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DIETARY INFLUENCE OF CASSIA SIEBERIANA (MALGA) PODS MEAL ON THE GROWTH AND DIGESTIBILITY OF 'YANKASA SHEEP' IN SEMI-ARID ENVIRONMENT

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ABSTRACT

A study was conducted at Argungu town in Kebbi State, North-Western Nigeria, to assess the nutritional composition and utilization of Malga (Cassia sieberiana) pods in the diets of 'Yankasa sheep. A feeding trial, nutrients digestibility and carcass analysis were carried out to evaluate the growth performance of 'Yankasa rams fed graded levels of Malga pods meal, replacing cotton seed cake (CSC) at 0, 5, 10 and 15% inclusion rates in semi-arid climatic zone, using 20 growing 'Yankasa rams allocated to four treatments, replicated five times in a Completely Randomized Design (CRD). The data collected, on feed intake, liveweight gain, feed conversion ratio (FCR), nutrients intake, dry matter intake (DMI), nitrogen utilization, digestibility and carcass characteristics, were subjected to analysis of variance using SPSS (Version 20), and Least Significant Difference (LSD) was used for means separation at 5% level of significance. The results show that animals on 10% Malga pods meal diet were better compared to rams on other treatments in terms of dry matter intake, liveweight gain, nutrients digestibility, dressing %, and cost of feed per kg liveweight gain. It was concluded that Malga (Cassia sieberiana) pods meal could be used as a feed resource, replacing cotton seed cake (CSC) and could be included in the diets of sheep up to 10% level without detrimental effect on the growth performance. The pods could serve as cheaper source of protein, energy, as well as antioxidant micronutrient supplements to ruminant animals. It was recommended that more trials be carried out with different species of ruminants in order to further ascertain the true feeding value of Malga (Cassia sieberiana) pods meal on growth performance of ruminants in semi-arid environments.

Keywords: Malga, digestibility, semi-arid environment, 'Yankasa sheep.

1. INTRODUCTION

The main feed resources for small ruminants are natural pastures consisting of grasses, legumes and browse species (Mubi, 2003). The pasture depends on rainfall, which fluctuates especially in the northern part of the country where the largest percentages of the animals are raised. The scarcity of energy and protein feedstuffs during the dry season and poor production practices by peasant farmers are major setbacks to ruminant livestock production in the tropics (Adegbola, 1982). The increase in human population further worsens the situation because of the pressure placed on the available land for grazing by other agricultural and non-agricultural activities. During this period, the available forages are dry, protein content is very low and there is a marked decrease in voluntary intake and digestibility by these animals (Oyenuga, 1968 and Steinbach, 1997). The nutritional problems of ruminants have thus been increased by competition between man and his livestock for the scarce grains and the protein concentrates feed making it difficult to meet up with nutritional requirements of the animals at affordable cost. Other factors which have contributed to the increasing cost of feed are under-production of various ingredients such as energy and protein concentrates used in feed formulation and high inflation rates. The commonest protein supplements for ruminant feed in Nigeria in periods of low yield and availability of poor quality herbage are Soya-Bean Meal (SBM), Groundnut Cake (GNC), Palm Kernel Cake (PKC), and Cotton Seed Cake (CSC) (Adamu et al., 2013).

Browse plants are less subjected to seasonal variation than grasses in terms of nutrients content. Furthermore, their leaves are green at the end of the dry season, before the rains and before other forage plants appear. This occurs at a time when animals' need is maximal for feed of a high nutrient content, as they are grazing on low-quality grasses. Browse plants alone keep healthy animals in fair condition, but may be inadequate as the sole feed stuff. A mixture of several species for browsing is superior to a single species (Crowder and Chheda, 1982). Most of the plant materials are high in protein, ranging from about 10% to more than 25% on dry weight basis, and are high in most minerals except phosphorus, which may drop to 0.12%.

Problem statement

The problem of high cost of protein concentrates such as CSC, GNC, PKC and SBM (i.e. problem of protein supply and its supplements) especially during the long dry season of the year, thus making feed supplements beyond the reach of smallholder farmers in the zone, and also makes livestock production unprofitable nowadays (Rueda et al., 2003).

This consequently forces farmers to look for alternative feed resources. Pods (whole fruits, seeds plus husk) from bearing leguminous tree species are potential feed resources to improve livestock performance in dry tropical ecosystems (Mlambo et al., 2007) since they generally contain higher crude protein (>120g/Kg) and in vitro dry matter digestibility (540–800g/Kg) than grasses (Durr and Rangel, 2002; Ku, 2005). However, despite the large body of literature that exists regarding the use of pods as animal feed, little information is known about the Malga plant usage for ruminants. There is paucity of information on the utilization of Malga pods as feed for ruminants (Lack of or inadequate data and documentation about usage of Malga plant by ruminant farmers in the study area). Consequently, knowledge of the nutritional and anti-nutritional values of Malga plants on the growth performance of sheep is therefore necessary to explore its feeding potentials.

Justification of the study

Kebbi State is one of the highest ruminant producing states in Nigeria (Kebbistate.org.ng, 2019). De Leeuw and Rey (1995) reported that sheep are concentrated in the arid and semi-arid regions of Western Africa. Kebbi State as part of the semi-arid region of Nigeria is blessed with abundant livestock resources because of its climatic condition which is suitable for livestock production. Cassia sieberiana pods, which could be used as a protein supplement in ruminants' diets are in abundance and readily available in the state throughout the year at almost no cost. Malga plant (Cassia sieberiana) is a leguminous tree whose pods have been suggested as a potential feed for livestock and a possible replacement for the conventional protein sources such as CSC, SBM, PKM and GNC for ruminants. In view of this therefore, the study had examined how Cassia sieberiana (Malga) pods could effectively be utilized to an advantage and as a possible replacement to conventional protein sources such as cotton seed cake, soya-bean meal, palm kernel cake, groundnut cake, etc. for feeding ruminants so that more animal products could be obtained from given quantities of the pods than at present.

Aim and objectives of the study

The study aimed to assess the dietary effects of Malga (Cassia sieberiana) pods meal on the growth and digestibility of 'Yankasa sheep in semi-arid environment.

The specific objectives were to:

i. assess the growth performance of 'Yankasa rams fed diets containing graded levels of Malga pods meal.

ii. evaluate the nutrients digestibility of 'Yankasa sheep fed experimental diets.

iii. determine the cost of feeding 'Yankasa sheep per kg liveweight gain with the experimental diets.

2. MATERIALS AND METHODS

The study area

The study was conducted in Livestock Research Farm, Adamu Augie College of Education, Argungu, Kebbi State, Nigeria, situated between Latitudes 10° 8′N – 13° 15′ North and Longitudes 3° 30′E – 6° 02′ East (Figure 1). The state is located in the semi-arid ecological zone with a total land area of approximately 37,698km^2. The annual rainfall varies between 500mm and 750mm, with over 60% falling during July and August (Mamman et al., 2000). The mean annual temperature of about 27°C is recorded in all locations, but temperature is generally high (KARDA, 2015). The vegetation is classified as Guinea and Sudan savannah and comprises variety of trees and shrubs, which include; Cassia sieberiana, Piliostigma reticulatum, etc.

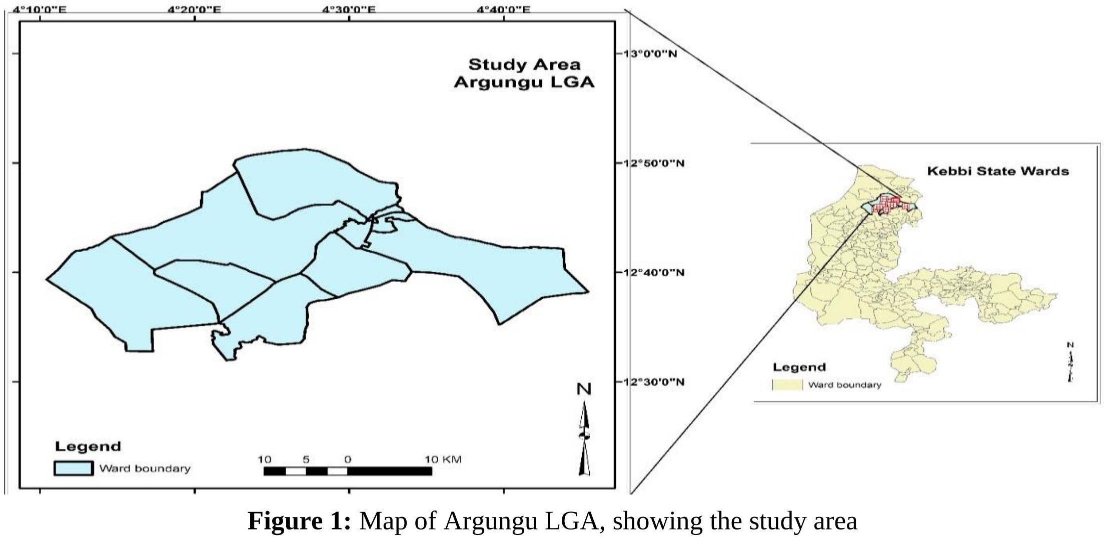

Figure 1: Map of Argungu LGA, showing the study area

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Experimental design and procedure

A feeding trial to determine performance and nutrients digestibility with 20 growing 'Yankasa rams fed diets containing graded levels of Malga pods meal as replacement for cotton seed cake (CSC) was conducted from September to December 2024.

A Completely Randomized Design (CRD) was used in this experiment as outlined by Steel and Torrie (1980). Five rams were allocated as replicates to each of the four experimental diets as treatments. The feeding trial lasted for 90 days after a 2 week adaptation period. The rams were housed in an individual pen measuring 1.5m x 1.5m. The pens were cleaned and disinfected with dettol and hydrogen peroxide solution periodically.

Diets preparation

Four experimental diets were prepared using Malga (Cassia sieberiana) pods meal as replacement for cotton seed cake (CSC) at 0%, 5%, 10% and 15% levels of inclusion and mixed with other agro-based by-products. The diets were allocated according to the treatment groups as outlined in Table 1.

Table 1: Gross composition of experimental diets

			Treatments	
Ingredient (%)	T1(0%)	T2(5%)	T3(10%)	T4(15%)
G/nut hay Malga pods meal	15 0	13 5	10 10	4 15
Cotton Seed Cake	30	25	20	15
Wheat Offal	30	30	30	30
Cowpea Husk	9	6	4	30
Rice Milling Waste	15	20	25	5
Vit./Mineral Premix Salt	0.25 0.75	0.25 0.75	0.25 0.75	0.25 0.75
Total	**100**	**100**	**100**	**100**
Calculated Chemical	**Analysis:**			
ME (kcal/kg)	2097	2004	1913	1833
CP (%)	17.2	17.3	17.4	17.8
CF (%)	23.1	22.8	22.5	22.5

Cost of feed/Kg diet was calculated.

Feed cost determination

The cost of feed (₦/Kg) was calculated progressively from the cost of individual ingredients used during feed preparations. In addition, feed cost per Kg live-weight gain was calculated by multiplying feed cost per kg by feed conversion ratio (FCR) in line with Roberts (2021).

Data collection

The following productive performance parameters were examined.

- Initial body weight of the rams
- Final body weight
- Liveweight gain / Average daily weight gain
- Feed intake/Dry matter intake
- Feed Conversion Ratio (FCR)
- Nutrient intake / Dry matter intake (DMI)
- Apparent Digestibility
- Carcass characteristics

Digestibility trial

Data on apparent nutrients retention trial were collected towards the end of experiment.

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Faeces and urine samples were collected from the animals during a 10-day digestibility trial as described by Omole et al. (2006). Each day, record of daily feed intake was kept and fresh faeces were collected three times (i.e. morning, afternoon and evening) with the aid of digestibility (harness) bags attached to the animals. The faecal samples were oven-dried at 105°C until a constant weight was obtained to determine dry matter content (%DM); and 5% was taken from each group for laboratory analysis. Determination of dry matter, apparent digestibility, nutrients intake and protein efficiency were done according the procedures of Williamson and Payne (1978).

$$\% \text{ Dry Matter (DM)} = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100$$

$$\text{Digestibility} = \frac{\text{Nutrient intake} - \text{Nutrient voided}}{\text{Nutrient intake}} \times 100$$

Nutrient intake = Nutrient in feed x DM intake

$$\text{Protein efficiency} = \frac{\text{Average daily gain (ADG)}}{\text{CP intake}}$$

Determination of carcass characteristics

At the end of the feeding trial, two (2) sheep from each treatment group were randomly selected and slaughtered. Pre-slaughter liveweight of the rams was recorded immediately with a spring balance before slaughter. Carcass (dressed carcass) weight (in kg) and weight of non-carcass components; such as head, legs/feet and skin were measured. The visceral organs (liver, lung, kidney, trachea, heart and spleen), and abdominal fat removed from the omenta and mesentery fat were measured with electronic balance and recorded shortly after slaughter. Fresh carcasses were separated from bones and various organs were measured with electronic (digital) balance. Dressing percentage (%) was calculated as described by Banerjee (1998).

Dressing percentage (%) = Carcass weight divided by liveweight x 100

3. RESULTS AND DISCUSSION

Growth performance of 'Yankasa rams fed diets containing graded levels of Malga pods meal

The result for the performance characteristics of experimental animals is presented in Table 2. The values for the liveweight gain (11.87–13.00kg/ram) obtained in this study showed a significant ($P<0.05$) variation across the treatments; with treatments 2 and 3 having the highest values and the least weight gain was recorded in treatment 1 (11.87kg/ram). However, the results for liveweight changes among the treatments did not follow the level of Malga (Cassia sieberiana) pods meal inclusion in the diets. Similarly, the results of the average daily gain (ADG) followed a similar trend, with the least average daily gain recorded in treatment 1 (118.70g/day) and highest values observed in treatments 2 (130.0g/day) and 3 (129.30g/day) respectively. These values were better than 53g/day/ram reported by Abil et al. (1992) when they replaced CSC and maize with wheat bran in the diet of sheep. Adu and Brickman (1985) also reported an ADG of 65g/day when he replaced maize with brewer's dried grains in the diets of growing sheep, which is less than the ADG values obtained in this trial. Treatments 2 and 3 with the highest liveweight gain also recorded the highest average daily gain (ADG) than treatments 1 and 4. This implies that the lowest average daily weight gain (ADG) of the control diet relative to diets containing Malga pods meal was attributable to the lowest feed intake of the rams on that diet. The values for treatments 2 and 3 were similar ($P>0.05$) in the present study. The mean daily feed intake was lowest ($P<0.05$) for rams on the control group - treatment 1 (890g). But feed intake values for treatments 2, 3 and 4 (containing graded levels of Malga pods meal) were statistically ($P>0.05$) similar but higher ($P<0.05$) than the value recorded in the control diet. TFI decreased with increasing level of Malga pods meal in the diets and vice-versa.

The feed conversion ratio (FCR) values (6.53 – 7.52) were significantly affected ($P<0.05$) by the dietary treatments. Rams fed control diet had the better FCR value than those fed Malga (Cassia sieberiana) pods meal. The FCR values obtained were comparable to the values (5.10 – 8.94) reported by Mainasara (2022) but were lower than the values (8.12 – 12.51) reported by Aruwayo et al. (2008) on growing sheep in Sokoto. This results reveal the ability of animals on diet 1 (control) to convert the feed consumed to weight gain better than those fed with Malga (T2, T3 and T4); which might be attributed to the fact that Malga pods were found to contain some traces of phyto-chemicals in them, which could limit nutrients digestibility but could however be removed through proper processing.

The total dry matter intake (TDMI) recorded (77.49 – 95.16kg/ram) among the treatments were significantly ($P<0.05$) affected by the inclusion rate of Malga pods meal in the diets. The highest DM intake was recorded in treatment 2

(95.16kg/ram) and the lowest DM intake was observed in treatment 1 (77.49kg/ram). The DM intake decreased as the level of Malga inclusion in the diets increases. The decrease in the dry matter intake in the control diet might be attributed to the substitution effect of Malga pods meal, indicating increased palatability to the rams. The increase in the DM intake in treatments 2 to 4 could be as a result of the inclusion of Malga pods meal in the diets, which was in agreement with the report of Abdurrahman et al. (2015) that the pods and leaves of browse plants are highly consumed by small ruminants during the dry season. The DM intake as percentage of body weight gain was not significantly (P>0.05) affected by the inclusion level of Malga pods meal in the diets; but followed a similar trend accordingly. However, the values obtained for treatments 2, 3 and 4 (those with Malga) were numerically higher than the value observed in the control group.

Table 2: Performance characteristics of 'Yankasa rams fed experimental diets

		Malga pods meal			
Growth performance	1 (0%)	2 (5%)	3 (10%)	4 (15%)	SEM
Initial Body. Wt. (kg)	17.33	20.67	19.33	20.17	1.37
Final Body. Wt. (kg)	29.20	33.67	32.27	32.17	2.24
Weight Gain (kg/ram)	11.87^{b}	13.00^{a}	12.93^{a}	12.00^{ab}	0.96
Av. Daily Gain (g/day)	118.70^{b}	130.00^{a}	129.30^{a}	120.00^{b}	6.98
Mean Daily Feed Intake (g/day/ram)	890^{b}	1,080^{a}	1,040^{a}	1,030^{a}	60.00
Total Feed Intake (kg/ram)	88.49^{c}	107.52^{a}	103.42^{b}	102.40^{b}	3.42
Feed Conversion Ratio	6.53^{b}	7.32^{a}	7.00^{a}	7.52^{a}	0.42
Total Dry Matter Intake (kg/ram)	77.49^{b}	95.16^{a}	90.57^{ab}	90.23^{ab}	0.05
Dry Matter Intake as % Body Weight	2.65	2.83	2.81	2.80	0.53

a,b,c Means in the same row with different superscripts are significantly (P<0.05) different.

Nutrients intake by 'Yankasa rams fed experimental diets

The results of nutrients intake by growing 'Yankasa rams fed diets containing varying levels of Malga (Cassia sieberiana) pods meal is presented in Table 3. The dry matter (DM) intake (87.57 – 88.51g/day) values in the present study were statistically (P>0.05) similar. The crude protein (CP) intake, which ranged from 108.20g/d in treatment 2 to 153.66g/d in treatment 4, was significantly affected by the dietary treatments. The values obtained (0.78 - 1.20) in the protein efficiency were significantly (P<0.05) different among treatment means. The highest value was obtained in treatment 2 (1.20) and the least was recorded in treatment 4 (0.78). The crude fiber (CF) intake values, which ranged from 193.80 to 255.86g/d, were significantly (P<0.05) different among the treatments. The highest CF intake was recorded in treatment 4 while the lowest CF intake was obtained in control diet. The CF intake values generally increased with increasing Malga pods meal inclusion in the diets. The values obtained for ether extract (EE) and nitrogen free extract (NFE) show that treatment 2 had the highest EE value (382.50g/d) and NFE (362.21g/d); while the lowest EE (187.68g/d) and NFE (249.13g/d) values were recorded in treatment 4. Both the EE and NFE intakes decreased with increasing Malga pods inclusion in the diets. There was significant (P<0.05) variation among the treatments in the values obtained for ash intake. The highest value (108.10g/d) was obtained in treatment 2, while the lowest value (77.88g/d) was recorded in treatment 1. The ash values for treatments 3 and 4 were statistically similar (P>0.05) among their means. The values for neutral detergent fiber (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were significantly (P<0.05) affected by the rate of Malga pods meal inclusion in the diets. Rams fed 20% Malga diet (T3) had the highest NDF (579.74g/d) and ADF (264.35g/d) intake, respectively. The NDF, ADF and ADL intake in this experiment did not follow a definite trend. The ADL intake values obtained here ranged from 148.78g/d in the control group to 343.53g/d in rams fed 10% Malga (T2 diet). The values obtained for crude protein (108.20 -153.66g/d), protein efficiency (0.78 - 1.20) and crude fibre (193.8-255.9g/d) in the present study were comparable to the values reported by Muftau (2017). The values obtained for EE, Ash, NDF and ADL intakes in this trial were all higher than those reported by Muftau et al. (2018); except for ADF intake, which was similar and NFE intake value that was comparable to the earlier work of Muftau et al. (2018). The disparity in values may be due to differences in nutrient contents of diets and age of the animals. Results reported by Muftau (2017) were obtained when Uda rams were fed Kalgo pods meal, which have lower CP content (8.01%) compared to Malga pods meal (9.81% CP).

Table 3: Nutrients intake by 'Yankasa rams fed experimental diets

		Malga pods meal			
Nutrient intake (g/d)	1 (0%)	2 (5%)	3 (10%)	4 (15%)	SEM
Dry Matter Intake	87.57	88.51	88.12	87.58	1.36^{ns}
Crude Protein Intake	131.20^{b}	108.49^{c}	138.03^{b}	153.66^{a}	11.35
Protein Efficiency	0.90^{b}	1.20^{a}	0.94^{b}	0.78^{c}	0.20
Crude Fiber Intake	193.80^{d}	212.68^{c}	237.49^{b}	255.86^{a}	5.86
Ether Extract Intake	268.12^{b}	382.50^{a}	359.56^{a}	187.68^{c}	8.65
Nitrogen Free Extract	214.10^{c}	326.21^{a}	252.42^{b}	249.13^{b}	7.84
Ash Intake	77.88^{c}	108.10^{a}	89.78^{b}	85.59^{b}	6.14
Neutral Deter. Fiber	400.62^{c}	569.53^{ab}	579.74^{a}	522.79^{a}	9.21
Acid Detergent Fiber	251.84^{ab}	226.0^{b}	264.35^{a}	258.96^{a}	10.47
Acid Detergent Lignin	148.78^{c}	343.53^{a}	333.30^{ab}	263.92^{ab}	7.87

a,b,c Means in the same row with different superscripts are significantly (P<0.05) different.

Apparent nutrients retention

Table 4 shows the results for nutrients digestibility of growing 'Yankasa rams fed diets containing graded levels of Malga pods meal. The results indicated non-significant (P>0.05) differences across the treatments in some of the parameters measured; such as DM, NDF, ADF and ADL. The dry matter (DM) digestibility values ranged from 85.50% in treatment 1 to 86.44% in treatment 4. The crude protein (CP) digestibility ranged from 74.41% in Treatment 4 to 80.04% in Treatment 1. The CP digestibility in this trial decreased with increasing Malga pods meal in the diets; while the DM digestibility did not follow a definite trend accordingly. Ether extract (EE) digestibility result reveals that the digestibility of this nutrient decreased as the level of Malga pods meal inclusion in the diets increases; while the values (61.52 – 77.83%) obtained for crude fibre (CF) digestibility did not follow a definite pattern. The CF digestibility results indicate a highest value (P<0.05) in Treatment 3 (77.83%) and lowest value was recorded in Treatment 1 (61.52%). There were significant (P<0.05) differences for ash digestibility (which ranged from 53.67% in treatment 1 to 70.06% in treatment 4) among the diets. The ash and nitrogen free extract (NFE) digestibility increased as the inclusion level of Malga pods meal in the diets increases. The result of the nitrogen free extract (NFE) digestibility (59.50 - 66.18%). The highest NFE value was obtained in treatment 4 (66.18%) while the lowest value was recorded in treatment 2 (59.50%). However, there was no significant difference (P>0.05) between the treatments (T1, T2, T3 and T4) for Neutral Detergent Fiber, Acid Detergent Fiber and Acid Detergent Lignin retention in the animals' bodies in this trial. The results of the digestibility from this study reflect a higher degree of utilization as a result of the inclusion level of Malga pods meal in the diets.

Table 4: Nutrients digestibility of 'Yankasa rams fed graded levels of Malga pods meal

	Malga pods meal				
Digestibility (%)	1 (0%)	2 (5%)	3 (10%)	4 (15%)	SEM
Dry Matter	85.50	86.33	86.25	86.44	1.66^{ns}
Crude Protein	80.04^{a}	79.77^{a}	76.49^{b}	74.41^{b}	2.76
Ether Extract	62.76^{b}	75.17^{a}	66.50^{b}	58.70^{c}	1.68
Crude Fiber	61.52^{c}	66.71^{b}	77.83^{a}	75.60^{a}	2.24
Ash	53.67^{c}	62.97^{b}	67.84^{a}	70.06^{a}	2.13
Nitrogen Free Extract	61.86^{b}	59.50^{b}	64.62^{a}	66.18^{a}	3.02
Neutral Deter. Fiber	60.01	59.12	59.03	58.97	2.13^{ns}
Acid Detergent Fiber	28.25	27.26	27.15	26.98	2.32^{ns}
Acid Detergent Lignin	31.76	31.86	31.88	31.99	0.69^{ns}

a,b,c Means in the same row with different superscripts are significantly (P<0.05) different.

ns means not significant.

Carcass characteristics of 'Yankasa rams fed graded levels of Malga pods meal

Table 5 summarizes the results of carcass characteristics of 'Yankasa rams fed graded levels of Malga pods meal. The average values for pre-slaughter liveweight and carcass weight in % to liveweight for all the treatment groups were not significantly (P>0.05) affected by changes in the level of Malga pods meal inclusion in the diets. The differences observed, in carcass or dress weight, were only numeric but the values recorded were higher than the values (5.68 – 6.68kg) reported by Olayode et al. (2014) in their research on WAD sheep. This variation in carcass weight may be attributed to breed and age differences of the animals. Similarly, the values obtained for rack weight, shoulder weight, liver weight in % to dress weight and large intestine length were also not significantly (P>0.05) different among all the treatment groups. However, the animals in control group (T1) had significantly (P<0.05) lower values for skin weight (2.50kg) and neck weight (14.55kg) than rams in other experimental groups (T2, T3 and T4). The measurements for small intestine weight, lungs, kidney and heart weight were significantly (P<0.05) affected by different inclusion levels of Malga pods meal in the experimental diets with control group (T1) rams having the highest values (15.76g, 3.64g, 1.65g and 1.68g) respectively compared to those in T2, T3 and T4 groups. Rams fed T3 diet had significantly (P<0.05) higher head and leg weight (0.475kg and 0.376kg) as well as large intestine weight (9.64g) than those in other treatment groups (T1, T2 and T4). Higher (P<0.05) dressing percentage value (49.05%) was recorded for rams in T2 group, closely followed by those in control group (47.62%) compared to those in T3 (45.50%) and T4 (45.65%) treatment groups.

Table 5: Carcass characteristics of 'Yankasa rams fed graded levels of Malga pods meal

		Malga pods meal			
Parameters	1 (0%)	2 (5%)	3 (10%)	4 (15%)	SEM
Carcass characteristics:					
Pre-slaughter wt. (kg)	21.00	21.00	22.00	23.00	0.48
Dressing %	47.62^{a}	49.05^{a}	45.50^{b}	45.65^{b}	0.62
Blood qty. (litres)	1.70	1.80	1.80	2.00	0.06
Skin wt. (kg)	2.50^{b}	2.90^{a}	2.60^{b}	2.90^{a}	0.10
Carcass wt. (kg)	10.25	10.30	10.00	10.50	0.10
Carcass length (cm)	54.30^{b}	60.00^{a}	53.00^{b}	58.00^{a}	1.62
Carcass height (cm)	28.00^{b}	26.00^{c}	28.70^{b}	31.00^{a}	1.03
Carcass Proportion:					
Neck (g)	14.55^{c}	19.28^{b}	18.75^{b}	22.35^{a}	1.60
Rack (g)	21.82	22.89	22.50	22.35	0.22
Loin (g)	12.12^{b}	12.05^{b}	13.75^{ab}	14.12^{a}	0.54
Shoulder (g)	20.61	21.69	21.25	22.35	0.37
Flank (g)	3.64^{b}	3.61^{b}	5.00^{a}	2.35^{c}	0.54
Head (kg)	0.452	0.437	0.475	0.465	0.82
Legs (kg)	0.35^{b}	0.33^{b}	0.38^{a}	0.38^{a}	1.09
Head & Legs	0.80^{b}	0.77^{b}	0.85^{a}	0.84^{a}	0.47
Non-carcass Components:					
Gut contents (kg)	8.73^{b}	9.39^{ab}	8.75^{b}	9.65^{a}	2.32
Omentum (g)	0.73^{a}	0.60^{a}	0.47^{b}	0.35^{b}	0.08
Reticulum (g)	2.20^{a}	1.66^{b}	1.75^{b}	1.82^{b}	0.12
Omasum (g)	1.16^{ab}	0.92^{b}	0.70^{c}	1.28^{a}	0.13
Abomasum (g)	1.99^{b}	2.25^{a}	1.91^{b}	1.92^{b}	0.08
Small intestine length (m)	20.90^{b}	16.11^{c}	22.67^{b}	25.16^{a}	1.91
Small intestine wt. (g)	15.76^{a}	13.25^{b}	13.75^{b}	12.35^{b}	0.72

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Large intestine length (m)	6.24	6.00	6.49	7.13	0.24
Large intestine wt. (g)	8.48^{b}	7.50^{bc}	9.64^{a}	5.88^{c}	0.80
Liver (g)	4.54	4.05	4.27	4.84	0.17
Kidney (g)	1.65^{a}	1.47^{b}	1.32^{c}	1.37^{b}	0.07
Heart (g)	1.68^{a}	1.12^{b}	1.27^{b}	1.33^{b}	0.12
Spleen (g)	1.16^{a}	0.33^{c}	0.71^{b}	0.88^{b}	0.17
Lungs (g)	3.64^{a}	3.26^{b}	2.57^{c}	3.00^{b}	0.22
Trachea (g)	1.28^{b}	0.92^{c}	1.37^{a}	1.21^{b}	0.10

a,b,c Means in the same row with different superscripts are significantly ($P<0.05$) different.

Feed cost per kg liveweight

Table 6 presents the cost of feed per kg liveweight of the growing 'Yankasa rams fed diets containing graded levels of Malga pods meal. The cost of feed per kg of diets was highest (₦140.14) in the control diet than in other diets (T2, T3 and T4). The least cost of feed (₦117.23) per kg diet was obtained in T4 diet (15% Malga pods meal). This cost decreased as the inclusion level of Malga pods meal increases.

This finding was in line with the observations of Suleiman et al. (2014) that the cost/kg decreased as the inclusion levels of Daniellia oliveri leaf meal increased in the diets of Savanna brown goats. Similar trend was observed in the cost of feed per live-weight gain.

The cost of feeds consumed (₦) per ram per day were similar between treatments. The highest cost of feed per kg liveweight gain (₦2,089) was recorded in T1 (Control) diet and the least cost of feed per kg liveweight gain (₦1,887) was recorded in T3 diet (10% Malga) and therefore resulted into the highest savings (10%) realized and least savings was observed in T4 diet (3.2%) in relation to the control diet; implying that a combination of Malga pods meal and CSC in the diets of growing sheep tends to be more economical than diets containing only CSC or Malga pods meal as a sole protein supplement.

This shows that, it is more cost-effective to mix Malga pods meal, even at 5% with a given quantity of a conventional protein supplement in formulating diets for small ruminants in this ecological zone. However, for best economic returns, the inclusion rate should not be beyond 15%.

Table 6: Cost of feed per kg liveweight of 'Yankasa rams fed graded levels of Malga pods meal

	Malga pods meal			
Parameters	1 (0%)	2 (5%)	3 (10%)	4 (15%)
Cost of feed (₦/kg)	140.14	121.02	119.06	117.23
Cost of feed consumed/day/ ram (₦)	248.05	260.19	244.07	242.67
Cost of feed/kg weight gain (₦/kg)	2,089	2,001	1,887	2,022
% Feed cost savings/kg gain	-	4.21	9.67	3.21

4. CONCLUSION

Based on the major findings of this study, the following conclusions were made:

Rams on 5 - 10% Malga pods meal diets (T2 and T3) were better compared to other treatments (T1 and T4) in terms of dry matter intake, liveweight gain, nutrients digestibility, and feed cost per kg liveweight, it could be concluded that supplementation with Malga pods meal from 5 – 10% levels of inclusion in sheep diets were satisfactory for growth performance of 'Yankasa sheep in this ecological zone; and therefore Malga (Cassia sieberiana) pods meal could be used as a potential replacement for the conventional protein supplements, such as CSC, GNC, PKM, SBM and CCM in sheep diets especially during the dry season.

5. RECOMMENDATIONS

i. Further studies should focus on the sensory characteristics of meat by conducting meat quality analysis.

ii. More trials should be carried out with different breeds of sheep or other ruminant species and or in different agro-ecological zones in order to further ascertain the true feeding value of Malga (Cassia sieberiana) pods meal on growth performance of sheep in semi-arid environments.

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