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RESEARCH ARTICLE

Hematological Parameters and Carcass Characteristics of Weanling Rabbits Fed Sesame Seed Meal (*Sesamum indicum*) in a Semi-Arid Region

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ABSTRACT

The effect of replacing groundnut cake with Sesame seed meal (*Sesamum indicum*) on hematology, blood chemistry and carcass characteristics was evaluated in rabbits. Sixteen (New Zealand white rabbits) were randomly assigned to four dietary treatments in a completely randomized design with four rabbits per treatment. The rabbits were fed diets containing 0, 4, 8 and 12% of sesame seed meal (SSM) and designated as T_1, T_2, T_3 and T_4, respectively. The experimental diets and clean drinking water were supplied *ad libitum* throughout the experimental period of nine weeks. At the end of the feeding trial, three rabbits per treatment were selected for hematological analysis and carcass evaluation. There were significant differences (P<0.05) among treatments for hemoglobin (Hb), white blood cell (WBC), red blood cell (RBC) counts, the values increased with increasing in levels of SSM and mean corpuscular volume (MCV) mean corpuscular hemoglobin concentration (MCHC) were not affected (P>0.05) by the levels of SSM in the diets. There were significant differences (P<0.05) for blood glucose serum globulin, cholesterol, creatinine and urea, but there was no effect (P>0.05) on serum albumin and total proteins among treatments. The carcass characteristics also showed significant differences (P<0.05) among treatments for slaughter weight, carcass weight, dressing percentage, loin, hind legs, kidney fat and abdominal fat. The slaughter and carcass weights were better in the group receiving 8% SSM. It is concluded that inclusion of up to 12% SSM in the diets of growing rabbits has no adverse effect (P>0.05) on the hematological parameters, serum biochemical indices and carcass characteristics.

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INTRODUCTION

The animal proteins are essential for human health. The level of animal protein consumption in Nigeria estimated 8.27g per caput per day as against recommended 35g (Ahamefule *et al.,* 2000). Thus, Nigerians consume less than one quarter of the animal proteins required for normal metabolic body processes (Adegbola, 1991). Shortage of animal proteins may be met by small animals such as rabbits, poultry and pigs. Increased rabbit production can bridge the supply demand gap of protein in the country (Shahrbabak *et al*., 2009; Sarikhan *et al*., 2010). Rabbit meat is rich in protein, certain vitamins and minerals. It contains fats with higher proportion of essential polyunsaturated lioleic and linolenic acids.

Sesame seed (*Sesamum indicum*) contains about 25% crude protein (Asogwa *et al*., 2005) and 50% fat (Anon, 2006). Sesame seeds are also a good source of manganese, copper, calcium, magnesium, iron, phosphorus, vitamin B_1, zinc and other substances which limit their use in monogastric animal feed. Phillips *et al.* (2005) reported that the seeds contain phytic and oxalic acids, which are anti- metabolites. However, the nutritive value of sesame seed would be comparable with that of groundnut cake if the anti-nutritional factors are reduced or eliminated by heat treatment.

The ingestion of dietary components has measurable effects on blood constituents (Animashahun *et al*., 2006). Although nutrient levels in the blood and body fluids are not valid indications of nutrient function at cellular level, they are considered to be proximate measures of long-term nutritional status (Doyle, 2006).

Hematological values are widely used to determine systemic relationship and physiological/pathological adaptations including the evaluation of general health condition and diagnosis and prognosis of various types of animals diseases (Shah *et al.,* 2007). The knowledge of the hematological reference values in the rabbits, like many other livestock, cannot be overemphasized since the values could help in associating certain inherent resistant to infection (Svoboda *et al.,* 2005). A lot of work has been carried out on the blood parameters of various domestic animals and livestock (Ahamefule *et al.,* 2006). The present study was conducted with the aim of assessing the blood parameters and carcass characteristics of rabbits receiving various levels of SSM in their diets and kept under semi-arid environment of Nigeria.

MATERIALS AND METHODS

Sixteen rabbits (New Zealand white breed), 6-10 weeks of age, were randomly assigned to four dietary treatment groups with four rabbits per treatment. These rabbits in each treatment were housed in hutches measuring 45 x 30 x 42cm. These rabbits were randomly divided into four equal groups and assigned to four experimental diets designed as T_1, T_2, T_3 and T_4 contained 0 (control), 4, 8 and 12% Sesame seed meal respectively (Table 1). For preparation, the sesame seeds were toasted for 15 minutes in an open wide aluminum pan mixed with clean fine sand to prevent the burning of the seed coat and enhance even distribution of heat. Sand was then sieved and the seeds allowed cooling, milled for incorporation into the diets. The experimental diets were analyzed for dry matter (DM), crude fiber (CF), crude protein (CP), ether extract (EE) and ash according to AOAC (2002) methods (Table 2). The experimental diets and clean drinking water were supplied to the rabbits *ad libitum* throughout the experimental period of nine weeks. At the end of the experiment, three rabbit per treatment were randomly selected, slaughtered and skinned. After evisceration and removal the gastro-intestinal tract (GIT), carcass weight was recorded. The carcass was cut into parts viz: head, tail, feet, shoulder, rack/ribs, loin and hind legs. The weights of the heart, liver, lungs and kidneys were measured. The kidney fat and abdominal fat weight were also recorded and expressed as percentage of slaughter weight.

Blood samples with (EDTA) and without anticoagulant were collected from marginal ear vein before slaughter. From each treatment, the blood samples were collected in triplicate. Blood samples collected with EDTA were sued to determine packed cell volume (PCV), red blood cell counts (RBC), white blood cell (WBC) counts and the hemoglobin in blood samples. The PCV, RBC, WBC and Hb values were determined using the Wintrobe's microhaematocrit, improved Neubauer haemocytometer and cyanomethae- moglobin method respectively (Coles, 1986). The mean corpuscular hemoglobin (MCH) was calculated according to Bush (1991). Blood samples collected without anticoagulant were subjected to serum procurement which were then used to determine the biochemical components. Serum glucose and urea were estimated by methods described by WHO (1980) while total cholesterol was determined by colorimetric enzyme method as outlined by Bush (1975). Similarly, serum total protein, albumin and globulin concentration were determined by Biuret reactions (Bush, 1975).

Table 1: Percent composition of the experimental diets

Ingredients	Treatments			
	T_1	T_2	T_3	T_4
White maize	38.35	38.35	38.35	38.35
Groundnut cake	12.00	8.00	4.00	0.00
Sesame seed	0.00	4.00	8.00	12.00
Groundnuts haulms	18.00	18.00	18.00	18.00
Maize bran	24.00	24.00	24.00	24.00
Fish meal	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00
Salt (NaCl)	0.50	0.50	0.50	0.50
*Premix	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00

*Composition of premix (Bio-mix) supply the following per kg diet: Vitamin A 500,000 I.U. Vitamin D, 800,00IU, Vitamin E, 12,000mg Vitamin K, 5000mg, Biotin 10,000mg, Vitamin B, Biotin 10,000mg, Vitamin B_2 200mg, Vitamin B_6 15000mg, Niacin, 12,000mg, Panthothenic Acid, 20,000mg, Biotin 10m000mg, Vitamin B_{12}, 30,000mg, Folic Acid, 150,000mg, Cholride, 60,000mg, Manganese 10,000mg, Iron 15,000mg, Zinc 80,000mg Copper 400mg, Iodine 80,000mg Selenium 8,000mg.

Statistical analysis

All data collected were subjected to analysis of variance (ANOVA) following completely randomized design. Significant differences (P<0.05) among treatment means were determined by the least significant difference (LSD), as outlined by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Hematological studies

The results of the hematological indices are presented in Table 3. There were no significant differences (P>0.05) among treatments for packed cell volume (PCV) and mean corpuscular hemoglobin concentration (MCHC). The PCV (31 to 36%) was within the range of 31 to 38% reported by Shah *et al.* (2007). This suggests that the processing method was good enough for detoxification of sesame seeds as may be demonstrated in the normal PCV range of values observed for rabbits on diets containing sesame seed meal. PCV is an index of toxicity reduction in the blood usually and suggest presence of a toxic factor which has adverse effect on blood formation (Oyawoye and Ogunkunle, 1998). The hemoglobin (Hb) increased with increase in the levels of sesame seed meal with the lowest value (10.30g/d1) for T_1 and highest values (12.00g/d1) for T_3 and T_4. These values were within the range of 10.67 to 12.60g/dL by Njidda *et al.* (2006). The results show that the experimental diets contain good quality proteins that met the rabbits nutritional requirements. Adejumo (2004) reported that hematological traits especially PCV and Hb were correlated with the nutritional status of the animal.

The values of the WBC counts also increased with increase level of sesame seeds (P<0.05) with T_4 having the highest value of 7.20 x 10^3mm^3 and T_1 having the lowest value of 4.8 x 10^3/mm^3. However, WBC counts were close the range of 5 to 13 x 10^3/mm^3 reported by Hillyer (1994). It shows that the animals remained healthy because decrease in number of WBC below the normal range is an indication of allergic conditions, anaphylactic shock and certain parasitism or presence of foreign body in circulating system (Ahamefule *et al.*, 2008).

Table 2: Proximate composition of experimental diets

Ingre-dients	Treatments				
	T_1	T_2	T_3	T_4	SEM
DM	96.4±0.8	95.0±0.8	95.0±0.8	96.1±0.8	98.4±0.9
CP	22.4±1.6	30.9±2.7	31.5±1.2	32.0±0.8	30.1±0.8
CF	11.0±1.3	11.0±1.3	13.0±1.3	19.5±1.2	39.0±1.3
EE	16.5±1.5	15.0±0.8	13.5±1,3	10.0±0.8	9.5±0.9
Ash	3.0±0.8	2.0±0.9	1.5±0.9	1.5±0.9	4.0±0.9
NFE	43.5±1.3	37.9±2.1	36.4±0.9	33.1±1.3	15.8±1.9

SSM=Sesame Seed Meal; DM=Dry matter; CP=Crude Protein; CF=Crude Fiber; EE=Ether Extract; NFE=Nitrogen-Free Extract.

Table 3: Hematological indices of rabbits fed sesame seed meal

	Treatments				
Parameters	T_1	T_2	T_3	T_4	SEM
PCV (%)	31.0	34.0	36.0	36.0	3.92
Hb (g/dL)	10.3^c	11.3^b	12.0^a	12.0^a	0.19*
WBC (x 10^3/mm^3)	4.8^c	5.4^b	5.2^b	7.2^a	0.78*
RBC (x 10^6/mm^3)	6.0^a	4.0^b	8.0^a	7.0^a	0.12*
MCV (fl)	52.2^b	85.0^a	45.0^c	51.0^b	0.31*
MCH (pg)	17.2^b	28.3^a	15.0^c	17.0^b	0.003*
MCHC (%)	33.0	33.0	33.0	33.0	4.27

Mean values bearing different superscripts in a row differ significantly (P<0.05); * = Significant (P<0.05); SEM = standard error of the means.

The RBC counts showed significant difference (P<0.05) among treatments. The values were within the range 3.8 to 7.9 x 10^6/mm^3 reported by Anon (2004). The values for MCV and MCH were higher in T_2 (85.00fl and 28.30pg) than the other treatment groups. This may be due to the negative interaction between protein and energy levels in the diets. Barger (2003) reported that any increase in MCV, MCH and decrease in MCHC of rabbit above or below the normal range indicates macrocytic and hypochronic anemia, probably due to the increased activity of bone marrow and deficiency of some haemopoietic factors influencing the capacity of bone marrow to produce red blood cells (Awodi *et al.*, 2005). However, MCHC is very significant in the diagnosis of anemia. There was no negative effect of sesame seed meal inclusion on RBC up to 12%, since all the RBC values were within normal range. The higher values observed for MCV and MCH in T_2 however, may not pose a serious problem since PCV, RBC, WBC and MCHC in all the treatments were within the normal ranges for healthy rabbits.

Serum biochemistry

The results of the serum biochemistry are presented in Table 4. There were significant differences (P<0.05) among treatment groups except for albumin and total protein that showed no significant effect (P>0.05) among treatment groups. The values for albumin and total protein ranged from 4.10 to 4.20g/dL and 5.5 to 6.1g/dL, respectively. These values were close to the normal values of 2.5 to 4.0g/dL reported by Anon (1980) for albumin and 5.0 to 7.5g/dL for total proteins reported by Onifade and Tewe (1993). Similarly serum globin of values 1.30 to 2.0g/dL were within the ideal range of 1.5 to 3.3g/dL reported by Anon (2004). However, serum globulin values were higher in rabbits given sesame seeds compared to controls, (P<0.05). The normal values for albumin, total protein and globulin obtained in this study indicate nutritional adequacy of the dietary proteins for rabbits.

The blood glucose values ranged from 6.9 to 10.9 mmol/L although there was a significant decrease in group T_3 was observed compared to control. The higher values observed in T_1 (9.30mmol/L) and T_4 (10.90mol/L) may not pose any problem, since Flurharty and Loerch (1996) reported that high energy did not have any detrimental effects on the health of the animals, but rather it increase the growth rate in the tropics. According to Mayes (1996), continues supply of glucose is necessary as a source of energy especially for the nervous system and the erythrocytes. However, the normal range of blood sugar level obtained for rabbits in this study indicate that the animals were not surviving at the expense of body tissues.

Serum total blood cholesterol values ranged from 3.80 to 4.50mmol/L and were lower in rabbits of T_4 group compare to control. These values are within the range of 3.8 to 8.00mmol/L reported by Njidda *et al*. (2006), who fed rabbits with molasses as energy source in a tropical environment. Since there was no sign of ill health observed in the rabbits and the protein levels in the diets were within the recommended levels, the possible explanation could be due to environmental factor. Blood urea concentration was also normal among treatment groups, suggesting also the effectiveness of processing methods. Increase on serum urea concentration in rabbits fed sesame seeds may suggest an increase in activities of urea enzymes ominthine, carbonyl transferase and arginase which may also indicate kidney damage (Ajagbonna *et al*., 1999).The urea values ranged from (2.50 to 5.80mmol/L). The lowest and highest values were in T_1 andT_4, respectively. The blood urea increased with increase in level of sesame seed meal in diet. The blood urea values were lower than that reported by Anon. (2004), but similar to that reported by Njidda *et al*. (2006) who fed rabbits using molasses as energy source in a tropical environment. Since there was no sign of ill health observed in the rabbits and the protein levels in the diets were within the recommended levels, the possible explanation could be due to environmental factor. Blood urea concentration was also normal among treatment groups, suggesting also the effectiveness of processing methods. The creatinine value ranged from 44 to 59µmol/L with the highest value in T_4 and lowest in T_3. It decreased with low level of sesame seeds, but increased with high level compared to control. The differences could be due to a reason that could not be explained.

CARCASS CHARACTERISTICS

The results of the carcass characteristics are shown in Table 5. There were significant differences (P<0.05) among treatments for slaughter weight, carcass weight dressing percentage, loins and hind legs express as percentage of slaughter weight.

Table 4: Blood chemistry of rabbit fed sesame seed meal

Parameters	Units	Treatments T_1	T_2	T_3	T_4	SEM
Albumin	ng/dl	4.1	4.2	2.2	4.2	0.60
Total protein	ng/dl	5.5	6.1	6.1	6.0	2.83
Globulin	ng/dl	1.3^{b}	2.0^{a}	1.9^{a}	1.8^{a}	0.21*
Blood glucose	nmol/L	9.3^{a}	7.9^{ab}	6.9^{b}	10.9^{a}	1.13*
Total Cholesterol	nmol/L	4.0^{a}	4.3^{a}	4.5^{a}	3.8^{b}	0.20*
Blood Urea	nmo/L	2.5^{c}	3.4^{b}	3.7^{b}	5.8^{a}	0.02*
Creatinine	ımol/L	50.0^{b}	45.0^{c}	44.0^{c}	59.0^{a}	1.32*

Mean values bearing different superscripts in a row differ significantly (P<0.05). * = Significant (P<0.05).

Table 5: Effects of sesame seed meal on body components of growing rabbit expressed as percentage of slaughter weight

Parameters	Treatments T_1	T_2	T_3	T_4	SEM
Slaughter weight (g)	1150.0^{b}	1150.0^{b}	1216.7^{a}	1136.7^{c}	1.49*
carcass weight (g)	566.7^{b}	566.7^{b}	600.0^{a}	566.7^{b}	1.04*
Dressing %	45.3^{b}	50.2^{a}	48.7^{a}	48.3^{a}	1.27*
Head	8.7	8.7	8.2	8.5	3.33^{NS}
Skin (Pelt)	7.3	8.7	8.2	8.5	0.58^{NS}
Tail	0.5	0.5	0.4	0.4	0.04^{NS}
Feet	2.4	2.4	2.5	2.9	0.90^{NS}
Shoulder/forelegs	8.2	8.0	9.5	7.4	0.90^{NS}
Rack/ribs	10.6	10.8	11.9	10.8	0.30^{NS}
Loin	9.7^{b}	11.9^{a}	11.4^{a}	12.3^{a}	0.66*
Hind legs	18.2^{b}	16.7^{c}	19.6^{a}	21.1^{a}	0.82*

Body component expressed as percentage of slaughter weight Mean values bearing different superscripts in a row differ significantly (P<0.05). * = Significant (P<0.05).

Table 6: Effect of sesame seed meal on organ weight of rabbits expressed as percentage of slaughter weight

Parameters	Treatments T_1	T_2	T_3	T_4	SEM
Heart	0.3	0.3	0.3	0.3	0.20
Liver	3.8	3.3	3.4	3.6	2.25
Lungs	0.6	0.6	0.5	0.8	0.11
Kidneys	0.7	0.8	0.7	0.7	0.03
Kidneys fat	1.2^{d}	1.6^{c}	2.3^{a}	1.7^{b}	0.20*
Abdominal fat	0.9^{c}	1.8^{b}	2.7^{a}	0.9^{c}	0.12*

Mean values bearing different superscripts in a row differ significantly (P<0.05). * = Significant (P<0.05).

Slaughter weight and carcass weight were higher in rabbits fed 8% sesame seed in diet compared to control. The dressing percentage ranged from 45.30 to 50.18 with the highest value for T_2 and lowest for T_1.These values were lower than the range of 50 – 60% reported by Fielding (1991), who further stated that the dressing percentage will tend to be 50% or less if the rabbit is young, thin and with a full digestive tract at killing. This might be the possible reason why the dressing percentage was low. However, the values increased with sesame feeding compared to control. On the average, the relative weight of the shoulder (forelegs) appears to be lower when compared to that of the thigh (hind legs). This may be attributed to the late maturing characteristics of the fore legs especially the scapular regions (Ijaiya and Fasanya, 2004). The organ weights (Table 6) showed significant difference (P<0.05) for kidney fat and abnormal fat with a non significant effect (P>0.05) for heart, liver, lungs and kidneys. The kidney and abdominal fat were higher in T_3 (2.28 and 2.75g) than the other treatment groups though the values for both kidney and abdominal fat were higher than the control group (T_1). This may be due to the high content of fat in sesame seed meal as shown in Table1. The high dietary fat content of sesame seed meal might have led to excess deposition of adipose tissue (Sirato–Yasumoto *et al.*, 2001).

Values obtained for heart, lungs, kidney and liver weights (Table 6) in this study showed no significant difference (P>0.05) among treatment groups. It is a common practice in feeding trials to use weights of some internal organs like liver and kidney as indicators of toxicity. Bone (1979) reported that if there is any toxic elements in the feed, abnormalities in weights of liver and kidney would be observed. The abnormalities will arise because of increased metabolic rate of the organs in attempt to reduce these toxic elements or convert anti-nutritional agents to non-toxic metabolites. Our observation with the reported liver and kidney weights in rabbits of different treatment groups suggest that the test diets did not contain any appreciable toxin. Ekpo *et al.* (2009) observed no significant difference (P>0.05) among treatments for heart, lungs, kidney and liver weightof rabbits fed cassava tuber meals.

Conclusions

Based on the results obtained, it appears that the inclusion of upto 12% sesame seed meal in to the diets of growing rabbits has no adverse effect on haematological parameters, serum biochemical indices and carcass characteristics of growing rabbits. However, the number of rabbits used in each group is too small to draw any conclusion. Further studies involving more number of rabbits are recommended.

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