifolia seed meal (SOSM). The seed were divided into four. Portions. The first portion was raw SOSM; second portion was boiled SOSM; third portion was toasted SOSM and the fourth batch was fermented SOSM. The differently processed seeds were properly sun-dried, milled and analyzed in triplicates for their proximate composition, amino acid profile and levels of anti-nutritional factors using standard laboratory procedures. The chemical composition of the processed SOSM was significantly ($P<0.05$) affected by the different processing methods. The lowest protein content, amino acid profile, and the levels of antinutritional factors were recorded in the SOSM. The toasted and the fermented SOSM however indicated the highest protein contents of 17.25 and 17.15%. The different processing methods were observed to reduce the levels of the anti-nutritional factors. However, the fermented SOSM indicated the lowest tannins (0.66 mg/100 g), alkaloids (0.63 mg/100 g) phytates (0.37 mg/100 g), oxalates (0.46 mg/100 g) and saponins (0.41 mg/100 g). In conclusion, the different processing methods were effective in reducing the levels of the anti-nutritional factors but boiling and fermentation was observed to be more effective in enhancing the nutritional qualities of the seeds and it is therefore, recommended for feeding livestock Animal SOSM.

Background
The scarcity and high cost of conventional ingredients are major factors limiting the growth of the poultry industry globally. This has driven research into alternative ingredients for poultry feeding. Senna obtusifolia or cassia, a widely distributed shrub, is invasive in many regions of the world. The seeds and leaves of the plant are moderate protein sources with the protein having an acceptable amino acid profile, especially essential amino acids. This nutritional profile of Senna obtusifolia products (seeds and leaves), coupled with their availability make them potential protein supplements for poultry feeding; however, the presence of several antinutritional factors (ANFs) (Oxalate, phytate, saponins, tannins and haemagglutinins) hinders their fullest use in the diet. In recent years, there has been increasing research interest into processing techniques to reduce the ANFs content and make these products safe for poultry feeding.

Keywords: *Sickle Pod, Proximate, Processing, Anti-Nutritional Factors*

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I. Introduction

The ultimate aim of any livestock industry is the attainment of sustainable livestock production in the shortest time possible (Ayssiwede *et al*., 2011). One of the ways of increasing protein supply in Nigerian populace is through broiler production. However, there are several problems being encountered in the Nigerian livestock industry. One of such problems is feed. Due to economic situation of the nation, protein intake of most Nigerians is inadequate and often lacks protein of high biological value derived from animal products. Recently, there is a tremendous decrease in poultry production as a result of high cost of protein and energy feedstuffs (Medugu *et al*., 2010).

Feed is the major input and feed cost is the major constraint, but a major mean for manipulating production cost, making enterprise profitable. A sizeable quantity of cereals and edible oil seeds meals are used in poultry ration, and thus compete with the human being directly. Hence availability of feed resources could be one of the major constraints to poultry production in the future as the opportunity for the area expansion for cultivation is almost exhausted. Therefore, more careful approaches to sustain the poultry industry in the competitive market should be the reduction of cost of production (Thirumalaisamy, 2016).

Production of feed stuffs fluctuates greatly due to low productivity, insects, weeds, environmental conditions, cost efficiency, sustainability, and declining area under cultivation etc. Further the farmers are also

encouraged for diversion towards production of cash crops. These factors contribute to the production of poultry feed ingredients in decreasing trend in recent years and increasing demand so the cost of feed ingredients goes high (Chandrasekaran, 2014).

Utilization of unconventional local feeds as substitutes of conventional ones is a popular trend in broiler feeding practices (Rajat, 2016).

The potential of legume seeds in Monogastric nutrition have attracted the attention of researcher's worldwide (Shaahu *et al*., 2012). Several conventional legume seeds have been studied and evaluated for inclusion in non-ruminant feeds in Nigeria. The over dependence on these conventional legume seeds has affected their availability and affordability, especially for non-ruminant animals. There is, however, some unconventional legume seeds that are completely unutilized depending on the part of the world, most of which very little is known about their chemical composition and nutritional values. There is therefore, need for continuous screening of these minor legume for use as an alternative feed resources for Monogastric diets (Shaahu *et al*., 2013). Depending on availability and nutritional values, many unconventional feeds are used in broiler rations to economize the feeding. In the study area, *Senna obtusifolia* seed meal may be one of such promising unconventional feeds as it is abundantly available and is a good source of protein, energy and rich in other nutrients. However, its utilization is limited by the presence of some anti-nutrient/toxic components which might not only be toxic, but also can be lethal in extreme situations. To nutritionists, removal of the anti-nutrients from the wild and underutilized legumes with minimal compromise on the nutritional qualities has been a great challenge. Information on the response of the seed to different processing treatments seems to be meager (Augustine *et al*., 2013).

Senna obtusifolia commonly called ''Sickle pod'', is a plant mostly grows in the wild and can cover an extensive useful farmland area as weed, making farmlands either a waste or more difficult to cultivate. Other names for the plant include Foetid senna, Cassia tora, Sickle senna, Coffee weed, and Arsenic weed and somewhat ambiguously as "blunt-leaved senna". It is also known as "Coffee pod" or Java bean (English), Gyeolmyeongia (Korean), Juemingzi (Chinese), Ebisu-gusa (Japanese), Fedegosa (Portugese) and Chiranta Chokad (Hindu), Tafasa (Hausa) (Neils *et al*., 2013). The plant grows to a height of about 1.5-2.5m tall and 1m wide. The Pod is 10-15cm long, 3.5mm wide and sickle shaped. The leaves, seeds and roots are used for folk medicine especially in Asia. The roasted seeds are used for tea, Coffee or food additives, it is also used as a thickener and for commercial Cassia gum (Queensland Government, 2006).The proximate composition of the seeds shows high dry matter (95.50%), Crude protein (29.54%), Crude fibre (10.18%) and 3252.80kcal/kg metabolizable energy which qualifies it to be a source of both energy and protein to broiler chickens and also high concentrations of anti-nutrients which can be detoxified through processing (Ingweye *et al*., 2010; Ayssiwede., *et al.* 2011). The dried leaves of *Senna obtusifolia* are employed in the treatment of ulcers, ring worm and other parasitic diseases in Northern part of Nigeria (Dharmendra *et al*., 2010).

Objective of the study

To evaluate the proximate composition of raw and differently processed *Senna obtusifolia* seed meal.

To assess the amino acid profile of raw and differently processed *Senna obtusifolia* seed meal.

To evaluate the level of anti-nutritional factors of raw and differently processed *Senna obtusifolia* seed meal.

II. Materials And Method

Experimental Site

The study will be conducted at Chemistry Laboratory, Department of Science Laboratory and Technology, Yobe State College of Agriculture Gujba, located in Damaturu. Damaturu is located between latitude 11^0 43' and 37" North and longitudes 11^0 58' and 26" East and elevation of 456 m above sea level. It is in the semi-arid region of Nigeria with tropical continental climate. The area is characterized by a short period of rainfall (June – September) and a long period of dry season (October - May). The mean daily maximum temperature ranges from 29.2^0C in (July and August) to 43^0C in (March and April). Annual rainfall ranges from 500mm to 1000mm and usually from June to September (El- Idriss, 2000).

Collection and Processing of the Test Ingredients: The mature pods of *Senna obtusifolia* will be obtained from mature dry Plants (Plate 1) from the wild around the study area. The Pods will be harvested, sun dried, threshed as shown in Plate 2. The whole seed of *Senna obtusifolia* will be divided in to five (4) different representative group:

(a) Raw: This will be achieved by grinding the dry seed in a feed milling machine without subjecting to any processing method, partly (coarsely) ground and label as raw *Senna obtusifolia* seed meal (RSOSM) until required for feed formulation.

Plate 2: Green Stands Of Sickle Pod (*Senna Obtusifolia*) Plants.

Plate 3: Raw Sickle Pod (*Senna Obtusifolia*) Seeds.

(b) Fermentation: The seed of *Senna obtusifolia* will be boiled for one (1) hour, wash and be kept in an air tight container to ferment naturally for five days (Augustine *et al*. 2017). The fermented seed will be air dried for 2 days and coarsely ground with and label as fermented *Senna obtusifolia* seed meal (FSOSM).
(c) Toasting: This would be achieved by constant stirring of the seed for 30minutes in a metallic frying pan along with clean fine sand to prevent the burning of the seed coats and to maintain uniform distribution of heat until the seed turn to light brown. The seed will be allowed to cool, coarsely ground and tag as toasted *Senna obtusifolia* seed meal (TSOSM) (Tarimbuka *et al*. 2017)
(d) Boiling: The seed of *Senna obtusifolia* will be boiled for 60 minutes. It will then be allowed to cool, dry and coarsely ground and tag as boiled *Senna obtusifolia* seed meal (BSOSM) according to Augustine *et al*. (2017).

One hundred grams (100g) each of the raw and differently processed *Senna obtusifolia* seed meal will be analyzed to determine the proximate composition, amino acid profile, mineral and vitamin constituents and levels of anti-nutritional factors. So also, the dietary energy and protein sources.

Chemical Analysis

The proximate composition will be carried out according to the methods outlined by the association of Official Analytical Chemists (A.O.A.C, 2000). The Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Crude Fibre (CF) and Nitrogen Free Extract (NFE) will be determined. The gross energy of the samples will be determined using bomb calorimeter.

Statistical Analysis

All data collected will be subjected to analysis of variance using Statistical Package for Social Science (SPSS, 2006) and where significant differences among treatment exist, Duncan multiple test range (Duncan, 1955) was used to separate them.

III. Results And Discussion

The proximate composition of the differently processed *SOSM* is presented in Table 1. The result revealed significant (P<0.05) difference in the dry matter content of the Processed *SOSM*. The boiled and fermented *SOSM*, recorded the highest dry matter loss which was attributed to the combined effects of boiling and fermentation resulting in more dry matter loss. Fermentation was reported to cause dry matter loss (Smith *et al*., 2011). Microorganisms through series of metabolic activities can generate heat which in turn accelerates oxidation, moisture absorption hydrolysis, pyrolysis and other chemical processes resulting in dry matter loss (Richardson *et al., 2002).* This might be the reason for the dry matter losses observed in the boiled and fermented SOSM.

Chemical analysis

The proximate composition, amino acid profile and levels of the anti-nutritional factors were determined using the procedures of AOAC (2010).

Proximate Composition and Energy Content of *Senna obtusifolia* seed Meal Subjected to Different Processing Methods.

Proximate Components (%)	T1(RSOSM)	T2(BSOSM)	T3(TSOLM)	T4(FSOSM)	SEM
Dry matter	92.50^{a}	90.08^{a}	87.65^{b}	86.07^{b}	3.05
Crude Protein	16.25^{b}	14.75^{b}	17.25^{a}	17.15^{a}	0.001
Crude fibre	9.03^{a}	7.27^{b}	5.23^{c}	5.15^{c}	0.22
Ash	5.21^{b}	4.08^{c}	6.40^{a}	6.24^{a}	12.71
Ether extract	4.02	3.12	2.07	2.03	0.06
NFE	33.38	32.51	32.75	30.95	3.08
Energy Kcal/kg	2112.35^{a}	1952.57^{b}	1968.54^{b}	1897.51^{c}	11.07

RSOSM = Raw *Senna obtusifolia* seed meal; BSOSM = Boiled *Senna obtusifolia* seed meal; TSOSM = Toasted *Senna obtusifolia* leaf meal; FSOSM = Fermented *Senna obtusifolia* leaf meal; NFE = Nitrogen-free extract

The crude protein content was discovered to be significantly (P<0.05) different by the different processing methods. An increase in the protein content was observed in both the TSOSM and FSOSM. This increase was attributed to the proteolytic activities of micro- organisms. This was declared by Pranoto *et al.* (2013) who reported that protein increase during fermentation is partly due to degradation of complex protein by micro-organism thereby releasing peptides and amino acid which is concordant with the findings of this study. Smith *et al*. (2018) reported that dry matter loss is always accompanied by increase protein content which is also another reason for the increase in the protein content observed in this study. Augustine *et al*. (2018) also observed an increase in the protein content of *Senna obtusifolia* seed subjected to different fermentation periods. Lower fibre content was ascertained in the boiled, toasted and fermented *Senna obtusifolia* seed meal . However, the fermented SOSM recorded the lowest crude fibre. This decrease was connected to the effects of microbial activities during

fermentation. Similar findings were reported by Augustine *et al*. (2018) for *Senna obtusifolia* seeds subjected to varying fermentation period.

The result in the present study indicated an increase in the ash content of the fermented and the toasted SOSM when compared to the raw and boiled. The boiled SOSM however, indicated the lowest ash content which might be due to leaching out of minerals into the boiling water which is in line with the finding of Jasraj and Kiran (2010) who likewise, observed a reduction in the ash content of boiled African leafy vegetables. The increase in the ash content of the fermented SOSM was linked to the activities of fermenting micro-organisms which is in correspondence with the report of Pranoto *et al*. (2013) who reported that fermentation increases mineral such as iron, calcium and Zinc. Day and Morawicki (2018) far explained that, increase in mineral content during fermentation is due to loss of dry matter as microbes degrade carbohydrate and protein.

The nitrogen-free extract and energy content of the seed meal were significantly ($P<0.05$) different. The raw *Senna obtusifolia* seed meal however, transcribed the highest nitrogen-free extract and energy content. This suggests that the raw SOSM led to minimal loss of these components which is consistent with the collection of Umar *et al*. (2017). The lowest nitrogen-free extract and energy were recorded in the FSOSM. This ascertained effect was due to the impact of fermentation which is consonant with the report of Osman *et al*. (2011) who reported that, fermentation activates starch-hydrolyzing enzymes such α-amylase and maltase which degrade starch into maltose, dextrin and simple sugars such as glucose which are utilized by the fermentation microbes resulting to a decrease in total carbohydrate.

The amino acid profile is presented in Table 2. The amino acid content of the SOSM was significantly ($P<0.05$) different.

Amino acid profile (mg/100g)	T1(RSOSM)	T2(BSOSM)	T3(TSOSM)	T4(FSOSM)	SEM
Lysine	2.18^{b}	1.25^{c}	2.94^{a}	2.72^{a}	0.007
Methionine	1.12^{b}	0.87^{c}	1.65^{a}	1.86^{a}	0.006
Threonine	2.07^{b}	1.79^{c}	2.75^{a}	2.64^{a}	0.005
Isoleucine	2.58	2.77	2.85	2.83	0.004
Leucine	1.65^{c}	1.24^{c}	1.85^{b}	2.77^{a}	0.001
Phenylalanine	1.61^{a}	0.65^{c}	1.70^{a}	1.72^{a}	0.012
Valine	1.47	1.53	1.55	1.52	0.006
Tryptophan	3.78^{a}	1.54^{b}	3.88^{a}	3.91^{a}	0.0011
Histidine	1.70	1.63	1.52	1.46	0.007
Alanine	2.61^{b}	1.96^{c}	2.93^{b}	3.51^{a}	0.003
Glutamic acid	1.54^{b}	1.56^{b}	2.99^{a}	2.50^{b}	0.005
Tyrosine	1.28	1.22	1.28	1.30	0.025
Serine	2.13^{b}	1.63^{c}	2.78^{a}	2.83^{a}	0.017

RSOSM = Raw *Senna obtusifolia* seed meal; BSOSM = Boiled *Senna obtusifolia* seed meal; TSOSM = Toasted *Senna obtusifolia* leaf meal; FSOSM = Fermented *Senna obtusifolia* leaf meal; NFE = Nitrogen-free extract

The lowest amino acid content was observed in BSOLM which is similar to the finding of Augustine *et al*. (2018) for *Senna obtusitolia* leaves subjected to different boiling periods. The fermented SOSM indicated highest amino acid profile which might be due to metabolic activities of the fermenting microorganisms that synthesized new products during fermentation. Pranoto *et al*. (2013) stated that microbes degrade complex protein during fermentation thereby releasing peptides and amino acids resulting to an increase in amino acid content as observed in the present study.

The effects of the raw and differently processed methods on the levels of the ant-nutritional factors (Table 3) showed decrease in the lowest levels of the anti-nutritional factors which is an indication that it is the safest for intake by livestock which agreed with the findings of Nuha *et al*. (2010) for fermented *Senna obtusitolia* leaves. This outcome was possibly due to the actions of microorganisms during fermentation. Doudu *et al*. (2003) and El–hag *et al*. (2003) discovered that, micro-organisms fermenting food can utilize anti-nutritional factors, thus leading to their reduction. Emmambuse and Taylor (2003) reported that prolonged fermentation decreased tannin content due to microbial phenyl oxidase action.

Anti-nutritiona; factors (mg/100g)	T1(RSOSM)	T2(BSOSM)	T3(TSOSM)	T4(FSOSM)	SEM
Tannins	3.06^{a}	1.17^{c}	0.91^{d}	0.66^{c}	0.004
Alkaloids	3.67^{a}	1.22^{b}	0.63^{c}	0.64^{c}	0.016
Phytates	2.12^{a}	0.87^{b}	0.41^{c}	0.37^{d}	0.003
Oxalates	1.98^{a}	0.66^{b}	0.42^{c}	0.46^{c}	0.001
Saponins	1.81^{a}	0.61^{b}	0.6^{b}	0.41^{c}	0.002

IV. Conclusion

Based on availability and nutritional composition, *Senna obtusifolia* products (seeds and leaves) have potential as protein supplements in poultry diets but antinutritional factors (oxalate, phytate, saponins, tannins and hemagglutinins) hinder its fullest use in the diet. Several processing techniques, which can reduce the ANFs content and improve the utilization of these products by poultry, are available. Depending on the class of birds,. Newer processing methods will likely developed in response to the increasing market price of conventional protein sources.

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