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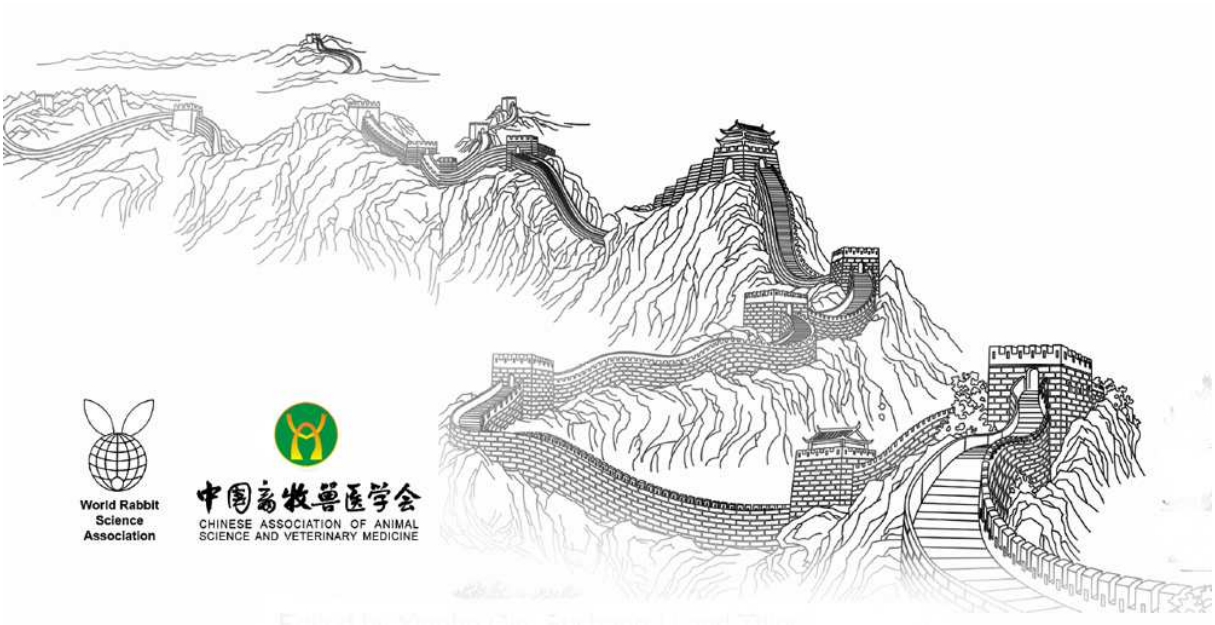

PROXIMATE COMPOSITION OF SHEA NUT MEAL, ITS INCLUSION IN GROWER RABBIT DIETS AND ELICITED PHYSIOLOGICAL RESPONSES

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ABSTRACT

This study was designed to evaluate the proximate composition of shea nut meal (SNM) and physiological implications of SNM in rabbit diets. Sixty grower rabbit of New Zealand and Flemish Giant crosses were randomly allotted to five treatments (D_1: 0.0% SNM; D_2: 2.0% SNM; D_3: 4.0% SNM, D_4: 6.0% SNM; D_5: 8.0% SNM). The performance, haematological and serum biochemical indices were monitored and the results indicated that it contained 1.2% crude protein, 5.2% crude fibre, 1.5% ash and as high as 3,995.3kcal/kg gross energy. Feed intake value was least (2.94kg/week) in D_4 and highest (3.19kg/week) in D_5. While body weight gain was lowest (0.04g/week) in D_1 (Control), it was highest in D_2 (0.17g/week). Packed cell volume varied between 27.7 and 40.0%, white blood cell (5.28 and 6.49g/dl) and total protein ranged from 59.2 g/l in D_4 to 75.8g/l in D_2. Serum cholesterol concentration was highest (3.85Mmol/l) in D_2, slightly followed by D_3 (3.65Mmol/l), D_5 (3.35Mmol/l), D_1 (3.38Mmol/l) and D_4 (2.9Mmol/l). Although, none of the parameter value across the treatments followed a uniform trend, they were all within the normal ranges reported in healthy rabbits. Therefore, grower rabbit may tolerate up to 8.0% SNM-based diets without eliciting adverse physiological response.

Key words: Blood parameters, performance, grower rabbits, SNM

INTRODUCTION

The shea nut tree is indigenous to Africa and could be found in Central African Republic, Ghana, Nigeria, Guinea and Congo. A by-product of the butter extraction is called shea nut meal (SNM) or shea nut cake, which could be used as feedstuff (Heuze and Tran, 2011; USDA, 2009). However, shea nut tree and its products contain phenolics, tannins, saponins as well as alkaloid (theobromine) which makes it very bitter, unpalatable and irritates the digestive tract of animals (Oddoye, 2012; Abidemi *et al*., 2009; Dei *et al.*, 2008a). Göhl (1982) recommended that the seeds must be processed in order to reduce the amount of toxic factors. Based on this, several methods of detoxification of shea nut meal have been proposed including boiling and fermentation (Dei *et al*., 2008b; Annongu *et al*., 1996). Utilization of shea butter in foods, pharmaceuticals as well as cosmetics has been reported and its biochemical properties indicated some antioxidant and anti-inflammatory activities (Honfo *et al.,* 2014; Akihisa *et al*., 2010). There is a quest to identify additional sources of feed to expand the livestock industry in order to boost animal protein supply. This has prompted in-depth research activities into the use of agro-based industrial by-products in animal feeds (Fleury, 1981; Hall *et al*., 1996).

Inclusion of SNM in livestock diets revealed that ruminants can tolerate higher levels than monogastrics however, inclusion levels higher than 30% was discovered to depress digestibility in the ruminants. Meanwhile, up to 20% boiled shea nut cake was tolerated by pigs but a higher inclusion rate was observed to be poisonous (Rhule, 1999; Göhl, 1982). Shea nut cake or meal was reported to have poor nutritional value in poultry ration, due to its low protein and high toxic factors contents, which resulted in low performance, decreased red blood cells and haemoglobin as well as serum cholesterol concentrations (Pousga *et al*., 2007; Dei *et al*., 2008a; Atuahene *et al.,* 1998). Thus, 2.5% was recommended as the

maximum inclusion level in broiler diets. Interestingly, processing techniques such as boiling and fermentation of the SNM was reported to improve the nutritional quality and enhanced livestock growth performance. Also, amino acid and molasses supplementations were found to alleviate the negative effects of the toxic factors (Dei *et al*., 2008b; Annongu *et al*., 1996).

Shea nut tree grows in the wild everywhere in Nasarawa State, Nigeria and the SNM is readily available everywhere, particularly in cottage industries where the butter is extracted locally. Unfortunately, the SNM is either burnt, used as manure or dumped along roadsides constituting environmental menace. Painful enough, there are little or no documentations on the utilization of SNM in rabbit nutrition. Therefore, this study was designed to evaluate the proximate composition and feeding potential of SNM in grower rabbits.

MATERIALS AND METHODS

Animals and experimental design

A total of 60 grower rabbits of New Zealand and Flemish Giant origin, weighing 0.97 – 1.2kg at about 7 weeks old were procured from National Veterinary Research Institute, Plateau State, Nigeria. The rabbits were randomly allotted to five treatments (D_1: 0.0% SNM; D_2: 2.0% SNM; D_3: 4.0% SNM, D_4: 6.0% SNM; D_5: 8.0% SNM). Each treatment had 12 rabbits that were paired in six hutches (each measuring 64cm x 62cm x 48cm). Antistress, antibiotics including dewormer was administered and the hutches, pens as well as the surroundings were regularly cleaned to maintain good hygiene. Lighting system was supplied at night throughout the experimental period to provide warmth and enhance feeding. The animals were acclimatized for 2weeks before the commencement of the feeding trial that lasted 8 weeks.

Chemical analysis and experimental diets formulation

The proximate composition of the SNM was determined following AOAC (2012) procedure. The SNM was procured from Kwandere, Nasarawa State, and the premix as well as soya bean meal were obtained from Jos, Plateau State while, other feedstuffs were sourced from Shabu, Nasarawa State. All the feedstuffs were used in compounding the experimental diets as presented in Table 1 according to Lang (1981). The nutritional value of the experimental diets was calculated using Aduku (1993) feedstuff table. The compounded feed and clean drinking water were offered to the experimental animals *ad libitum*.

Table 1: Experimental diets fed to grower rabbits

	Graded levels of SNM in the diets (%)				
Feedstuff	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**
Maize offal	35.0	34.5	34.0	34.0	34.0
Rice offal	27.0	26.5	26.0	26.5	25.0
Wheat offal	25.0	24.5	24.0	24.5	23.0
Soya bean meal	10.0	9.5	9.0	8.0	8.0
Shea butter meal	0.0	2.0	4.0	6.0	8.0
Fish meal	2.0	2.0	2.0	2.0	2.0
Premix	0.2	0.2	0.2	0.2	0.2
Salt	0.25	0.25	0.25	0.25	0.25
Bone meal	0.25	0.25	0.25	0.25	0.25
Methionine	0.15	0.15	0.15	0.15	0.15
Lysine	0.15	0.15	0.15	0.15	0.15
Total	100	100	100	100	100
Calculated nutrients					
Crude protein (%)	16.5	16.1	15.8	16.1	15.4
Crude fibre (%)	11.4	11.4	11.2	11.4	11.7
Gross energy (kcal/kg)	2, 869.3	2, 854.9	2, 938.7	2, 908.9	2, 992.4

D_1: 0.0% SNM; D_2: 2.0% SBNM; D_3: 4.0% SBNM; D_4: 6.0% SNM; D_5: 8.0% SNM; SNM: Shea nut meal.

Data collection and statistical analysis

The body weight gain, feed and water intake values were recorded weekly. At the end of the experiment, blood samples were collected by a veterinary expert in bottles with and without EDTA for serum biochemical and haematological indices as described by Mitruka and Rawnsley (1977). All the sets of data

were analyzed according to analysis of variance of GenStat (2005) statistical package and the mean values were separated using least significant difference of the same software package.

RESULTS AND DISCUSSION

The proximate composition of SNM is provided in Table 2. The crude protein, fibre and ether extract values were 1.2%, 5.2% and 45.0% in that arrangement. The ash, nitrogen free extract and gross energy values were 15.0%, 8.49% and 3,995.3kcal/kg at 25.0% moisture content.

Table 2: Proximate composition of shea nut meal

Parameter	Composition
Crude protein (%)	1.20
Crude fibre (%)	5.20
Ether extract (%)	45.0
Ash (%)	15.0
Moisture content (%)	25.0
Nitrogen free extract (%)	8.49
Gross energy (kcal/kg)	3, 995.3

It was observed that the crude protein value was less than 5.9%, the ether extract value was greater than 8.0% and the ash value was similar to 12.9% reported by CIRAD (2008). This observation could be due to agronomic influence and probably due to the laboratory protocols adopted (Givens *et al.*, 2000). Although, the toxic factor composition was not determined in the present study, SNM produced in Nigeria may sustain livestock productivity.

The effects of graded levels of SNM-based diets on grower rabbit performance, haematological and serum biochemical indices are presented in Table 3. There were no statistical differences (P>0.05) in all the treatment mean values except in packed cell volume, red blood cell and total protein.

Table 3: Performance, haematological and serum biochemical indices of grower rabbit fed graded levels of shea nut meal

	Experimental diets						
Parameters	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**SEM**	**P-value**
Performance							
Weekly feed intake (kg)	2.98	2.96	2.95	2.94	3.19	0.0075	0.468
Weekly water intake (ltr)	4.91	4.84	4.91	4.93	4.93	0.031	0.377
Weekly weight gain (g)	0.04	0.17	0.12	0.13	0.12	0.004	0.633
Haematology							
Packed cell volume (%)	27.7^{c}	32.7^{b}	33.0^{b}	29.7^{c}	40.0^{a}	3.36	0.000
Red blood cell ($x10^{12}$)	2.17^{c}	2.91^{b}	2.88^{b}	2.48^{c}	3.73^{a}	0.012	0.000
White blood cell (g/dl)	5.28	5.65	6.13	5.45	6.49	1.75	0.507
Serum biochemistry							
Total protein (g/l)	62.3^{c}	75.8^{a}	68.7^{b}	59.2^{c}	61.3^{c}	21.03	0.000
Albumin (g/l)	29.2	26.5	24.3	25.8	26.0	8.66	0.104
Cholesterol (Mmol/l)	3.38	3.85	3.65	2.90	3.35	0.43	0.164

^{a,b,c}: Means along the same row with different superscripts differ significantly at P<0.05; ^{SEM}: Standard error of mean; D_1: 0.0% SNM; D_2: 2.0% SBNM; D_3: 4.0% SBNM; D_4: 6.0% SNM;D_5: 8.0% SNM; ^{SNM}: Shea nut meal; $^{P\text{-value}}$: probability level

Meanwhile, feed intake (3.19kg) and white blood cell (6.49g/dl) values were highest in D_5. Similarly, water intake value was superior in D_5 and D_4 but body weight gain (0.17g) and cholesterol (3.85Mmol/l) values were highest in D_2 whereas albumin value (29.2g/l) was highest in D_1. This observation was similar to the report of Adedeji *et al*. (2006) when Castor seed cake was fed to rabbits. While the packed cell volume varied from 27.7 to 40.0%, red blood cell ranged between 2.17 and 3.73 x 10^{12} and total protein ranged from 61.3 to 75.8g/l). It was observed that the packed cell volume, red blood cell and white blood cell values were similar to 31 – 36.5%, 2.21 – 2.3 x 10^{12} and 3.1 – 4.3g/dl respectively reported by Adedeji *et al*. (2006) in rabbits when boiled castor seedcake based diet was fed. While the observed albumin value was less than 34.5 – 44.0g/l, the total protein was higher than 30.5 – 45.5g/l reported by Adedeji *et al.* (2006).

CONCLUSIONS

The results showed that the protein value of SNM was very low and the energy was very high. It was revealed that weight gained by the rabbits was apparently due to the SNM-based diets. Although, the haematological and serum biochemical indices did not follow a particular trend, it was shown that SNM inclusion in grower rabbitdiets probably did not elicit physiological responses. The observed normal growth tendency among the rabbits as revealed by the packed cell volume, red blood cell, total protein and albumin values as well as the relatively low cholesterol levels recorded, grower rabbit may tolerate up to 8.0% SNM, contrary to maximum of 2.5% reported in other monogastrics specifically poultry species.

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