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UTILIZATION OF *Prosopis africana* PULP FOR RABBIT FEEDING: 2. EFFECTS ON NUTRIENT DIGESTIBILITY, BLOOD COMPONENTS AND CARCASS CHARACTERISTICS

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ABSTRACT

A study was conducted to determine the effects of feeding *Prosopis africana* pulp (PAP) on nutrient digestibility, haematological indices and carcass components of growing rabbits. The experiment which lasted 10 weeks consisted of thirty (30) rabbits of five to six weeks of age. They were randomly allotted to five dietary treatments in groups of six but caged individually. The PAP replaced maize weight for weight at levels of 0, 10, 20, 30 and 40% in diets I (control), 2, 3, 4 and 5 respectively. The formulated diets contained similar crude protein content of 18%. The apparent digestibility of nutrients, carcass parameters as well as haematological indices were not significantly (P>0.05) different among the treatments. These results indicate that *Prosopis africana* pulp can completely replace maize in the diets of growing rabbits without adverse effects on nutrient digestibility, carcass components and blood parameters.

KEYWORDS: *Prosopis africana* pulp, rabbit feeding, digestibility, blood, carcass.

INTRODUCTION

In many developing countries, one of the most important nutritional problems is inadequate intake of protein especially that of animal origin (Fielding, 1991). Animal protein contains more essential amino acids required to meet human nutritional needs than plant protein. FAO (1986) asserted that an average Nigerian consumed only 45.0 g total protein and only 7.0 g comes from animal protein, despite recommendation of 60–64 g per individual per day out of which 27.3 g should come from animal sources. The consequences are retarded growth, high incidence of kwashiorkor, high rate of child mortality, short life span and widespread protein–energy malnutrition (Adegbola, 1999). Production and multiplication of prolific monogastric animals and provision of adequate feeding appear to be some of the options for solving these problems. The ability of rabbits to thrive on forages and other similar feeds makes rabbit production comparatively cheaper (Aduku and Olukosi, 1990). Therefore, to sustain interest, there is need to evaluate many feed resources, especially the legumes that are abundant during the dry season in the semi-arid areas of Nigeria.

Prosopis africana pods are among the earliest leguminous feeds known to man and still serve as a valuable source of carbohydrate and protein for many desert dwellers. Livestock also relish the pods which, in many species contain a sweet yellow pulp. It is used in ruminant feeding, but there is a dearth of information on its suitability in rabbit feeding. The objective of this study therefore was to assess the effect of *Prosopis africana* pulp on nutrient digestibility, carcass components and blood composition of growing rabbits.

MATERIALS AND METHODS

The experimental site, experimental stock, management and experimental diets were similar to what was reported previously (Igwebuike *et al.,* 2011). At the end of week six of the experiment, three rabbits from each treatment were selected and placed individually in metabolism cages. Feed intake was measured, and faeces collected from each rabbit for five days were oven-dried and assayed for apparent digestibility of crude protein, ether extract, crude fibre, ash and nitrogen –free extract.

At week eight of the experiment, blood samples were also collected from three rabbits in each treatment for blood analyses. Blood samples were collected from the ear veins of the rabbits using sterile disposable syringe and needle. The rabbits were starved overnight and collection done the following morning at about 8.0a.m in order to avoid excessive bleeding. Ethylene diamine tetracetic acid (EDTA) was used as an anticoagulant to prevent clotting of the blood collected for the haematological indices.

The haematological indices which include packed cell volume (PCV), red blood cells (RBC) count, white blood cells (WBC) count and haemoglobin (Hb) concentration were measured according to the methods expounded by Bush (1975). PCV, RBC, WBC and Hb were determined by micro-haematocrit, improved Neubauer haemocytometer and cyanomethaemoglobin methods respectively. Mean corpuscular volume (MCV),

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mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated according to standard formulae (Schahn *et al.,* 1975).

Serum biochemical indices which include serum albumin, total protein, globulin, cholesterol, glucose, calcium (Ca.) and Phosphorus (P) were measured according to methods described by Bush (1991). The serum glucose, urea and cholesterol were estimated by orthotoluidine, Diacetyl monoxime and colorimetric enzyme methods respectively. The total protein and serum albumin were determined by Biuret reactions (Bush, 1975).

At the end of week 10 of the study, three rabbits from each treatment were selected, weighed and then starved overnight (12 hours) but water was provided. The weights of the rabbits were recorded in the morning before slaughter. The dressed carcass, body components and organs were weighed and expressed as percentage of slaughter weight. Dressed carcass and digestive tract length were also measured.

The data collected were subjected to analysis of variance (ANOVA) using the randomized complete block design (Steel and Torrie, 1980). Means where significant (P<0.05) were separated using Least Significant Difference (LSD).

RESULTS AND DISCUSSION

The mean apparent digestibility of dry matter, crude protein, crude fibre, ether extract and nitrogen-free extract are presented in Table 1. There were no significant differences (P> 0.05) in nutrient digestibility among all the treatment groups. This may be due to the similarity in the composition of the experimental diets, especially the protein contents. Although the digestibility of the nutrients was statistically similar, slightly higher digestibility was recorded in diet 1 (control) and this steadily decreased up to treatment 5. The progressive decrease in nutrient digestibility with increasing levels of PAP could not be attributed to high level of dietary fibre as observed by Butcher *et al.,* (1981) and Onibi and Owa (1999) because the crude fibre in the diets (10.70-17.67%) were within the normal range of 11.0-18.0% recommended in literature (Davidson and Spreadbury, 1975; Adegbola *et al.*, 1985; Igwebuike *et al*., 1998). It may however, be due to low feed intake and depressed nutrient intake and utilization arising from increasing tannin levels associated with the addition of PAP in the diets. Tannin is reported to depress nutrient digestibility and feed utilization (Mole, 1989). On the other hand, Kassa *et al,* (1989) found a positive correlation between intake and digestibility of feeds in ruminants. Bohra and Ghosh (1980) and Gohl (1981) reported similar results with camels fed *Prosopis cineraria* pods. These observations are indications that the adverse consequences of tannins are more pronounced in non-ruminants than in ruminants (Jansman, 1993).

Data on carcass characteristics are presented in Table 2. There were no significant differences (P> 0.05) in the slaughter weights among all the treatments. These results agree with those of Sankhyan *et al.* (1991) and Igwebuike *et al*. (1995) for growing rabbits. The dressing percentage values obtained in this study are lower than those reported by Garcia *et al.* (1993) who slaughtered rabbits of 2.0–2.5 kg live weight and recorded dressing percentages of 58.0 and 60.0% respectively. These may be attributed to the differences in slaughter weight since a positive correlation has been established between slaughter weight and dressing percentage (Garcia *et al.,* 1993).

The components/organs shown in Table 2 (head, skin, feet, heart, liver, lung, small intestine, large intestine, stomach, gullet, oesophagus, kidney and kidney fat) were weighed and expressed as a percentage of slaughter weight. They were not statistically different (P>0.05) among the treatment groups. The values recorded here compare favourably with those reported by Igwebuike *et al.* (1995) who fed sorghum waste to growing rabbits in the same environment.

The length of gastro-intestinal tract and dressed body weight showed no significant differences (P> 0.05) among the different treatment groups. This indicates that the growth and development of these organs were not adversely affected by the various levels of PAP in the diets despite the variation in the protein, fibre and tannin levels of the diets. This is supported by the works of Aduku *et al.* (1986), Sankhyan *et al.* (1991), Ijaiya and Fasanya (2004) who reported that the average dressing percentages and weights of body parts of rabbits fed different levels of protein and energy were not significantly (P>0.05) affected. The observation also agrees with the work of Zhao *et al.* (1995) who reported that in rats, these components are hardly affected by the fibre levels of the diets. It is therefore concluded that the inclusion of PAP in diets of growing rabbits did not affect the proportionate development of the body components and organs.

Table 1: Mean apparent digestibility by rabbits fed graded levels of *Prosopis africana* pulp (PAP)

Nutrients (%)	**Diets/Treatments**					
	1	2	3	4	5	SEM
Levels of PAP (%)	0	10	20	30	40	
Dry matter	66.95	64.41	62.10	60.84	59.08	26.25 ^{NS}
Crude protein	79.32	76.47	74.67	73.46	72.26	2.15 ^{NS}
Crude fibre	38.41	37.68	37.57	35.98	34.49	19.99 ^{NS}
Ether extract	70.27	68.08	66.19	65.92	61.11	10.00 ^{NS}
Ash	60.09	59.09	57.59	56.95	54.87	16.69 ^{NS}
Nitrogen-free extract	89.89	86.59	93.36	79.65	78.92	21.33 ^{NS}

SEM = Standard Error of Means
NS = Not significant (P>0.05)

Table 2: Carcass data, weight and length of selected organs of rabbits fed graded levels of Prosopis africana pulp (PAP)

	Diets/Treatments					
Parameters	1	2	3	4	5	
Level of PAP (%)	0	10	20	30	40	SEM
No. of rabbits slaughtered	3	3	3	3	3	-
Slaughter weight (g)	1483.00	1300.00	1307.00	1250.00	1033.00	1100.0^{NS}
Wt. of dressed carcass (g)	689.0	682.71	675.33	637.36	670.54	55.28^{NS}
Dressing percentage (%)	46.96	47.57	46.94	45.64	44.90	10.20^{NS}
Body Components as Percentage of Slaughter weight (%)						
Head	7.668	8.329	7.856	8.513	9.624	0.57^{NS}
Skin	4.818	6.800	6.186	6.254	6.429	1.095^{NS}
Feet	2.122	2.274	2.329	2.585	2.603	0.177^{NS}
Heart	0.211	0.229	0.218	0.260	0.178	0.002^{NS}
Liver	2.796	2.826	2.581	2,458	2.827	0.171^{NS}
Lung	0.449	0.465	0.458	0.576	0.641	0.022^{NS}
Spleen	0.025	0.024	0.032	0.028	0.031	0.002^{NS}
Kidneys	0.468	0.500	0.495	0.491	0.605	0.006^{NS}
Oesophagus	0.823	0.824	0.856	0.831	0.793	0.005^{NS}
Stomach	5.628	5.106	6.538	6.569	7.902	1.513^{NS}
Small intestine	3.660	3.688	3.778	3.599	3.568	0.035^{NS}
Large intestine	5.100	6.075	6.172	5.061	4.997	0.89^{NS}
Caecum	0.831	0.841	8.873	0.712	0.790	0.004^{NS}
Kidney fat	0.507	0.623	0.681	0.281	0.39	0.062^{NS}
Length of Gastro-intestinal Tracts (cm)						
Oesophagus	10.30	1033	10.50	10.167	10.00	0.718^{NS}
Stomach	9.00	9.167	9.267	8.33	7.67	0.48^{NS}
Small intestine	233.50	234.33	235.68	233.33	230.33	209.00^{NS}
Large intestine	143.20	143.33	144.33	143.00	142.00	5.945^{NS}
Caecum	9.667	9.667	9.00	11.50	9.00	2.77^{NS}
Body length	31.00	29.23	29.17	29.33	28.17	1.58^{NS}

PAP = Prosopis africana Pulp
SEM = Standard Error of Means
NS = Not Significant (P>0.05)

Haematological and Erythrocytic Indices

The haematological and erythrocytic indices are presented in Table 3. The packed cell volume (PCV) and haemoglobin (Hb) concentration values were between 30% and 35% and 10.68 and 12.0 g/l00ml respectively. There were no significant differences (P> 0.05) among the treatment means for PCV and Hb. All the values fall within the normal range of 31 to 50% and 8.0 to 15.97 g/l00rnl for PCV and Hb respectively reported in literature (Schalm *et al.,* 1975; Anon, 1980). The normal and similar values obtained for all the treatment groups indicated nutritional adequacy of the various diets since abnormal values would have indicated mal–or under nutrition (Church *et al.,* 1984). Hackbarth *et al.* (1983) found that there is a strong influence of diet on haematological traits with PCV and Hb being very strong indicators of nutritional status of animals. The PCV and Hb values obtained in this study are similar to the 29.50 to 36.5% and 10.40 to 12.6 g/l00ml reported by Alade *et al.* (2001) for rabbits fed dry poultry waste. The values were however, slightly lower than the 38.0 to 41.25% and 10.30 to 11.05 g/100ml PCV and Hb values respectively reported by Igwebuike (2001) for growing rabbits.

The values for white blood cell (WBC) counts and red blood cell (RBC) count are between 3.78 and 5.20 x $10^3/mm^3$ and 5.86 and 6.33 x $10^6/mm^3$ respectively. There were no significant differences (P> 0.05) between the treatment groups for either WBC or RBC counts. These values are within the normal range of 3.0 to 12.5 x $10^3/mm^3$ and 3.0 to 7.73 x $10^6/mm^3$ for WBC and RBC counts respectively (Schalm *et al.,* 1975; Anon, 1980). The slightly lower counts for WBC and RBC of rabbits fed diets 1, 4 and 5 compared to diets 2 and 3 may be attributed to the feed intake. Reduced feed intake normally leads to reduced nutrient intake which will include the iron needed for the formation of haemoglobin (Bush, 1975).

Table 3: Haematological indices of rabbits fed graded 1evels of *Prosopis africana* pulp (PAP)

Parameters	Treatments					
	1	2	3	4	5	SEM
Levels of PAP (%)	0	10	20	30	40	
Haematocrit (PCV %)	34.35	35.35	35.00	33.00	33.00	6.73^{NS}
Haemoglobin (Hb g/100ml)	11.33	12.0	12.0	11.68	10.68	1.23^{NS}
WBC ($x10^3/mm^3$)	4.28	4.70	5.20	3.88	3.78	1.28^{NS}
RBC ($x10^6/mm^3$)	5.73	6.31	6.31	6.01	5.86	0.71^{NS}
MCV (Fl)	54.13	55.49	57.85	55.62	50.94	7.83^{NS}
MCH (pg)	19.69	19.08	19.88	19.68	18.17	8.47^{NS}
MCHC (%)	43.95	34.29	34.11	36.11	35.45	0.79^{NS}

NS = Not significant (P> 0.05)
PCV = Packed Cell volume
WBC = White Blood Cell
RBC = Red Blood Cell
MCV = Mean Corpuscular Volume
MCH = Mean Corpuscular Haemoglobin
MCHC = Mean Corpuscular Haemoglobin Concentration
SEM = Standard Error of Means

The WBC and RBC counts recorded in the study are lower than those reported by Igwebuike (2001) who recorded the range of 5.28 to 9.05 x $10^3/mm^3$ and 4.65 to 6.50 x $10^6/mm^3$ for WBC and RBC counts respectively for growing rabbits fed *Acacia albida* pods. This may be attributed to the higher ambient temperature (30–42°C) during the period of the study. High ambient temperature (36–40°C) could lead to low WBC count in chickens (Kwari and Ubosi, 1991). Thermal stress has been shown to induce immuno-depression in birds (Subba Rao and Glick, 1977) and this may apply to rabbits.

The values for mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) presented in Table 3 were not significantly (P> 0.05) different ad were within the normal range of 60–73fl, 16–23 pg and 26–34% for MCV, MCH and MCHC respectively reported by Anon. (1980). The normal values recorded in this study indicate that up to 40% PAP could be fed to growing rabbits without adverse effect on the blood components of growing rabbits. The total protein, albumin and globulin are presented in Table 4. There were no significant differences (P> 0.05) among the treatment groups for these parameters. The values are within the normal ranges of 5.0–8.0 g/dl, 3.13–3.80 g/dl and 2.27 to 2.97 g/dl for protein, albumin and globulin respectively as reported by Anon. (1980). Since these parameters are influenced by total protein intake (Birt and Schuldt, 1982), the values obtained in this study indicate nutritional adequacy of the dietary proteins. Abnormal serum albumin usually indicates an alteration of normal systematic protein utilization (Apata, 1990) and blood proteins are known to depend on the quality and quantity of dietary proteins (Awosanya *et al.*, 1999). Therefore the normal values obtained in this experiment indicate that the levels of PAP included in the diets had no adverse effect on serum protein level of the blood.

The values for glucose and cholesterol (Table 4) ranged from 76.33 to 94.33 mg/dl and 32.33 to 44.33 mg/dl respectively and these were not significantly (P> 0.05) different among the treatment groups. They, however, fall within the normal reference values of 78–155 mg/dl and 20.0 to 83.0 mg/dl respectively reported for normal healthy rabbits (Anon, 1980; Onifade and Tewe, 1993). Since glucose and cholesterol levels were within the normal range, anorexia, diabetes, liver dysfunction and mal-absorption of fat which are symptoms of abnormal levels in the blood (Bush, 1991) are ruled out.

Serum calcium (Ca) and phosphorus (P) obtained in this study were not significantly different (P> 0.05) among the treatment groups. The values obtained compared favourably with the normal ranges of 5.6–12.7 mg/dl and 2.3–6.9 mg/dl for calcium and phosphorus levels of rabbits respectively (Anon, 1980).

Table 4: Serum biochemical indices of rabbits fed graded levels of *Prosopis africana* pulp (PAP)

Parameter	Treatments					
	1	2	3	4	5	SEM
Levels of PAP (%)	0	10	20	30	40	-
Total protein (g/dl)	6.58	6.30	6.73	6.10	5.70	1.19^{NS}
Albumin (g/dl)	3.68	3.33	3.80	3.20	3.43	0.08^{NS}
Globulin (g/dl)	2.90	2.97	2.93	2.97	2.22	0.15^{NS}
Glucose (mg/dl)	86.67	85.33	94.33	86.67	76.33	13.98^{NS}
Cholesterol (mg/dl)	40.33	39.0	44.33	32.33	40.0	7.15^{NS}
Calcium (mg/dl)	6.33	6.33	6.42	6.33	6.31	0.03^{NS}
Phosphorus (mg/dl)	2.47	2.40	3.10	2.37	2.13	0.11^{NS}

SEM = Standard Error of Means, NS = Not Significant (P>0.05)

Since there was no sign of ill-health or anaemia observed in all the treatments, the diets might have met the minimum nutrient needs of the rabbits. Diets have very strong influence on haematological traits and serum biochemical indices (Hackbarth *et al.,* 1983). Abnormal values of these parameters would have indicated mal – or under-nutrition (Duncan and Prasse, 1977 and Bush, 1975).

These results underline the usefulness of PAP for rabbit feeding. Haematological constituents reflect the physiological responsiveness of the animal to its internal and external environments and these include feeds and feeding (Esonu *et al.,* 2001). The normal blood indices obtained in this study shows that upto 40% PAP could be incorporated into the diets of growing rabbits without compromising the health status of the animals.

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