

PERFORMANCE AND NUTRIENT DIGESTIBILITY BY WEANED RABBITS FED BIODEGRADED *PROSOPIS AFRICANA* SEED COAT.

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Abstract: A study was conducted to evaluate the performance and nutrient digestibility by rabbits fed diets containing *Prosopis africana* pod for a period of 84 days. A total of 25 weaned rabbits of about 4-5 weeks with similar weights were assigned to 5 treatments consisting of 1 rabbit in a replicate. The design used was completely randomized design (CRD). Control experiment (T1) had no *Prosopis* (0% *Prosopis*), whereas, feed served to rabbits contained 25%, 50%, 75%, and 100% of *Prosopis africana* pod, representing T₂, T₃, T₄ and T₅, respectively. Feed and water were given *ad libitum*. Performance and nutrient digestibility indices were measured. Results revealed that all the performance indices measured were not significantly ($P>0.05$) affected but body weight. Also, nutrient digestibility parameters were not affected by treatments except for nitrogen free extract that significantly decreased across treatments. The study concluded that, *Prosopis africana* pod meal could replace maize in rabbits' diets upto 100% without compromising their performances.

INTRODUCTION

Production of feed that is cost effective is the focal point of attention in recent times. The reason is that "cost of production accounts for about 70-75% of the total cost of production" (Abang *et al.*, 2013). Conventional feedstuffs are responsible for this high cost; millet, maize, soybean, groundnut because "they are highly competed for by man, animal and industries" (Abang *et al.*, 2015). This quest has drawn the attention of researchers to non-conventional feedstuffs that are not faced with the issue of seasonality nor competing with man for food ((Jurgen *et al.*, 1998; Adeyi *et al.*, 2021). In the light of the foregoing, *Prosopis* seed coat is considered potential feedstuffs for rabbit production.

Prosopis africana seeds, pods and seed coat are rich in protein, fibre/ carbohydrates, respectively. However, the setback of using *Prosopis* is high content of anti-nutritional factor such as haemagglutinin, tannins, *prosopine* and toxic amino acid which are capable of hindering the bio-availability of nutrients when consumed without adequate processing (such as boiling, fermentation, sun drying, grinding) (Abang *et al.*, 2013; Bishop *et al.*, 2021; Odey *et al.*, 2019). Abang *et al.* (2016) asserted that, adequate scientific data on direct or processed use of *Prosopis* seed coat and its nutritive value is lacking, available information deals mainly with the use of *Prosopis* leaves, seed and pods. *Prosopis* seed is used in making "Dawa Dawa" seasoning- Maggi in Nigeria after going through process of production. However, the study investigated effect of

feeding varying levels of fermented *Prosopis* seed coat to weaned rabbits.

Objectives of the study

1. To study the growth performance of weaned rabbits fed diet containing different levels of *Prosopis africana* seeds coat meal.
2. To examine nutrient digestibility and utilisation of different level of fermented *Prosopis africana* seeds coat meal.

Materials and Methods

Location of the Study

The study was carried out in the Rabbitry Unit of the Livestock Teaching and Research farm of the University of Agriculture Makurdi, Benue State, Nigeria. The experiment was conducted in the same location as described by Abang *et al.* (2021^a).

Processing of *Prosopis africana* Seed coat

Prosopis africana seed coats were obtained around Makurdi metropolis. The seed coats were collected and fermented with fresh rumen content for three days. Forty (40) kg of *Prosopis africana* seed coat mixed with twenty-five (25) kg of fresh rumen content was collected in black poly bags and allowed to ferment for 72 hours in an anaerobic condition. The fresh rumen content was obtained in the early hours of the morning in the Month of March. The fermented seed coats were then spread to dry before being winnowed to remove the chaff then ground and incorporated into the feed as required per treatment. A proximate analysis of the fermented *Prosopis africana* was conducted according to the methods of AOAC (2006).

Experimental diets

Five dietary treatments with crude protein ranging from 17.24 – 17.78% and metabolizable energy from 2491.00 – 2542.57Kcal/kg designated T1, T2, T3, T4 and T5 representing 0%, 25%, 50% 75% and 100% inclusion of fermented *Prosopis africana* seed coat in the diets of the rabbits. The diets were formulated using the following ingredients as shown in Table 1.

Proximate analysis

Proximate analysis of the test ingredient as well as the experimental diets was determined by (AOAC, 2006). Metabolizable energy (ME) was calculated using the methods outlined by Puazenga, (1985). The analysis was done at the Nutrition Laboratory University of Agriculture, Makurdi.

Experimental diets

Table1. Composition of experimental diet with varying levels of fermented *Prosopis africana* seed coat meal for weaned rabbits

Ingredients	T₁ (0%)	T₂ (Pa25%)	T₃ (Pa50%)	T₄ (Pa75%)	T₅ (Pa100%)
Maize	36.00	27.00	18.00	9.00	0
<i>Prosopis Africana</i>	-	9.00	18.00	27.00	36.00
Soya bean meal	15.00	15.00	15.00	15.00	15.00
Brewer Dry Grain	35.00	35.00	35.00	35.00	35.00
Maize Offal	10.00	10.00	10.00	10.00	10.00
Bone meal	2.25	2.25	2.25	2.25	2.25
Salt	1.00	1.00	1.00	1.00	1.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vitamin/Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00

Calculated nutrient:

ME(kcal/kg)	2542.57	2529.57	2515.80	2504.00	2491.00
Crude Protein	17.24	17.38	17.51	17.65	17.78
Crude fiber	10.00	10.93	11.91	13.00	14.04
Calcium	0.92	0.92	0.94	0.93	0.93
Phosphorus	0.52	0.52	0.51	0.50	0.49
Lysine	0.85	0.83	0.81	0.78	0.76
Methionine	0.56	0.54	0.53	0.51	0.49

**To provide the following per kg of diet vitamin A – 15,000.00IU, Vitamin D3 - 3, 000,000IU, Vitamin E- 30,000IU, Vitamin K – 3,000mg Vitamin B1 3000,mg Vitamin B2-6000mg, Vitamin B- 5,000mg, Vitamin B12-40mg, Biotin 200mg, Niacin-40,000mg, Pantothenic acid 15,000mg,Folic acid 2,000mg, choline 300,000mg,Iron 60,000mg, manganese 80,000mg, copper 25,000mg,Zinc 80,000mg cobalt 150mg, iodine 500mg, selenium 310mg, Antioxidant 20,000mg.*

Experimental design and management of rabbits

A total of twenty five (25) rabbits of mixed breed and sexes obtained from Dagwam farm NVRI Vom Plateau State, Nigeria were used for the study. The rabbits were weighed and assigned to five treatments with five rabbits each (four New Zealand white and one chinchilla) for each treatment, with similar mean live weight. Five diets were randomly assigned to each of five (5) experimental treatments in a Completely Randomized Design (CRD). Rabbits were housed in three-tier hutch system with a dimension of 120 by 150 cm. Well design vaccination programme was adhered to. All routine management practices were strictly observed throughout the study period. Feed and water were provided *ad-libitum*, weaned rabbits of 4 – 5weeks were allowed to acclimatize for 7days before starting the experiment.

Parameters mensured:

Performance indices:

Data collected on performance parameters were; feed conversion, body weight and weight gain, Protein efficiency. The data were computed using the formulae as described by Abang *et al.* (2021^b)

Digestibility trial

At the end of twelve (12) weeks, 3 rabbits each from the five treatment groups with similar mean live weights were selected from each replicate and transferred into metabolic cages for individual feeding and fecal collection. The rabbits were then fasted overnight but water was given. A certain amount of feed was served to the rabbits and the left over feed was quantified. Fecal samples were collected for seven days by placing clean tray under the cages. Fecal samples were separated from feed and other foreign materials, weighed, bulked together and stored in a freezer. At the end of the feeding trial, the samples were thawed and oven dried at 60°C to constant weight. The fecal samples for each diet was bulked, finely ground and analyzed for chemical composition according to the method outlined by (AOAC, 2006).

The percentage nutrient was calculated using the equation as outlined by Abang *et al.* (2023).

Statistical analysis

Data collected during the experiment were statistically analyzed using the general linear model procedure of software package (SPSS, 2013). When the differences between treatments means were significant, they were separated by Duncan Multiple Range Test (Steel and Torrie, 1980).

Results and Discussion

Proximate compositions of experimental diet

Crude protein (CP) value ranged between 17.94-19.25%. This is in agreement with the 18% crude protein content recorded by Adamu (2011). CP did not significantly differ across the dietary treatments. The crude fibre from the analysed differed significantly from calculated crude fibre, this may due to the variation in the actual nutrient composition of the feed ingredient used in the compounded feed or some error during analysis. The metabolizable energy (ME) of the analysed nutrient is slightly higher than the calculated ME composition of the experimental diet, however, this met the requirement of the animal.

Table 2: Proximate composition of diets fed to weaned rabbits using *Prosopis africana* seed coat (%)

Parameters	Treatment Levels					
	T1	T2 (Pa 0%)	T3 (Pa 25%)	T4 (Pa 50%)	T5 (Pa 75%)	(Pa 100%)
DM		88.83	88.65	89.44	88.48	89.38
CP		18.16	17.94	18.81	19.25	18.38
EE		3.24	3.37	2.91	2.77	2.36
ASH		7.79	7.52	10.41	9.45	13.51
CF		3.15	4.52	4.86	6.43	6.67

NFE	56.49	55.30	52.45	50.58	48.46
Moisture	11.17	11.35	11.37	11,52	10.62
ME	2942.35	2902.60	2795.99	2734.43	2593.44

Pa = *Prosopis africana*

Growth performance of weaned rabbit

Final weight (g)

The recorded average final weight ranged from 1455.30 to 1892.30g and were significantly different ($P < 0.05$) across the dietary treatments. The final weight in T₁ (936.67 to 1211.12g) agrees with that of Adamu *et al.* (2013) while T₂ to T₅ were not in agreement with the report of Adamu *et al.* (2011). However, these results indicated that the inclusion level of *Prosopis africana* across the dietary treatments did not affected the performance of the animals.

5.2.3 Average daily weight gain (g)

The average daily weight gain reported in this study ranged from 8.22g to 14.23g which differed statistically ($P < 0.05$) across the five (5) dietary treatments. This range was higher than the range of 6.54 to 10.36g reported by Adamu *et al.* (2010) on rabbits fed *Prosopis africana* pulp. This shows that the anti-nutritional factor like; tannins, trypsin inhibitors, protease inhibitors were reduced to a tolerable level by the processing method adopted.

5.2.4 Average daily feed intake (g)

The average daily feed intake recorded in this study ranged from 77.68 to 83.96g. These results did not significantly differ ($P > 0.05$) across the five dietary treatments. These values were higher than the values of 41.86g to 47.37g reported by Adamu *etal*, (2010) on rabbits fed *Prosopis africana* pulp. Although, the high feed intake had no negative effect on the experimental animals during the trial period.

5.2.5 Feed efficiency

The result of efficiency of feed utilization obtain in this study (4.60 to 6.34) with no significant differences ($P > 0.05$) across the treatments were comparable with the values of 5.95 to 6.83 reported by Adamu *et al.* (2013) on rabbits fed *Prosopis africana* . Protein efficiency ratio (1.34 to 2.11) was equally not significant ($P > 0.05$) across the dietary treatments. This results we're comparable with 0.83 to 1.19 recorded by Adamu *et al.* (2013) on rabbits fed *Prosopis africana* pulp. This result indicated that the rabbits utilized the dietary protein well during the experiment. Low mortality was recorded during the experimental period. One (1) mortality was recorded which represented 20% of the total number of the animals in treatment one (T1) with the same figure observed at treatment three (T3), While treatments two (T2) and four (T4) recorded no mortality which represented 0% in those treatments. This low mortality indicated that the tested ingredients (*Prosopis africans*) did not negatively affected the experimental rabbits.

Table 3: Effect of Replacing Maize with *Prosopis africana* on Growth Performance of Weaned Rabbits

Parameters	Treatment levels					
	T1	T2	T3	T4	T5	
	(Pa 0%)	(Pa 25%)	(Pa 50%)	(Pa 75%)	(Pa 100%)	
SEM						
Initial weight (g)	724.86	768.33	760.50	721.83	740.83	38.15 ^{NS}
Final weight (g)	1455.30 ^d	1890.30 ^{ab}	1881.00 ^{ab}	1892.30 ^a	1858.30 ^c	90.92*
ADWG (g)	8.62 ^c	12.34 ^b	14.05 ^a	14.23 ^a	13.76 ^{ab}	1.07*
ADFI (g)	83.96	78.27	77.68	80.17	79.36	1.95 ^{NS}
FE (g)	4.60	4.52	4.45	4.36	4.32	0.09 ^{NS}
PER (g)	2.11	1.45	1.34	1.35	1.34	0.02 ^{NS}
Mortality	1.00	0.00	1.00	0.00	1.00	0.01 ^{NS}

abcd= mean in the row with different superscript are significantly different (P<0.05)

SEM = Standard Error Mean, ADWG= Average daily weight gain, ADFI = Average daily feed

intake, FE= Feed efficiency, PER =Protein efficiency ratio, NS = Not significantly different

(P>0.05), * = Significantly different (P<0.05)

Effect of Replacing Maize with *Prosopis africana* on Coefficient Digestibility of Weaned Rabbits

Dry matter (DM)

The values of DM varied from 83.22 to 94.10 and were higher than 74.14 to 83.35 (Omole *et al.*, 2003) and 61.64 to 64.97% recorded by Sarhan, (2005) who replaced clover hay with dietary pea vines hay and pea pods hulls partially or completely. However, there were no significant differences (P>0.05) in dry matter digestibility. The Ether extract coefficient digestibility shows no significant differences (P>0.05) across the dietary treatments with the values ranges from 89.74 to 94.94%. These values were observed to be within the range of 88.90 to 91.40% reported by Hon *et al.* (2007) when sweet orange pulp meal was served to rabbits. This result indicated that rabbit can utilize dietary fat effectively as reported by Beyen (1988). The high coefficient of digestibility of crude protein of the diet in this study (88.42 to 96.37%) could be attributed to better utilization of nutrients by rabbits. This result agrees with the result of Cheeke *et al.* (1987). This is an indication that inclusion level of *Prosopis africana* did not affected the crude protein digestibility of weaned rabbit. The coefficient of .digestibility of crude fibre values in this study ranged from 56.82% to 75.80% with no significant differences (P>0.05) across the dietary treatments. These values were higher than 33.10% to 40.53% reported by Sarhan (2005) for Bouscat rabbits fed pea vines hay. Fibre from different sources could vary in digestibility depending on the proportion of cellulose, hemicellulose and lignin.

Nitrogen free extract (NFE). The nitrogen free extract digestibility in this study ranged from

82.90% to 96.37% with significant differences ($P < 0.05$) across the treatments, these results agreed with that of Onifade and Tewe (1993) who noted that the high digestibility of maize based diet was due to the high availability of their carbohydrates. Also NFE decreases across the treatments because the energy of maize is higher than that of *Prosopis africana* and so the nitrogen free extract decreases as the quantity of *Prosopis* increases across the treatments. The decrease in nitrogen free extract was also observed by Adam *et al.* (2010) when he replaced *Prosopis africana* pulp with maize.

Table 4: Effect of replacing maize with *Prosopis africana* on nutrient digestibility coefficient of

weaned rabbits

Parameters	Treatments Levels					SEM
	T1 (Pa 0%)	T2 (Pa 25%)	T3 (Pa 50%)	T4 (Pa 75%)	T5 (Pa 100%)	
Dry matter	94.10	90.1	86.24	85.74	83.22	2.65 ^{NS}
Ether extract	94.94	94.16	92.08	89.74	90.14	2.31 ^{NS}
Crude protein	96.37	94.03	91.07	91.08	88.42	1.60 ^{NS}
Crude fibre	75.80	69.05	56.82	67.86	62.21	7.14 ^{NS}
Nitrogen free Extract	96.37 ^a	94.03 ^{ab}	87.51 ^b	86.60 ^b	82.90 ^c	2.15 [*]

abc= mean in the row with different superscript are significantly different ($P < 0.05$)

Pa = *Prosopis africana*, SEM = Standard Error Mean, NS = Not significantly different ($P > 0.05$)

* = Significantly different ($P < 0.05$)

Conclusion

This study concluded that *Prosopis africana* fermented with rumen content could replace maize in weaned rabbit diet up to 100%.

DECLARATIONS

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Authors' contribution

E. E. NSA conceived wrote, original draft preparation, review and editing. F. B. P. ABANG performed conceptualization, writing, original draft preparation, review and editing. E. D. IZUKI performed editing and evaluation of manuscript before submission. B. B. VINA performed editing and evaluation of manuscript before submission.

Ethical Approval

All authors hereby declared that “the University Committee on Ethnical Matters have Examined and Approved all Experiments.

Conflict of Interests

The authors declared that there is no conflict of interest.

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