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Acceptability and Nutrient Digestibility of West African Dwarf Goat Fed Different Dietary Inclusion of Baobab (*Adansonia digitata)*

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***Abstract*:** *Exploring the potentials of alternative feed resources is significant in ameliorating the characteristic weight loss of ruminants, attributed to inadequate dry season feeding in tropical countries. Sixteen West African Dwarf (WAD) goat (average 6kg±0.23kg body weight) were used in a twelve weeks feeding trial to determine the acceptability and nutrient digestibility of goats fed different level of baobab (Adansonia digitata) as supplement to wheat offal. Two experimental diets designated P and Q containing baobab whole fruit and pulp only respectively were fed to determine the acceptability of baobab based meal. The coefficient of preference determined for pulp only meal was greater than 1 and considered more acceptable than whole baobab fruit. Results indicated no significant differences (P>0.05) in the final body weight of all treatments. There were significant differences (P<0.05) in the dry matter (DM), crude fibre (CF) and nitrogen free extract (NFE) digestibilities among the treatments. However, goats on diet 2 performed better than others in DM, CP, EE digestibility and weight gain measured. Results obtained from this study showed that even though all the dietary inclusion level were satisfactory, inclusion level of 10% gives optimum performance when fed to WAD goats.*
Keywords: *body weight, guinea grass, pulp, supplement, wheat offal*

I. Introduction

The traditional ruminant livestock feeding system typical of all tropical countries depends mainly on the use of native grasses, legumes and some foliage [1]. During the dry season, the quantity and quality of these natural forages undergo drastic reduction [2], grasses wilt and most of the trees and shrubs lose their leaves. The consequent scarcity of forage thus compels the animals to consume higher quantity of less palatable species [3], which result in reduction of about 50% of the live weight gained during the wet season and consequently increases mortality. There is substantial restriction on the productivity of domestic goats despite ability to survive decrease in natural forage in dry seasons [4] [5].

Over the years, innumerable ways of combating the problem of dry season feeding in ruminant production have been suggested. The exclusive use of roughages and concentrates has been identified as the major helping tool in this situation and several research results have also shown that fodders conserved in form of hay and silage also play significant role in the maintenance of ruminant productivity during this critical period. Additional practices include feeding local traditional by- products such as cane tops, bagasse, brewer's grains and crop residues from local farms [6].

Considering the current environmental degradation coupled with the recent increase in human population and their corresponding demand for animal protein, these solutions are becoming inadequate and can no longer guaranty an all year round production of animal protein. The cost of procurement of concentrates is another factor mitigating the success of some of the suggested strategies. Reports from Nicaragua (the largest country in Central America) showed that the exorbitant cost of concentrates has largely result in their exclusion in ruminant feeding regimes [6]. Ultimately, the critical economic situation of marginal farmers in developing countries often makes it impossible for them to afford concentrates for commercial feeding. Hence, this necessitates the use of local natural resources as sustainable alternatives [7].

Several reports have also indicated that lots of less-popular native crop species are high in nutrients and could possibly relieve critical food shortages if given adequate promotion and research attention [8]. However, prior to utilization of such unconventional resources, data indicating the nutrient composition, toxic factors, acceptability and digestibility should be available. In addition, [9] suggested that toxicological evaluation and methods of processing that will enhance their use as food or feed ingredient are all necessary in order to achieve optimal utilization. Many studies have indeed evaluated the use of different plants (fresh or as silage) for the supplementation of ruminants. However, little research efforts have been stimulated to explore the potential benefits of the native baobab fruit as dry season feed for ruminants.

Baobab (*Adansonia digitata*) is a deciduous tree with multipurpose uses, native to arid Central Africa [10] but with wide distribution in most of Sub-Sahara Africa's semi-arid and sub-humid regions as well as in western Madagascar [11]. [12] reported that this very long-lived tree has been introduced to areas outside Africa and thrive successfully. Baobab tree is characterized by an extensive root system and high water holding capacity which greatly contributes to its ability to survive well in dry climates and also resists fire. The fruits which consist of large seeds embedded in a dry, acidic pulp and shell are abundantly available during dry seasons. Baobab leaves, bark and fruit are used as food and for medicinal purposes in many parts of Africa while the high nutritional compositions of baobab fruit, seed, leaves and pulp have been reported [10] [13] [14] [15] [16]. Hence, the objective of this study is to evaluate the acceptability and nutrient digestibility of goats fed different level of baobab (*Adansonia digitata)* as supplement to wheat offal.

II. Materials and Methods

2.1 Experimental Site

The experiment was carried out at the ruminant production and research unit of the Teaching and Research Farm, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Oyo State, which is located on longitude $4^0 5^1$ east of the Greenwich meridian and latitude 8^0 7^1 north of the equator in the derived savannah zone of Nigeria.

2.2 Experimental Treatments and Diets

Sixteen WAD weaned goats (average 6kg±0.23kg body weight) comprising of equal sexes were used in this experiment. The goats were housed individually in metabolic cages designed for the separate collection of faeces and urine, and provision of fresh feed and water daily. The animals were quarantined, treated against endoparasites and ectoparasites prior to the commencement of the experiment. Two rations containing baobab whole meal (P) and pulp only meal (Q) were formulated for acceptability trial while four rations were formulated in such a way that baobab fruit meal was made to supplement wheat offal in a concentrate meal for the digestibility trial. Feed was offered daily at 0010 h and water provided *ad libitum* during the experimental period. The goats were adapted for 10 days to the experimental diets before actual data collection commenced and then, they were randomly allotted to four dietary treatments in a completely randomized design. The diets were labeled 1, 2, 3 and 4 with diet 1 being the control diet and having 0% inclusion level of baobab. Diet 2, 3 and 4 contain 10%, 20%, and 30% dietary level of the test ingredient (milled baobab fruit) respectively. TABLE 1 depicts the gross composition of the experimental diets. The animals were fed 3% of their body weight [17] and the experiment lasted for 84 days.

2.3 Data Collection

The animals were also weighed at the beginning of the experiment and subsequently weekly till the end of the experiment. For the acceptability trial, individual goats were allowed free choice feeding of P and Q. The consumption was measured daily by computing the difference between the quantity of feed offered and remnants for each goat. At the end of the 4^{th} week, this was then used to estimate the coefficient of preference (COP) value by calculating from the ratio between the intakes for P and Q, divided by their average intake [18]. Therefore, diet was inferred to be relatively acceptable provided the COP was greater than 1. At the beginning of the 12^{th} week, data of feed intake and, faeces and urine voided over a period of 7days were collected for digestibility studies. The faecal samples were first air dried during the period of collection and then later oven dried at a temperature of 60^0C for a period of 3 days. The faecal and feed samples were later bulked, milled to pass through 1 mm sieve and preserved for chemical analysis.

2.4 Chemical Analysis and Statistical Analysis

Samples of feedstuffs, feaces and urine were analysed for DM, crude protein (CP), crude ash (CA), crude fibre (CF) and ether extract (EE) using AOAC (1990) method [19]. Nitrogen-free extract (NFE) was calculated as 100 - (Moisture% + Crude Protein% + Crude Ash% + Crude Fibre% + Ether Extract %). Gross energy of feed was measured by bomb calorimetry using benzoic acid as a standard (26437 J/g). Data obtained were statistically analyzed with the general linear model of SAS (2000) [20] and the Duncan`s multiple range test was used to detect significant differences among means.

Table 1: Gross composition of the Experimental Diets

Ingredient	Diet 1	Diet 2	Diet 3	Diet 4
Baobab fruit	0.00	10.0	20.0	30.0
Wheat offal	63.0	53.0	43.0	33.0
Fixed ingredients	37.0	37.0	37.0	37.0
Cal. Energy (mcal/kg)	2.86	2.58	2.33	2.09
Cal. crude protein (%)	10.7	10.8	10.9	11.1
Cal. crude fibre (%)	12.4	12.9	13.3	13.9
Total	100	100	100	100

Fixed ingredients; PKC, 15%; Cassava peels, 20%; Premix, 0.5%; DCP, 0.3%; salt, 1.0%

III. Results and Discussion

3.1 Acceptability

The coefficient of preference between baobab whole fruit meal and pulp meal is presented in TABLE 2. Pulp only meal had a higher relative average feed intake of 60.72% and 50.57% for whole fruit meal. Whole fruit meal showed a coefficient of preference of 0.91 lesser than 1while pulp only meal has a coefficient of preference 1.09, which suggests that pulp only is more acceptable to the animals than the whole fruit meal. The lesser preference for the whole baobab fruit could be attributed to the relatively high fibre content contributed by the shell of the fruit.

Table 2: Coefficient of preference between Baobab whole fruit meal and pulp only meal

Diet	AVFI (%)	COP
Whole fruit meal (P)	50.6	0.91
Pulp only meal (Q)	60.7	1.09

AVFI= Relative Average feed intake; COP= Coefficient of preference; Pulp only meal has a COP>1, while whole fruit meal shows COP<1.

3.2 Proximate composition of experimental diets

The data for chemical composition of the experimental diets shown on TABLE 3 indicate few differences among the diets, all of which had relatively close levels of crude protein and energy level. The dry matter composition (DM) ranged between 80.67 and 82.03 with a steep increase from diet 1 to 4. Diet 4 showed the highest level of crude fibre which could inhibit digestibility. This is because, the rate of microbial colonization of a feed with higher fibre content is lower compared to another with low fiber content [21]. The energy level is however greater in diet 1 containing 0% inclusion level of baobab.

Table 3: Chemical composition of experimental diets

Parameters	Diet 1	Diet 2	Diet 3	Diet 4
Dry matter %	80.7	80.9	81.9	82.0
Crude protein %	14.5	14.8	14.1	15.2
Crude fibre %	13.4	15.1	17.1	18.0
Ether extract %	18.1	20.1	18.0	18.5
Ash %	9.44	7.85	6.17	6.09
Nitrogen free extract %	44.6	42.1	44.5	42.2
Gross energy, Mcal/g	3.77	3.73	3.68	3.59

Diet 1= 0% baobab meal (control diet); Diet 2= 10% baobab meal; Diet 3= 20% baobab meal; Diet 4= 30% baobab meal

3.3 Performance

TABLE 4 depicts the mean values for change in live weight gain for a period of 12 weeks. No symptom of baobab toxicity was observed during the course of the experiment. Animals fed diet 2 and 3 showed higher growth rate of 30g and 29g/ animal/day respectively, relative to diet 4 and control (28 g/animal/day). The moderate rates of live weight gain are similar to those reported by [22]. Although, there was no significant difference ($P > 0.05$) among the treatment diet 2 and 3 gave the optimum performance in terms of growth rate.

Table 4: Mean values for change in live weight gain for a period of 12 weeks.

Parameters	T1	T2	T3	T4
Initial weight (kg)	6.03	6.04	6.05	6.04
Final weight (kg)	8.38	8.56	8.49	8.39
Weight gain (g/day)	28	30	29	28

Diet 4 showed the least NFE digestibility lesser than the control diet with 50.2% digestibility. The poor digestibility observed in diet 4 can be attributed to the cumulative effect of anti-nutritional factors to toxic levels since baobab seed cake contains some anti-nutritional factors such as oxalate, phytate, saponins and tannins [23].

Table 5: Mean values for digestibility coefficients of the diets

Parameters (%)	Diet 1	Diet 2	Diet 3	Diet 4
Dry matter	62.5^{ab}	65.3^{a}	54.4^{ab}	57.7^{b}
Crude protein	80.0	82.3	81.7	78.4
Crude fibre	62.4^{a}	44.7^{b}	40.2^{b}	37.7^{c}
Ether Extract	60.8^{b}	71.5^{a}	64.2^{b}	64.3^{b}
Nitrogen free extract	50.2^{ab}	56.0^{a}	57.3^{a}	46.9^{b}

a,b,c: Means with different superscripts on the same row differ significantly ($P<0.05$).

3.4 Nutrient Digestibility

TABLE 5 shows the mean values for digestibility coefficients of the diets. Diet 2 showed higher digestibility of DM, CP and Ether extract than other diets. No significant difference was observed in CP digestibility among all diets. Diet 2 and 3 showed similar CP digestibility. The crude fibre digestibility was higher in control diet than in other diets. Diet 2 and 3 though showed closed values for CF digestibility but shows significant difference ($p<0.05$) with diet 4 which had the lowest value of CF digestibility. There was no significant difference ($p>0.05$) among EE digestibility values obtained for diet 1, 3 and 4 while diet 2 is the highest. The calculated NFE digestibility was highest in diet 3 and shows no significant difference with NFE digestibility values obtained in diet 2.

IV. Conclusion

Data from this study showed that there is potential for improvement in growth rate and nutrient digestibility of WAD goats fed dietary level of baobab based meal. The results of the present study had shown that even though all the dietary inclusion level were satisfactory, inclusion level of 10% gives optimum performance when fed to WAD goats. It could be recommended from the results obtained from the acceptability trial that future studies should evaluate the use of baobab pulp only to evaluate if this could offer further improvement. Baobab can therefore serve as an important dry-season feed resource during the decline of nutritional quality of available forage species, and hence helps to reduce the characteristic animal weight loss attributed to this period.

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