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EFFECT OF FEEDING DIFFERENT PLANT PROTEIN SOURCES ON THE HAEMATOLOGICAL PARAMETERS, CARCASS CHARACTERISTICS AND NUTRIENT DIGESTIBILITY OF GROWING RABBITS.

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ABSTRACT

An eight-week feeding trial was conducted to determine the effect of different plant protein sources on the haematological parameter, carcass characteristics and nutrient digestibility of growing rabbits. Forty eight cross-bred rabbits (New Zealand White x Dutch) between six and seven weeks of age with average initial body weight of 489.80 g were housed individually and allotted to four (4) dietary treatments. Each treatment was divided into three replicates of four rabbits each. The rabbits were given diets and clean drinking water *ad libitum* throughout the period of the experiment. Diets 1, 2, 3, and 4 contained groundnut cake, sunflower meal, Bambara nut meal and soya bean meal respectively. The haematological indices measured were packed cell volume (PCV), haemoglobin (Hb) concentration, white blood cells (WBC) counts, red blood cells (RBC) counts, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and differential counts. The nutrient digestibilities as well as carcass characteristics were also measured. There were no significant differences in all the parameters measured for haematological parameters except haemoglobin concentration (Hb) where those fed groundnut cake gave significantly ($p<0.05$) higher Hb compared to those fed sunflower meal. Soya bean lowered the means for neutrophil and lymphocytes respectively. There were significant difference ($p< 0.05$) among treatment groups for slaughter weight, dressed weight and thighs/hind legs with soya bean giving consistently lower ($P>0.05$) mean, while others parameters were similar among the treatments. There were no significant differences among the treatments for nutrient digestibility. It was therefore concluded that the different plant protein sources can be fed to growing rabbits without deleterious effect on haematological parameters, carcass characteristics and nutrient digestibility.

Key words: Plant Protein, Growing Rabbits, Haematological Indices, Carcass Characteristics, Nutrient digestibility

INTRODUCTION

Protein malnutrition, particularly that of animal origin is rife in the third world countries Nigeria inclusive, where it is estimated that, on average, only 10 g of animal protein is consumed per head compared to the required daily allowance of 35 g (FAO, 1993). One reason for the acute shortage of animal protein in the diets of most Nigerians is inadequate supply and exorbitant cost of conventional feed ingredients leading to high cost of meat and animal products such as beef, mutton, goat meat, poultry eggs and milk. Small or micro-livestock production has been identified as the possible means of bridging the protein shortage of the under-nourished average Nigerian (Njidda and Isidahomen, 2011).

Plant protein sources are generally cheaper per unit of nutrient as compared to animal protein sources. In general, plant protein supplements

are lower in some essential amino acids, energy and minerals such as phosphorus as compared to animal protein supplements. The cost of animal protein sources is generally higher than that of plant protein sources, but the inclusion rates for animal protein sources are lower. Plant proteins are usually deficient in one or more amino acids hence, the needs to supplement with animal protein like fish meal (Ani and Omeje, 2007). This paper reports the effect of feeding different plant protein sources on the haematological indices, carcass characteristics and digestibility of growing rabbits.

MATERIALS AND METHODS

Location of the study

The study was conducted at the Livestock Teaching and Research Farm, University of Maiduguri, Maiduguri. Maiduguri is located between latitude $11^{o}5'$ and 12^{o} North and longitude $13^{o}05$ and 14^{o} East and at an altitude of 354 m above sea level (Encarta, 2007). The area has a semi-arid tropical climate with a wide range of seasonal diurnal of temperature. The hottest months are April and May with a range between 39.4 and 40.1^{0}C under shade (Wikipedia, 2013). There is a long dry season of 7-8 months between the months of October and May. During the last 2-3 months of the dry season there is hot diurnal temperature and comparatively cooler nights. This is followed by a wet season between the months of June and September. The average annual rainfall is about 500 mm. The relative humidity is about 45% in August and usually lowers to about 5% in December and January.

Experimental Animals and Management

Forty-eight crossbred rabbits (Dutch x New Zealand White) between 5 and 7 weeks of age were used for the 8 – week feeding trial. The rabbits were individually weighed and grouped and the groups were balanced for weight and randomly assigned to the four (4) treatments with three replicates with four rabbits per replicates. Each rabbit was housed individually. The rabbits were provided with the experimental diets and clean drinking water *ad libitum*. Data collection commenced after an initial adjustment period of seven days.

Experimental Diets

The four experimental diets were formulated using four (4) different plant protein sources: groundnut cake, sunflower meal, soya bean meal and Bambara nut meal as shown in Table 1.

Haematological Parameters

At week 8 of the experiment, blood samples were collected randomly from three (3) rabbits per treatment for the determination of the haematological and serum biochemical indices. Samples were collected from the ear vein of the rabbits by venipunture using disposable needle (21–gauge needle) and syringes. The rabbits were fasted overnight (12 hours) and bled in the morning (7.00–8.00 am). The collection site was cleaned with alcohol and xylene to dilate the veins. The blood samples were collected in sample bottles containing dipotassium salt of ethylene diamine–tetra acetic acid (EDTA–K^{2+}) which served as an anticoagulant. The haematological analysis of blood samples was carried out at the Animal science Laboratory of the Department of Animal Science, Faculty of Agriculture, University of Maiduguri, Nigeria, using the routinely available clinical methods (Bush, 1975). The haematological indices determined were packed cell volume (PCV), haemoglobin (Hb), red blood cell (RBC), white blood cell (WBC) and differential cell counts. Mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were obtained by calculation according to standard formulae (Jain, 1986; Uko *et al*., 2000).

Table 1: Composition of the Experimental Diets (%)

Ingredients	T1	T2	T3	T4
Maize	40.00	40.00	40.00	40.00
Groundnut cake	23.00	0.00	0.00	0.00
Sunflower meal	0.00	23.00	0.00	0.00
Bambara nut meal	0.00	0.00	23.00	0.00
Soya bean meal	0.00	0.00	0.00	23.00
Fish meal	3.00	3.00	3.00	3.00
Groundnut haulm	15.95	15.95	15.95	15.95
Wheat offal	15.00	15.00	15.00	15.00
Bone meal	2.50	2.50	2.50	2.50
Salt (NaCl)	0.30	0.30	0.30	0.30
Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00

* Premix (grow fast) Manufactured by Animal Care Service Consult (Nig) Ltd. Lagos, Supplying the following per kg of premix: Vitamin A, 5000,00 IU; Vitamin D_3 800,000IU; Vitamin E, 12,000mg; Vitamin K, 1,5000mg; Vitamin B_1, 1,000mg; Vitamin B_2, 2,000mg, Vitamin B_6, 1,500mg; Niacin, 12,000mg; Pantothenic acid, 20.00mg; Biotin,10.00mg; Vitamin B_{12}, 300.00mg; Folic acid, 150,000mg; Choline, 60,000mg; Manganese, 10,000mg; Iron;15,000 mg, Zinc 800.00mg; Copper 400.00mg; Iodine 80.00mg; Cobalt 40mg; Selenium 8,00 mg ,
T1= Groundnut cake; T2 =Sunflower meal; T3 =Bambara nut meal and T4 =Soya bean meal

Nutrient Digestibility Study

The nutrient digestibility study was conducted at the end of the last week of the experiment. Faecal samples were collected from three rabbits per treatment (one per replicate) for a period of seven days using fine wire mesh trays placed under the cage cells. The amount of faeces voided daily was weighed and allowed to dry for 24 hours at 80^0C in an oven. The dried faecal samples were stored in air-tight bottles and used later for proximate analysis. The proximate composition of the diets and faecal samples were determined according to AOAC (2000).

Carcass Characteristics

At the end of the experiment, three rabbits (one rabbit from each replicate) from each treatment were selected for slaughter. They were deprived of feed for 12 hours as recommended by Joseph *et al.* (1994) but drinking water was provided. The rabbits were weighed in the morning and slaughtered by cutting transversely across the trachea, oesophagus, large carotid arteries and jugular veins to ensure maximum bleeding (Mann, 1960). They were later opened and dressed as described by Blasco *et al.* (1993). The dressed carcasses, the portion of the rabbit remaining after the removal of the head, feet, skin (pelt), tail and visceral organs including kidneys were split into retail cuts namely shoulder/forelegs, thigh/hindleg, rack and loin as described by Blasco *et al*. (1993). The dressed carcass and the retail cuts were weighed and expressed as percentage of body weight at slaughter

$$\text{Dressing percentage} = \frac{\text{Carcass weight (g)}}{\text{Slaughter weight (g)}} \times 100$$

Statistical Analysis

All data collected in the course of the experiment were subjected to analysis of variance (ANOVA) using the Randomized Complete Block Design (Steel and Torrie, 1980) and where applicable, Duncan's Multiple Range Test (Duncan, 1955) was used for separation of means Computer package Statistix 9 (2008) was used for the analysis.

RESULTS AND DISCUSSION

Haematological Parameter of Growing Rabbits fed Different Plant Protein Sources

The results for the haematological parameters analysis are presented in Table 2. There were no significant ($p>0.05$) effect of feed on all the parameters measured except haemoglobin concentration (Hb), neutrophil and lymphocyte which shows significant ($p<0.05$) difference among the treatment groups. Rabbits fed groundnut cake diet (T1) had significantly ($p<0.05$) higher Hb compared to those fed sunflower meal (T2) but was similar ($p>0.05$) to others treatments. Packed cell volume (PCV) values (37.33-39.00%) and haemoglobin concentration values (12.30-13.73g/100ml) obtained in this study were within the normal range of 14.53-31% and 8-17g as described by Medirabbit (2003) as the ideal values for healthy rabbits. The values obtained for white blood cell (3-12.5 x $10^3/mm^3$), mean corpuscular volume (27.05 - 32.04fl), and mean corpuscular haemoglobin (MCH) values (17.13-23.32pg), were all within the reference values reported by Anon (1980). However, the mean corpuscular haemoglobin concentration values (32.89-33.28%) were lower than the reference value (62-73%) reported by Anon (1980).

Table: 2 Haematological Parameter of Growing Rabbits fed Different Plant Protein Sources

Parameters	Groundnut cake (T1)	Sunflower (T2)	Soya bean (T3)	Bambara nut (T4)	SEM
Packed cell volume (%)	38.67	37.33	39.00	39.00	0.99^{NS}
Haemoglobin concentration (g/dl)	13.73^{a}	12.30^{b}	12.97^{ab}	12.77^{ab}	0.24^{*}
Red blood cells (x $10^6/mm^3$)	6.42	5.90	7.67	6.40	0.93^{NS}
White blood cells (x $10^3/ mm^3$)	5.07	5.13	6.00	5.74	0.77^{NS}
Mean corpuscular volume (Fl)	27.05	28.11	28.01	32.07	9.50^{NS}
Mean corpuscular haemoglobin (Pg)	22.62	23.32	17.13	21.44	2.69^{NS}
Mean corpuscular haemoglobin concentration (%)	33.22	32.89	33.24	33.28	0.14^{NS}
Differential Counts					
Neutrophil (%)	46.00^{a}	45.33^{ab}	36.00^{b}	51.33^{a}	4.04^{*}
Eosinophils (%)	0.00	0.67	0.33	0.36	0.43^{NS}
Lymphocyte (%)	54.00^{ab}	54.00^{ab}	63.67^{a}	48.33^{b}	3.58^{*}

SEM = Standard Error of Means; NS = Not Significant ($P > 0.05$); * = Significant Difference ($P < 0.05$) a, b = Means in the same row bearing different superscripts differ significantly ($P< 0.05$)

Rabbit fed groundnut cake (T1) and soya bean meal (T4) diets had the highest neutrophils compared to those fed Bambara nut meal diet (T3), but they (T1 and T4) were similar to T2 (sunflower meal) diet. The value of lymphocytes in rabbits fed Bambara nut meal (T3) diet was higher ($P<0.05$) than the soya bean meal diet (T4), but similar the values in those fed groundnut cake (T1) and sunflower meal (T2) diets. The values of neutrophil and lymphocyte which ranged between 36.00 to 51.00% and 48 to 63% respectively fell within the normal range of 30 to 65% and 28 to 85%, respectively for healthy rabbits (Mitruka and Rawnsley, 1997). The eosinophils concentrations obtained in this study which ranged between 0.00 to 0.67% , were slightly lower than the values reported by Ahamefule *et al*. (2005) for rabbits fed sundried, ensiled and fermented cassava peel- based diets. The results of this study suggest that the inclusion of different plant protein source in the diets of growing rabbits did not adversely affect most of the haematological parameters.

Carcass Characteristic of Growing Rabbits Fed different Plant Protein Sources

The values of carcass parameters of rabbits fed different protein sources are summarized in Table 3. The slaughter weight and dressed weight of the rabbits fed groundnut cake (T1), sunflower meal (T2) and soya bean meal (T4) were not significantly ($p>0.0.5$) different but were significantly ($P<0.005$)heavier than for those fed Bambara nut meal Diet (T3). The rabbits fed groundnut cake diet (T1) had significantly ($P<0.05$) heavier thigh weight compared to those fed Bambara nut meal (T3) diet, but did not differ significantly ($p>0.05$) from those fed sunflower meal and T4 soya bean meal diets. However, slaughter and dressed weight and other body components expressed as percentage of slaughter weight were comparable to the values reported for healthy rabbits of similar ages and weight (Igwebuike, 2001).

Nutrient Digestibility of the Growing Rabbits fed Different Plant Protein Sources

The results for the nutrient digestibility parameters are presented in Table 4. There were no significant ($P> 0.05$) differences among the treatments for all the parameters evaluated. The result observed in this study agree with the findings of Iyayi (2001) who reported that digestibility values of dry matter, crude protein, crude fibre and ether extract were not significantly ($p>0.05$) different when growing rabbits fed with cassava leave meal . Benjamin (1986) reported that the addition of vegetable oil to a ration did not have any effect on digestion of dry matter, ether extract and crude protein. Lang (1981) also reported that the digestibility of most nutrients has been shown to increase as protein level rises. This is an indication that different plant protein sources were effectively utilize by growing rabbits.

Table 3: Carcass Characteristic of Growing Rabbits Fed Different Plant Protein Sources

Parameters	Groundnut cake (T1)	Sunflower (T2)	Soya bean (T3)	Bambara nut (T4)	SEM
Slaughter Weight (g)	1034.00[a]	1059.00[a]	903.30[b]	1046.70[a]	36.51*
Dressed Weight (g)	504.67[a]	511.33[a]	421.67[b]	504.33[a]	36.51*
Dressing Percentage (g)	47.72	45.44	44.80	46.63	1.6[NS]
Retail Cuts as Percentage of Slaughter Weight					
Shoulder/Forelegs	13.31	14.19	13.43	14.39	0.27 [NS]
Rack	3.27	3.24	3.33	2.91	0.23 [NS]
Loin	10.36	11.01	8.50	10.79	1.29[NS]
Thighs/Hindlegs	21.40[a]	19.57[ab]	17.62[b]	20.19[ab]	0.79*
Weight of Organs/Body Components Expressed as Percentage of Slaughter Weight					
Head	7.10	9.26	11.30	6.93	2.41[NS]
Tail	0.38	0.35	0.29	0.37	0.07 [NS]
Skin	7.66	7.18	8.43	7.36	0.57 [NS]
Feet	2.52	2.28	2.92	2.93	0.51 [NS]
Heart	0.32	0.31	0.33	0.32	0.03[NS]
Liver	3.36	3.41	3.32	3.32	0.24[NS]
Kidney	0.77	0.79	0.78	1.15	0.11[NS]
Lungs	0.62	0.63	0.55	0.66	0.09[NS]
Caecum	8.53	7.30	8.97	8.15	1.06[NS]
Large intestine	3.60	3.45	2.91	3.05	0.34[NS]
Small intestine	3.60	4.01	4.80	4.39	0.36 [NS]
Stomach	0.87	0.80	0.89	0.83	0.26 [NS]

SEM = Standard Error of Means; NS = Not Significant ($P > 0.05$); * = Significant Difference ($P < 0.05$) a, b = Means in the same row bearing different superscripts differ significantly ($P< 0.05$)

Table 4: Nutrient digestibility of Growing Rabbits fed different Plant Protein Sources

Parameters	T1	T2	T3	T4	SEM
Dry matter	64.21	67.76	57.72	62.23	5.33^{NS}
Crude protein	62.57	75.98	73.28	70.82	5.83^{NS}
Crude fibre	56.28	62.57	59.80	61.57	5.13^{NS}
Ether extract	85.86	86.06	81.87	86.04	3.29^{NS}

SEM = Standard Error of Means; NS = Not Significant (P > 0.05)
T1= Groundnut cake; T2 =Sunflower meal; T3 =Bambara nut meal and T4 =Soya bean meal

CONCLUSION

From the results of this study, it can be concluded that the inclusion of different plant protein source in the diets of growing rabbits did not adversely affect most of the haematological parameters, carcass characteristics and nutrient digestibility of growing rabbits. It is recommended that further study should be carried out on the effects of these plant protein sources on serum biochemistry and histopathology.

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