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EFFECT OF DIETARY SHEA NUT CAKE ON THE GROWTH AND BLOOD PARAMETERS OF RABBITS

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ABSTRACT

A 72-day feeding trial was conducted to determine the effect of dietary shea nut cake (SNC) on the growth, hematological and blood biochemical parameters of weaner rabbits. The double 3 x 3 Latin square design was employed for the experiment. The control diet (T1) contained 0% SNC, while the treatment diets T2 and T3 contained 5% and 10% SNC respectively. The feed intake and growth performance of the rabbits were not affected by SNC. Apparent DM digestibility did not also differ between treatment groups, although a gradual increase was observed as SNC inclusion level increased. The feed conversion efficiency (FCE) of the diets also increased with increasing inclusion levels of SNC (0.150, 0.171 and 0.209). The haematological and blood biochemistry results showed no significant differences ($p>0.05$) between T1 and T3, and T2 and T3 but there was a significant difference ($p<0.05$) between T1 and T2 for hemoglobin concentration (Hb), parked cell volume (PCV) and red blood cell count (RBC). The highest values for Hb, PCV and RBC were recorded for T1 (control). There were no significant differences ($p>0.05$) among the treatment means for WBC, neutrophils, lymphocytes, eosinophils, monocytes, basophils, cholesterol, albumin and total serum protein. WBC, neutrophils, eosinophils and monocytes were highest in T2 (5% SNC) but lymphocytes was highest in T1 (0% SNC). Values for albumin and total serum protein were highest in T2 (5% SNC) but cholesterol was highest in T3 (10% SNC) even though it was within the normal range for rabbits. Feeding SNC up to 10% inclusion level did not negatively affect the growth, hematological and blood biochemical parameters of weaner rabbits.

Keywords: Shea nut cake, rabbits, hematology, serum biochemistry, erythrocytes, leucocytes

INTRODUCTION

The Shea tree, *Vitellaria paradoxa* is a multi-purpose plant highly valued for the fat obtained from its seeds. The plant grows wild in the savannah zone of Africa. In Ghana, shea trees are widely distributed in the Northern savannah zone (Okai and Bonsi, 1989) and produce about 135,000 tonnes of nuts per annum (Adomako, 1985). The fat obtained by local processing may be used for cooking, soap making, hair and body cream and also medical ointment.

The residual cake after removing 45 - 55% fat in the seed is known as shea nut cake (SNC). This product has virtually been regarded as a waste material in Ghana and disposed off via incineration. SNC contains moderate amounts of crude protein (CP) and fat (Morgan and Trinder, 1980). Atuahene *et al*. (1998) reported a CP of 16.24% and metabolizable energy (MJ/kg) of 7.12. There is also evidence that it contains theobromine (Tettey, 1983). Dietary theobromine and saponin at certain concentrations and regardless of the source, is deleterious to animal growth (Clarke and Clarke, 1979). These anti-nutritional factors (ANFs) present in SNC do not allow the nutrients to be utilized well by the animals, hence resulting in low digestibility (Anto, 2004).

According to Rhule (1995), incorporation of SNC at 5 and 10% levels in the diets of grower and finisher pigs respectively is recommendable, while 25 and 30% can be tolerated by ruminants (Morgan and Trinder, 1980). Pobi (2002) and Atuahene *et al*. (1998) reported that 2.5% SNC is good for broiler chickens. According to Pobi (2002), Olorede and Lange (1999) and Atuahene *et al*. (1998), feed intake and weight gain response by animals fed SNC are relatively good when moderate or limited levels are included in the diet. However, as the level of SNC increases in the diets of animals, feed intake and weight gain retrogress in monogastric species. Specifically, The hematological parameters such as erythrocytes and leucocytes counts as well as biochemical parameters like cholesterol, albumin and total serum protein which are good indicators of the

physiological status of animals (Adenkola and Durotoye, 2004) may be affected by SNC inclusion in animal rations.

The production of rabbits at the backyard and commercial level can help alleviate the problem of inadequate protein supply and intake in the developing world. The small body size and fast growth rate of rabbits give them a comparative advantage over other livestock and poultry. There is therefore the need to investigate the use of locally available feedstuff such as SNC in the production of rabbits, which will help to reduce the cost of production and make rabbit production more attractive to small holder farmers.

The objective of this experiment was to determine the effects of shea nut cake on the growth, haematological and blood biochemical parameters of weaner rabbits.

MATERIALS AND METHODS

Study area: The study was carried out at the Nyankpala Campus of the University for Development Studies, Tamale, Ghana. Nyankpala is about 18 km west of Tamale in the Tolon-Kumbungu District. It is located on latitude 9° 25' 41″ N and longitude 0° 58' 42″ W at an altitude of 183 m above sea level (SARI, 2007). The area is in the Guinea Savannah Zone characterized by a unimodal rainfall pattern. Rains begin in April, rising to a peak in August - September and ending in October or November. Rainfall averages 1060 mm per annum (NAES, 1994). Temperatures range from as low as 15°C in January when the weather is under the influence of the North Easterly (Harmattan) winds and as high as 42°C around the end of the dry season in March (SARI, 2007).

Experimental diets: Three experimental diets were formulated (Table 1) and fed to the weaner rabbits twice a day. The experimental diets were control (T1), which contained 0% SNC, while T2 and T3 contained 5% and 10% SNC respectively.

Table 1: Composition of diets containing varying levels of shea nut cake fed to weaner rabbits

Ingredients	*T1*	*T2*	*T3*
SBM	15.0	15.0	15.0
SNC	0.0	5.0	10.0
WCS	10.0	10.0	10.0
Rice bran	23.0	18.0	13.0
Millet mash	50.0	50.0	50.0
Pre mix	0.5	0.5	0.5
Di calcium	1.0	1.0	1.0
Salt	0.5	0.5	0.5
Total	100	100	100

SBM: Soybean meal, SNC: Shea nut cake, WCS: Whole cotton seed

Experimental design and animals: Six weaner rabbits of about eight weeks old with an average body weight of 980±37.6 g were selected randomly from three different does (mothers) and used for the experiment. The rabbits were balanced for sex and the double 3 x 3 Latin square design was used for the experiment. The switch over was done every 3 weeks with three days change over a period to avoid carry over effects of treatments. The rabbits were housed individually in separate hutches with each hutch measuring 65 × 62 × 65 cm. Initial blood samples were collected three (3) days earlier before the experimental diets were fed. Blood samples were taken after every three week interval for nine weeks during the experimental feeding period.

The growth parameters measured included feed intake, apparent DM digestibility and weight gain. Experimental animals were given 150 g of feed daily, while water was provided *ad-libitum.* Feed leftover was collected, weighed and recorded after every 24 h. An estimated 500 g of each animal's faecal matter was collected at the end of each feeding phase of 21 days to determine the apparent DM digestibility.

Blood collection and assay: Blood from the rabbits was collected before the morning feeding between 7:00 and 9:00 am using the ear-vein procedure (Radostits *et al*., 1994). Heparinised capillary tubes were used to collect blood for the hematological assay, while for the biochemical assay 2 - 3 ml of blood was collected into sterilized plain test tubes. After collection, the blood samples were kept in a sample holder, placed in an ice chest and transported immediately to the laboratory.

The hemoglobin (Hb) concentration was determined using the cyanomethaemoglobin method as described by Cheesbrough (2001). The Microhaematocrit and Haemocytometry techniques as described by Mukherjee (2005) were used for the RBC, WBC and PCV determinations. The methods described by Linear chemicals (2009) for total protein, albumin and cholesterol determinations were used.

Data analysis: Data were analysed by ANOVA using the Genstat statistical package. Significant mean differences were separated by the Least Significant Difference method (Genstat, 2008).

RESULTS AND DISCUSSION

Growth performance: No disease condition or mortality was recorded during the experimental period. Table 2 showed the effect of shea nut cake (SNC) on the growth of the rabbits. Average daily feed intake increased with increase in SNC inclusion level. This result differs from the report of Atuahene *et al.* (1998), which indicated a significant ($p<0.05$) depression in inclusion levels beyond 2.5% in broilers. The decline in feed intake was attributed to the presence of theobromine, tannin and saponin in SNC. Theobromine and saponin are known to cause bitterness in feed, which in turn suppresses feed intake in animals.

Table 2: Feed intake and growth response of rabbits fed varying levels of Shea nut cake

Treatments	*T1*	*T2*	*T3*	*s.e.d*
Average daily feed intake (g)	59.4	59.6	63.0	4.1
Total intake (g)	1209.0	1246.0	1320.0	65.7
Average daily weight gain (g)	11.7	10.0	11.0	1.9
Final weight gain (g)	241.0	209.0	231.0	42.3
FCE	0.15	0.17	0.21	0.03
%DM digestibility	48.6	52.6	56.8	4.6
DMI (g)/BW (g)	1.0	1.0	0.9	0.1

s.e.d. = standard error of difference, DM= Dry matter, DMI= Dry matter/Body weight, FCE= Feed conversion efficiency

The increase in feed intake with an increase in SNC in the present experiment may be an indication that rabbits could better tolerate bitter taste than broilers. This is in agreement with the findings of Cheeke *et al.* (1997), who fed saponin containing alfalfa at various inclusion levels to rabbits. A decline in feed intake was recorded only after 35% inclusion of alfalfa in the diet of the rabbits (Cheeke *et al.,* 1997). The lack of significant difference ($p>0.05$) in daily weight gains in this experiment (Table 2) is not consistent with Pobi (2002) and Atuahene *et al.* (1998), who reported a depression ($p<0.05$) in weight gains when inclusion levels exceeded 2.5% in the diet of broilers. The difference could be due to the difference in the species used.

A gradual increase in DM digestibility was recorded as SNC levels increased although the differences were not significant. The feed conversion efficiency (FCE) also increased with increasing inclusion levels (0.150, 0.17 and 0.20). This is not consistent with Dei *et al.* (2008), who reported a significant decrease ($p<0.001$) in FCE in poultry fed unfermented shea nut meal. From the study, the animals on the SNC diet performed well in terms of weight gain and feed intake. Rabbits will normally eat to meet their energy requirement especially when fiber content of the feed is increased as in high SNC diets.

Microbes in the rabbit's caecum according to Cheeke (1994) produce more VFA on starch-based diets than on forage diets. This means that caecal microbes are more efficient in digesting starch-based diet such as SNC. This efficient micro flora caused by the SNC in the caecum may have accounted for the production of VFA, which in turn may have lead to high energy availability for the animal. Stevens and Hume (1995) indicated that VFA provide a major energy source in the rabbit colon. This may have accounted for the improvement in the growth of the rabbits on the SNC diet. The result then suggests that the energy content of treatment T1 may not be adequate for the rabbits.

Hematology: The hematological and biochemical results were shown in table 3. It was observed that PCV, Hb, and RBC all decreased for T2 and T3, whilst T1 increased when compared to the initials. There were significant differences ($p<0.05$) in Hb concentration, PCV and RBC among the treatments means. There were no significant differences between T1 and T3, and T2 and T3 but there was a significant difference between T1 and T2 for Hb concentration, PCV and RBC. The treatment T1 (0% SNC) recorded the highest value for Hb concentration, PCV and RBC.

Table 3: Hematological and biochemical parameters of rabbits fed varying levels of shea nut cake

Parameters	*Initial Value*	*T1*	*T2*	*T3*	*s.e.d.*
Hemoglobin (g/dl)	14.00	14.17^{a}	12.83^{b}	13.05^{ab}	0.58
Packed Cell Volume (%)	42.20	42.50^{a}	38.50^{b}	39.17^{ab}	1.73
Red Blood Cell ($\times 10^{6}$/µl)	5.40	5.40^{a}	4.90^{b}	5.00^{ab}	0.20
White Blood Cell ($\times 10^{9}$/l)	4.70	4.40	4.60	4.50	0.90
Neutrophils (%)	58.60	53.70	54.80	53.70	3.56
Lymphocytes (%)	40.80	47.20	44.00	46.30	3.10
Eosinophils (%)	0.60	0.83	1.00	0.33	0.57
Monocytes (%)	0	0.00	0.17	0.00	0.14
Basophils (%)	0	0	0	0	0
Cholesterol (mmol/l)	4.34	4.21	4.53	5.46	0.84
Albumin (mmol/l)	5.26	4.75	4.87	4.66	0.31
Total Serum Protein (mmol/l)	5.10	5.96	6.29	5.48	0.63

Means with different superscripts in the same row are significantly different ($p<0.05$).

Hb concentration, PCV and RBC all decreased with increase in the SNC level in the diets. This is an indication that higher levels above 10% may lead to a negative effect on the erythrocyte levels. Low erythrocyte values may mean a reduction in the circulating red blood cells or an increase in plasma volume (Frandson and Spurgeon, 1992). In any case, the erythrocytes values in the present experiment were within the reported normal range for rabbits (Igwebuike *et al.,* 2008).

The WBC increased in T2 and T3 but decreased in T1 when compared to the initial value (Table 3). It was observed that there were no significant differences ($p>0.05$) in WBC, neutrophils, lymphocytes, eosinophils and monocytes between treatment groups. Immune status is a function of neutrophils, monocytes and eosinophils and the similarity observed in the mean values for the weaner rabbits is an indication that the feeding of the SNC was not detrimental to the functioning of the immune system. This observation agrees with the report of Butcher and Miles (2002) who reported that most of the immunological abnormalities observed in malnutrition are usually corrected after nutritional rehabilitation.

Lymphocytes are known to play key roles in the immune defense system and are a function of the immune status. Values for WBC appeared to increase with increasing levels of SNC and their high counts could be an indication of their increased build up in the immune system. It may also be attributed to physiological phenomenon like strenuous exercise or excitement during handling. This observation is in agreement with Ekenyem and Madubuike (2007) who worked with pigs.

Biochemistry: Cholesterol level increased in T2 and T3 but decreased in T1 when compared to the initial value. There was a decrease in Albumin level in all the treatments when compared to the initial value, but the total serum protein increased in all the treatment diets. It was observed that even though the treatment means varied from each other, there were no significant differences ($p>0.05$) in Cholesterol, Albumin and Total Serum Protein. T2 (5% SNC) recorded the highest values for Albumin and Total Serum Protein but Cholesterol was highest in T3 (10% SNC).

The higher value of Cholesterol in T3 (10% SNC) was due to the higher amount of ether extract in the SNC and possibly due to the confined or intensive system used in housing the rabbits. This observation may also be due to the quantity and nature of protein fed to the present rabbits as Igwebuike *et al.* (2008) reported that cholesterol in the serum has been associated with the quantity and quality of protein supplied in the diet. Albumin values were similar ($p>0.05$) and low albumin values suggest poor clotting ability of the blood and hence poor prevention of hemorrhage (Ewuola and Egbunike, 2008). The higher values observed in total serum protein content may depend on both the quantity and quality of protein supplied in the diet (Iyayi and Tewe, 1998).

The cholesterol, albumin and total serum protein of the rabbits fed with SNC were not significantly different ($p>0.05$). This means that addition of the SNC up to 10% did not affect these parameters in the blood of the rabbits.

CONCLUSION

Shea nut cake (SNC) up to 10% inclusion level in the diets of weaner rabbits had no deleterious influence on feed intake, growth rate and the hematological and biochemical parameters of the rabbits.

RECOMMENDATION

Further studies should be carried out to look at the effect of SNC on the carcass characteristics of rabbits. It is also recommended that in subsequent feeding trials with SNC on rabbits, the feed should be offered in block/pellet form to reduce scratching.

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