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EFFECT OF DIFFERENT PROCESSING TREATMENTS ON NUTRIENTS AND ANTI-NUTRIENTCOMPONENTS OF *SENNA OCCIDENTALIS* SEED MEAL

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ABSTRACT

A laboratory analysis was conducted to evaluate the effects of different processing treatments (boiling, soaking, sprouting and fermention) on the chemical composition of *Senna occidentalis* seed meals (SOSM). The entire representative processed samples were properly dried and milled. Each sample was analysed in triplicate for proximate composition, amino acid profile and levels of anti-nutritional factors using standard methods of analysis. Data obtained were subjected to analysis of variance of the completely randomized design and the treatment means were separated using Duncan multiple range test. The result revealed that the processing treatment significantly (P<0.05) affected the proximate composition of the seed meals. The proximate composition were observed to decrease in the differently processed seeds except for fermentation and sprouting where increase in the crude protein and ash contents of the seeds where observed. Similarly, the amino-acid profile showed significant (P<0.05) reduction except for the fermented seed meal which showed an increase in some of the amino acids content. The processing methods were observed to significantly (P<0.05) reduced the levels of the anti-nutritional factors withfermentation producingthe highest reduction effect. It can be concluded that fermentation was more effective in reducing the level of anti-nutritional factors and also in improving the nutrient content of *Senna occidentalis* seed meal. Based on the findings of this study, fermentation is therefore recommended for processing of *Senna occidentalis* seed meal. Further studies on processing the seed meal using integrated processing treatments such as soaking and boiling and two-stage cooking are required. Furthermore, fermented *Senna occidentalis* seeds should be used in a feeding trial with a view to ascertain the best inclusion level for domestic animals especially monogastric animals.

Keywords: Different, processing methods, proximate composition, gross energy *Senna occidentalis* seed meal

INTRODUCTION

Studies on the utilization of lesser-known wild legumes are very essential in today's dispensation. This has become necessary because of the high cost of feeding domestic animals in developing countries like Nigeria. The limited supply and the increased cost of conventional protein feed ingredients has led to increase study in the utilization of lesser-known legumes (Khattab *et al*., 2009; Laudadio *et al*., 2011). Lesser-known legumes such as *Senna occidentalis* are under-utilized as livestock feed because they contain toxic components that limit their utilization as feed ingredients. The proximate composition of the seeds as revealed by Augustine *et al.* (2014) indicated that it can be a suitable alternative protein source that can replace the costly conventional protein ingredients but contain some toxic components which may limit nutrient utilization and animal performance. Processing treatments have been documented by Iorgyer*et al.* (2009) and Doss *et al.* (2011) to be effective in the detoxification of *Cajanus cajan* and *Canava liaensiformis* seeds. If *Senna occidentalis* is processed to remove toxic components, it may have potentials as feed ingredient for livestock especially monogastric animals. At the moment, information on the best processing method that can adequately detoxify *Senna occidentalis* seeds seems to be scanty hence the need to bridge such information gap.

MATERIALS AND METHODS

Seeds collection and processing

The seeds were harvested from mature stands of the plant at the commencement of the dry season (October) on uncultivated fields in Mubi area of Adamawa State. The seeds were threshed out from their dry pods and were further sun-dry**.** The whole seeds of *Senna occidentalis* were divided into five (5) representative samples. The first sample was left unprocessed (raw); the second sample of the seeds was soaked in water for 24 hours; the third sample was boiled for one hour, the fourth sample was sprouted and the fifth sample was boiled for one hour washed and kept in an air tight container to naturally ferment for five days. Each batch of the sample was properly dried, milled and sieved using a 1mm sieve.

Experimental design and statistical analysis

Each of the representative seed sample was divided into three replicates in a completely randomized design (CRD) with each of the replicate serving as a block. Data obtained were subjected to analysis of variance of the CRBD using a computer statistical package Statistix 9.0, Statistix, 2003.

Chemical analysis

The proximate composition and anti-nutritional components of *Senna occidentalis* were determined in triplicates using standard methods of AOAC (2004). The dry matter content was determined using the oven dry method and crude protein was determined using the Kjeldahl procedure. Soxhlet extraction method was used for the determination of ether extract. The fibre content was evaluated using the trichloroacetic method and the ash content was determined using the murfle furnace ignition method while nitrogen free extract (NFE) was computed indirectly by using the formula:

NFE = 100 – (% moisture + CP + CF +EE +ash)

Where:

CP = crude protein

CF = crude fibre

EE = ether extract

energy value for each replicate sample was calculated using the Pauzenga (1985) equation as outline below:

Energy (kcal/kg) = 37 × %CP + 81 × % EE + 35.5 × %NFE

The amino acid profile was analyzed using isocratic high performance liquid chromatography (HPLC) equipment model no. BLC 10/11.

RESULTS AND DISCUSSION

The effects of different processing treatments on the proximate composition of *Senna occidentalis* seed meal is presented in Table 1. The result revealed that the proximate composition of the differently processedseeds were significantly (P<0.05) affected by the different processing methods. The dry matter content of theseed meals was not affected (P>0.05) by the processing methods. However, both the raw and processed seed meals indicated high dry matter content an indication that the seed may have less storage problems and therefore can be stored for a long period of time.

The fermented *Senna occidentalis*seed meal recorded the highest crude protein followed by sprouted seed meal. The superior performance exhibited by fermentation treatment is consistent with the report ofAdebowale and Maliki (2011) and Igbabul*et al*. (2014) who reported that fermentation can increase the population of lactic acid bacteria resulting to increase in protein content. This was further buttressed by Sahlin (1999).Uwagbute*et al*. (2000) further explained that increase in protein during fermentation could be attributed to net synthesis of protein by the fermenting seeds which might have resulted in the production of amino acids by the fermenting microbes.The increase in crude protein observed in the sprouted seed meal may be due to the hydrolysis of storage proteins and transportation of amino acid into growing seedlings axis during germination which led to increase amino-acid profile and the quality of protein (Akande and Fabiyi*et al*., 2010)

Table 1: Effects of Different Processing Treatments on the Proximate Composition of *Senna occidentalis* Seed Meal (%)

Composition	RSOSM	BSOSM	SSOSM	SPSOSM	FSOSM	SEM
Dry matter	92.00	91.57	93.00	92.70	91.00	8.21^{NS}
Crude protein	18.70^{c}	16.09^{c}	16.11^{c}	21.00^{b}	23.58^{a}	3,07*
Crude fibre	9.80^{a}	7.20^{b}	7.19^{b}	7.40^{b}	5.90c	0.36*
Ether extract	5.00^{a}	4.50^{b}	3.60^{c}	3.40^{c}	3.00^{c}	0.21*
Ash	5.70^{b}	3.50^{c}	3.80^{c}	3.90^{c}	6.20^{a}	0.63*
NFE	49.70^{a}	48.77^{ab}	48.90^{ab}	46.62^{c}	44.70^{d}	11.31*
Energy (Kcal/kg)	2861.25^{a}	2687.78^{c}	2623.62^{c}	2707.41^{b}	2710.45^{b}	21.08*

*= Significant (P < 0.05); NS = Not significant (P > 0.05); a,b,c = Means in the same row bearing different superscripts are significantly different (P < 0.05) SEM = Standard error of the means

NFE = Nitrogen free extract; RSOSM = Raw *Senna occidentalis* Seed meal; BSOSM = Boiled *Senna occidentalis* Seed meal

SSOSM = Soaked *Senna occidentalis* Seed meal; SPSOSM = Sprouted *Senna occidentalis*Seed meal; FSOSM = Fermented *Senna occidentalis*Seed meal

Boiling and soaking on the other hand reduced the protein content of *Senna occidentalis* seeds. This could be attributed to the removal of soluble nitrogineous and proteineous compounds during the process of boiling or soaking. This finding is in agreement with the result of Iorgyer *et al*. (2009) that reported a decrease in crude protein content of boiled pigeon pea seeds and attributed it to leaching out of soluble proteineous part of the seed in water. Similarly, combined effects of soaking andboiling have been reported by Nsa*et al*. (2011) to reduce the crude protein content of castor (*Ricinus communis*).

The different processing methods were seen to decrease the crude fibre content of the seeds with fermentation exhibiting superior performance. This may be due to the activities of the fermenting microorganisms resulting in breakdown of the fibre. This is in line with the report of Rainbault, (2001) that lactic acid bacteria utilizes fibre as carbon source and convert them to microbial biomass.Similar findings were reported by other workers (Akinmutimi, 2004; Akinmutimi, 2007and Nsa *et al*., 2011) who found same for *Mucuna utilis, Mucuna pruriens* and *Ricinus commnunis,* respectively. Udensi *et al*. () also reported the reducing effect of soaking and boiling on the crude fibre content of *Mucuna flagellipes* seeds. Boiling can also weaken the structural bonds of fibreand make it softer.

The results further indicated that the ether extract of the seed meals was significantly (P<0.05) reduced by the processingmethods except for the soaked seed meal. This reduction is in line with the findings of some workers (Udedibie *et al*., 1999; Bawa *et al*., 2003: Nsa *et al*, 2011) who attributed such decrease to solubilization and leaching out of oil in water. Chinma *et al*. (2009) considered such decrease to the enzymatic activities of lipolytic enzymes during hydrolysis of fat.

The ash content was significantly (P<0.05) reduced by the different processing methods except for fermented seeds. This reduction is attributed to leaching out of mineral during boiling or soaking. This concurred with the findings of Nsa *et al*. (2011) who observed same for castor oil seeds. The increased in the ash content of the fermented seed meal was due to microbial activitiesand the ability of fermentation to lower the dry matter content resulting to an increase in in the concentration of minerals (Adams, 1990). Similarly, Sahlin (1999) reported that fermentation is effective in increasing the concentration of minerals.

The nitrogen-free extract (NFE) of the seeds wassignificantly (P<0.05) influenced by the processing methods with the fermented seeds indicating the lowest nitrogen free extract. The reduction of NFE in the fermented seeds which is a form of crude carbohydrate may be due to the utilization of some of the sugars by the fermenting microbial mass. This is in agreement with the report of Akindahunsi *et al*. (1999) and Oboh and Akindahunsi (2003) who pointed out that fermenting microbes can converts carbohydrate to glucose which is utilized by fermenting microorganisms as energy source thereby reducing the carbohydrate content.The energy content of the processed *Senna occidentalis* seed meal was significantly higher in the sprouted and fermented *Senna occidentalis* seed meal. This was attributed to the relatively high crude protein values of the seed meal which were used in computing the energy content.

The amino acid profile (Table 2) of the processed seed meals showed significantly (P<0.05) slight reduction except for the fermented seed meal which exhibited an increase in some of the amino acid contents signifying the effectiveness of fermentation in improving the amino acid composition of the seed meal. Uwagbute *et al*. (2000) reported thatnet synthesis of protein by the fermenting seeds might have resulted in the production of amino acids.Similar findings were reported by Ilyas *et al*. (1995) and Feng *et al*. (2007) for fermented soya bean meal which had increased small-sized peptide concentration, increased protein contents and available amino-acid composition. This finding is also consistent with the result of Ari *et al*. (2012) who reported same for differently fermented soya bean. The reduction in amino acid contents ofthe boiled and soaked *Senna occidentalis* seeds could be due to the adverse effect of heat on the amino acid composition and leaching out of soluble nitrogenous compound in water during boiling and soaking. Other workers (Obun and Kehinde, 2011; Ziena*et al*.,1991 and Siddhuraju and Becker, 2005) attributed losses of amino acid during cooking to transamination and deamination reactions.

The effects of the different processing methods on the anti-nutritional factors of *Senna occidentalis* seed meal is presented in Table 3. All the processing methods were observed to significantly (P<0.05) reduce the level of the anti-nutritional factors. However, fermentation method was more effective in reducing most of the anti-nutritional factors compared to other processing treatments which is due to the combined effect of cooking and microbial activities during the fermentation process.This decrease is connected to the activities of lactic acid producing bacteria which have been reported to break down tannins, oxalates, phytates and saponins and use them as source of carbon and energy (Patricia *et al*., 2012; Yukiko *et al*., 2014; Parul, 2014).This is consistent with the findings of Paredes-LoPez and Hary (1989) and Ugwu and Orange (2006) who reported same for common bean and *Treculia afriana* seeds, respectively.

Table 2: Amino acid Profile of *Senna occidentalis* as Affected by the Different Processing Treatments (g/100g)

	Different processing treatments					
Amino-acids	**RSOSM**	**BSOSM**	**SSOSM**	**SPSOSM**	**FSOSM**	**SEM**
Lysine	4.20^{a}	3.20^{c}	3.00^{c}	3.60^{c}	6.42^{a}	2.03*
Methionine	1.35^{b}	1.00^{c}	1.30^{c}	1.24^{c}	1.96^{a}	0.15*
Threonine	2.15^{b}	2.10^{b}	2.30^{b}	2.33^{b}	2.58^{a}	0.62*
Isoleucine	3.24^{b}	2.89^{c}	2.97^{c}	2.96^{c}	4.74^{a}	0.34^{NS}
Leucine	3.64^{b}	5.60^{a}	6.10^{a}	6.00^{a}	6.00^{a}	1.40*
Phenylalanine	4.31	4.20	4.30	4.22	4.18	1.33^{NS}
Valine	4.34^{bc}	3.90^{c}	3.95^{c}	4.94^{b}	6.30^{a}	0.76*
Histidine	2.85	2.00	2.20	2.14	2.56	0.18^{NS}
Arginine	2.80	2.15	2.30	2.30	2.50	0.44^{NS}
Serine	2.97^{ab}	2.61^{b}	2.40^{b}	2.44^{b}	3.71^{a}	0.33*
Cysteine	0.70^{b}	0.51^{c}	0.69^{b}	0.65^{b}	0.82^{a}	0.05*
Tyrosine	3.20	2.97	3.10	3.05	3.00	1.07^{NS}

*= Significant (P < 0.05) ; NS = Not significant (P > 0.05); a,b,c = Means in the same row bearing different superscripts are significantly different (P < 0.05) SEM = Standard error of the means

RSOSM = Raw *Senna occidentalis* Seed meal; BSOSM = Boiled *Senna occidentalis* Seed meal; SSOSM = Soaked *Senna occidentalis* Seed meal; SPSOSM = Sprouted *Senna occidentalis* Seed meal; FSOSM = Fermented *Senna occidentalis* Seed meal

Table 3: Levels of Anti-nutritional Factors of Differently Processed *Senna occidentalis* Seed meal (g/100g)

Different processing treatments						
Anti-nutrients	**RSOSM**	**BSOSM**	**SSOSM**	**SPSOSM**	**FSOSM**	**SEM**
Oxalates	0.90^{a}	0.35^{c}	0.45^{d}	0.56^{b}	0.30^{c}	0.07*
Tannins	2.30^{a}	0.54^{d}	1.10^{b}	0.71^{c}	0.48^{e}	0.17*
Flavonoids	1.20^{a}	0.66^{b}	0.65^{b}	0.48^{c}	0.32^{d}	0.03*
Phytates	2.10^{a}	0.61^{d}	1.08^{b}	0.93^{c}	0.51^{e}	0.11*
Saponins	1.85^{a}	0.65^{b}	0.52^{b}	0.48^{c}	0.37^{d}	0.02*

*= Significant (P < 0.05); NS = Not significant (P > 0.05); a,b,c = Means in the same row bearing different superscripts are significantly different (P < 0.05) SEM = Standard error of the means

RSOSM = Raw*Senna occidentalis*seed meal; BSOSM = Boiled*Senna occidentalis*seed meal; SSOSM = Soaked*Senna occidentalis*seed meal; SPSOSM = Sprouted*Senna occidentalis*seed meal; FSOSM = Fermented *Senna occidentalis* Seed meal

CONCLUSION

From the findings of this study, it can be concluded that fermentation was more effective in reducing the level of anti-nutritional factors and also in improving the nutrient content of*Senna occidentalis* seed meal. Based on the findings of this study, fermentation is therefore recommended for processing of *Senna occidentalis* seed meal. Further studies on processing the seed meal using integrated processing treatments such as soaking and boiling and two-stage cooking are required. Furthermore, fermented *Senna occidentalis* seeds should be used in a feeding trial with a view to ascertain the best inclusion level for domestic animals especially monogastric animals. Information on dry matter loss would be considered in future studies.

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