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Full Length Research Paper

Water Intake and Influence of Ambient Temperature on Carcass Characteristics of Savannah Brown Goats Fed Graded Levels of Maize Cob Diets Supplemented With Cowpea Husk

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This study investigated water intake and influence of ambient temperature on carcass characteristics of Savannah Brown goats fed graded levels of maize cob diets. A total of sixteen (16) Savannah Brown goats aged between 8-12 weeks with an average body weight of 10.19 ± 0.19 kg were used. The goats were randomly allotted to four (4) dietary treatments. T₁ (0 % maize cob diet), T₂ (10 % maize cob diet), T₃ (20 % maize cob diet) and T₄ (30 % maize cob diet) respectively. The goats were also fed cowpea husk as supplement. A complete randomized design was used. Each treatment was allotted four (4) goats and replicated twice with two (2) goats per replicate. The goats were kept under feedlot management and were allowed 7 days adjustment period during which the animals were dewormed using albendazole and treated with antibiotics against any sign of disease(s). The goats were each offered 500g of experimental diet between 7.00am-8.00am daily and the supplement was given to them between 4.00pm-5.00pm daily. The goats were offered three (3) litters of water daily without restriction. The experiment lasted for nine (9) weeks. Two (2) goats were randomly selected from each treatment and slaughtered for carcass characteristic and sensory evaluation. The result showed that ambient temperature had significant ($P < 0.05$) correlations with water intake and feed intake among the treatment groups. The result on carcass characteristics showed significant ($P < 0.05$) differences between all the treatment groups. The goats fed 20 % maize cob performed significantly ($P < 0.05$) better in most carcass cuts than those fed 0 % inclusion level. Also, the result on sensory evaluation showed that colour, tenderness, juiciness and flavor for both cooked and fried meat were significantly ($P < 0.05$) different among all the treatment groups. It can be concluded that 20 % inclusion of maize cob in the diet of Savanna Brown goats improved yield and water intake compare to the animals on the other treatments. Therefore, inclusion of maize cob into the diet of Savanna Brown goats up to 20 % is here by recommended.

Keywords: Water intake, ambient temperature, Savannah brown goats, Carcass

INTRODUCTION

Indigenous goats in Nigeria belong to three distinct breeds. The long-legged Sahel goat, Savanna Brown goat and

West African Dwarf (Osinowo, 1992). Nigeria has 52.4 million goats and 33 million sheep (FMAWR, 2008). Goat

meat is widely eaten throughout the world; it provides milk, hair, leather and other products (Hamayun *et al.*, 2006). Goat meat is characteristically lean, thus rich in nutrient that could attract health conscious consumers. However, the product can vary according to gender, age, genotype, and nutrition (Okeudo and Moss, 2005). Preferences and consumption patterns for goat meat are dictated by cultural, traditional and religious background and the socio economic status of the community. Meat and meat products have continued to claim their share of food value because of their acceptable sensory characteristics. Also, meat palatability depends on factors such as colour, texture, flavour, tenderness and general acceptability.

Inadequate nutrition has been the major factor limiting the expansion of animal production in Nigeria. To rescue this nutritional problem, there is need for utilization of other cheap and indigenous source of protein and energy particularly those that attract no competition from man (Oyenuga, 1999). The use of crop residues for ruminants animals such as goat was suggested. This is because these animals can use fibrous feed to generate nutrients for their maintenance and some level of production (Balogun *et al.*, 2003). Water is required for life (Beede, 2012). Water is already scarce for more than a billion people on the planet. If urgent measures are not adopted, one-third of the population may be without suitable water for consumption by 2025 (UNESCO, 2006). This possibility of water shortage also affects livestock, and therefore all procedures involving water use in animal production must be reviewed (Gherman *et al.*, 2010).

High environmental temperatures and humidity are detrimental to the productivity of livestock. Exposure to high temperatures also affects water use (NRC, 2007).

Feedstuffs which are derived from crop processing after harvest such as Maize cob and Cowpea husk can substantially reduce the cost of feed as this will give hope for feeding millions of Nigerians and safe guard their food security (Makkar, 2002).

The aim of this work is to investigate water intake and influence of ambient temperature on carcass characteristics of Savannah Brown goats fed graded levels of maize cob diets.

MATERIALS AND METHODS

Sixteen (16) Savannah Brown goats aged between 8 to 12 weeks with an average body weight of 10.19 ± 0.19 kg were used for the experiment. The animals were randomly allotted to 4 dietary treatments with each treatment having 2 replicates with 2 goats per replicate. Goats in Treatment 1 (control) were fed 0 % maize cob, Treatment 2 were fed

10 % maize cob, Treatment 3 were fed 20 % maize cob while Treatment 4 were fed 30 % maize cob. The goats were sourced from Beji market near Minna, Niger State, Nigeria. The experiment was carried out at the Teaching and Research Farm of the Department of Animal Production, Federal University of Technology, Minna, Niger State, Nigeria. The goats were fed 500g each of the experimental diet at 7am-8am daily while the supplementary feed was offered at 4pm-5pm. Three (3) liters of water was offered to each goat daily. Ambient temperature was measured between 12am-2pm daily with a suitable thermometer hanged inside the goat's pen. Feed intake and water intake were measured daily. The experimental design used was complete randomized design. At the end of experimental period, two goats were randomly selected from each of the treatments and were slaughtered after the goats were fasted for 12 hours. The goats were slaughtered by severing their jugular veins and allowed to bleed for 5 minutes after which their carcasses were weighed. The skin was removed (eviscerated) and the carcass was cut into various parts, weighed and expressed as percentage of their live weights. The meat from each animal was divided into two parts, the first part was cooked with 1 gram of salt added to water and cooked for 30 minutes while the other part was cooked for 30 minutes and then fried for 5 minutes using vegetable oil. Eighteen (18) untrained panelists were used for sensory evaluation to determine the color, tenderness, juiciness, flavour and overall acceptability of the goat meats.

Data collected were subjected to analysis of variance (ANOVA) and significant means were separated by Duncan multiple rang test, using a Statistical Package for Social Science SPSS version 17 (2008).

RESULTS

Table 2 showed the proximate composition and energy levels of maize cob, cowpea husk, and the experimental diets fed to Savannah Brown goats. The dry matter of maize cob (97.0 %) was higher than that of cowpea husk (95.4 %). The crude protein was higher in cowpea husk (12.97 %) than in maize cob (6.52 %). The crude fiber, ether extract and ash were higher in cowpea husk (33.40 %, 7.0 % and 10.70 %) respectively compared to (20.0 %, 0.21 % and 1.67 %) respectively in maize cob. However, Nitrogen Free Extract and metabolizable energy were both higher in maize cob (68.59 % and 3023.7 kcal/kg) than those of cowpea husk (41.63 % and 2812.8 kcal/kg) respectively. The dry matter values of the experimental diets ranged from 86.25 % to 87.40 %. The percentage crude protein decreases as the level of maize cob increases. The highest crude protein value of 16.35 % was recorded for T_1 and lowest value (14.60 %) was obtained by T_4 . The crude fiber on the other hand increases as the level of maize cob increased from 6.27 % in T_1 to 15.98 %

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Table 1. Composition of the experimental diets fed to Savannah brown goats

INGREDIENTS	TREATMENTS			
	T ₁	T ₂	T ₃	T ₄
Maize cob	-	10	20	30
Maize offal	67	57	47	37
Maize	24	24	24	24
Groundnut cake	8.0	8.0	8.0	8.0
Vitamin premix	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Total	100	100	100	100
Calculated				
% Crude Protein	13.37	12.92	12.47	12.03
Metabolizable energy				
(ME) (kcal/kg)	2710.40	2490.60	2270.90	2051.10
T ₁ -	Control (0% maize cob diet)		T ₂ -	10% maize cob diet
T ₃ -	20% maize cob diet		T ₄ -	30% maize cob diet

Table 2. Proximate composition and energy levels of maize cob, cowpea husk and experimental diets fed to Savannah Brown goats

Nutrients (%)	Treatments					
	T ₁	T ₂	T ₃	T ₄	maize cob	cowpea husk
Dry matter	86.25	87.40	87.15	87.10	97.0	95.49
Crude protein	16.35	15.09	14.80	14.60	6.52	12.97
Crude fiber	6.27	13.20	15.76	15.98	20.00	33.40
Ether extract	19.08	13.52	15.11	13.71	0.21	7.0
Ash	4.64	4.50	3.94	4.08	1.67	10.70
NFE	39.91	41.09	37.54	38.73	68.59	41.63
ME (Kcal/kg)	3967.6	3464.0	3453.5	3367.1	3023.7	2812.8
T ₁ -	Control (0% maize cob diet)					
T ₂ -	10% maize cob diet					
T ₃ -	20% maize cob diet					
T ₄ -	30% maize cob diet					
NFE-	Nitrogen free extract					
ME -	metabolizable energy					

Table 3. Water intake, evaporatory water loss and mean ambient temperature of Savannah Brown goats fed graded levels of maize cob diets supplemented with cowpea husk

PARAMETERS	TREATMENT				LS
	T ₁ (0 %)	T ₂ (10 %)	T ₃ (20 %)	T ₄ (30 %)	
AVWI (L)	53.50 ± 1.95	59.09 ± 5.81	53.93 ± 1.65	51.53 ± 2.23	NS
TEWL (L)	6.50 ± 0.0	6.50 ± 0.0	6.50 ± 0.0	6.50 ± 0.0	NS
ADWI (L/day)	0.85 ± 0.03	0.94 ± 0.09	0.86 ± 0.02	0.82 ± 0.04	NS
RWIFI(L/kg)	2.81:1	3.26:1	2.86:1	2.95:1	NS
MAT (°C)	34.7 ± 0.78	34.7 ± 0.78	34.7 ± 0.78	34.7 ± 0.78	NS

abc = Means with different superscript on the same row are significantly different (P<0.05)

LS = level of significances *Significant difference (P<0.05) ± Standard Error of Mean

AVWI = Average Water intake

TEWL = Total evaporatory water loss

ADWI = Average daily water intake

RWIFI = Ratio of water intake to feed intake

MAT = Mean ambient temperature

Table 4. Performance Characteristics of Savannah Brown Goats Fed Graded levels of Maize cob diets supplemented with Beans Husk

PARAMETERS	TREATMENTS				LS
	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	
Initial Body weight (kg)	10.38 ± 1.03	10.0 ± 1.22	10.38 ± 0.38	10.0 ± 1.15	NS
Final Body weight (kg)	12.88 ± 0.97	13.50 ± 1.24	14.88 ± 0.47	13.0 ± 1.17	NS
Body weight gain (kg)	2.5 ^c ± 0.20	3.5 ^b ± 0.96	4.5 ^a ± 0.54	2.0 ^c ± 0.20	*
Feed intake (kg)	19.11 ± 0.62	18.05 ± 0.81	19.00 ± 1.11	17.56 ± 0.51	NS
Feed Conversion Ratio	7.77 ^a ± 0.51	5.20 ^b ± 0.34	4.24 ^b ± 0.29	9.85 ^a ± 0.17	*

abc= Means with different superscript on the same row are significantly different (P<0.05)

LS= Level of significance *Significant difference ± Standard Error of Mean

in T₄. The values of ether extract ranges from 13.52 % to 19.08 % in T₂ and T₁ respectively. The Nitrogen Free Extract was also highest (41.09 %) in T₂ and lowest (37.73 %) in T₃. The metabolizable energy was found to have decrease as the level of maize cob increases in the diets. The highest value of 3967.60 kcal/kg and the lowest was 3367.10 kcal/kg were obtained in diets T₁ and T₄ respectively. Table 3 showed the water intake, evaporatory water loss and mean ambient temperature treatment period of Savannah Brown goat fed graded level of maize

cob diet. Although, the result showed no significantly (P>0.05) difference among all the parameters measured, it was observed that as the level of inclusion increases, the average daily water intake decreases. Table 4 shows the Performance Characteristics of Savannah Brown Goats Fed Graded levels of Maize cob diets supplemented with Beans Husk. The results showed that animals fed 20 % maize cob had significant better performance in body weight gain over control group. Similarly, feed conversion ratio values showed that animals fed 20 % maize cob were

Table 5. Correlation coefficients of feed intake, water intake, ambient temperature and other parameters of Savannah Brown goats fed graded levels of maize cob diets supplemented with cowpea husk

PARAMETERS	TREATMENTS			
	T ₁	T ₂	T ₃	T ₄
Feed intake and FCR	-0.370	0.590	-0.019	-0.092
Feed intake and water intake	0.827**	0.925**	0.893**	0.900**
Feed intake and ambient temperature	0.927**	0.947**	0.972**	0.948**
Water intake and FCR	-0.351	0.447	-0.079	-0.137
Water intake and ambient temperature	0.901**	0.931**	0.915**	0.885**
Ambient temperature and water loss	0.868**	0.868**	0.868**	0.868**

*correlation is significant at the (P<0.05) **correlation is significant at the (P<0.01)

T₁- Control (0 % maize cob diet),

T₂- 10 % maize cob diet,

T₃ - 20 % maize cob diet

T₄ - 30 maize cob diet

Table 6. Carcass characteristics of Savanna brown goats fed graded levels of maize cob diets supplemented with cowpea husk.

Parameter (expressed as % live weights)	T ₁ (0%)	T ₂ (10%)	T ₃ (20%)	T ₄ (30%)	LS
weight of carcass (g)	57.92 ^b ±1.14	57.95 ^b ±3.85	68.73 ^a ±0.73	44.55 ^c ±1.35	*
weight of fore limbs	16.86 ^a ±0.08	17.09 ^a ±0.90	18.60 ^a ±0.03	11.21 ^b ±0.21	*
Weight of hind limb	17.83 ^b ±0.06	17.88 ^b ±0.92	21.12 ^a ±0.03	15.02 ^c ±0.12	*
weight of neck	4.31 ^{ab} ±0.42	4.40 ^{ab} ±0.59	6.04 ^a ±0.32	3.89 ^b ±0.39	*
weight of backbone	7.56±0.33	8.31±0.69	8.09±0.28	6.72±0.32	NS
weight of ribs	5.67 ^b ±0.12	6.21 ^b ±0.39	9.07 ^a ±0.02	4.53 ^c ±0.13	*
weight of loin	5.67 ^a ±0.12	4.15 ^b ±0.35	5.81 ^a ±0.09	3.17 ^c ±0.17	*
weight of skin	6.75 ^a ±0.09	6.40 ^a ±0.40	5.35 ^b ±0.11	3.65 ^c ±0.15	*
weight of forelegs	1.68 ^{bc} ±0.09	2.39 ^a ±0.11	1.95 ^b ±0.04	1.42 ^c ±0.08	*
weight of hind legs	2.37 ^b ±0.15	2.49 ^b ±0.11	3.02 ^a ±0.16	1.66 ^c ±0.06	*

abc -means on the same row bearing different superscript are significantly different (P<0.05)

LS- Level of significant *- significantly different (P<0.05)

NS-non significantly (P>0.05) difference ±- SEM

significantly better than other groups. Table 5 shows the correlation coefficient of feed intake, water intake and feed conversion ratio of Savannah Brown goats fed graded

levels of maize cob diets supplement with cowpea husk. There is generally high significant (P< 0.01) correlation between feed intake and water intake and between feed

Table 7. visceral organs of Savannah Brown goats fed graded levels of maize cob supplemented with cowpea husk

Parameters (expressed as % live weight)	T ₁ (0%)	T ₂ (10%)	T ₃ (20%)	T ₄ (30%)	LS
Weight of liver	1.46 ^{bc} ±0.01	1.81 ^a ±0.09	1.63 ^{ab} ±0.01	1.41 ^c ±0.01	*
Weight of heart	0.59 ^a ±0.03	0.64 ^a ±0.06	0.65 ^a ±0.03	0.41 ^b ±0.01	*
Weight of GIT	12.43 ^b ±0.02	20.08 ^a ±0.98	21.86 ^a ±0.04	13.13 ^a ±0.17	*
Weight of kidney	0.35 ^{ab} ±0.02	0.37 ^a ±0.02	0.35 ^{ab} ±0.03	0.27 ^b ±0.03	*
Weight of lungs	1.58 ^a ±0.06	1.51 ^a ±0.01	1.23 ^b ±0.05	0.95 ^c ±0.09	*
Weight of spleen	0.16±0.05	0.21±0.01	0.32±0.04	0.37±0.08	NS

abc - means on the same row bearing different superscript are significantly different (p<0.05)

LS - Level of Significant * - significantly different (p<0.05)

NS -non significantly (p<0.05) difference

intake and ambient temperature. However, goats fed 10 % of maize cob had feed intake most correlated to water intake (0.925) and ambient temperature (0.947). Similarly, goats fed 10 % of maize cob recorded the highest significant P< 0.01) value (0.931) between water intake and ambient temperature. Table 6 shows the carcass characteristics of Savannah Brown goats fed graded levels of maize cob diet supplemented with cowpea husk. The result showed significant differences in favour of goats fed 10 and 20 % of maize cob over the control animals in weight of carcass, weight of hind limb, weight of ribs and weight of hind legs. It was also revealed that as maize cob increases from 10 % to 20 %, the values of those parameters mentioned above increases. Table 7 showed the visceral organs of Savannah Brown goats fed graded levels of maize cob diets. The weight of the liver and gastro intestinal tract (GIT) were observed to be significantly (P< 0.05) higher in goats fed 10 % maize cob. Similarly it is observed that weight of lungs reduces significantly as the maize cob increases.

DISCUSSION

Dry matter and crude protein values of beans husk are in the range with those reported by Tsado, *et al.*, (2011). The decrease in the crude protein of the diet as the maize cob increases could be attributed to the increase inclusion of maize cob which is high in fibre content and low in protein. The non significant difference observed in average daily water intake and ratio of water intake to feed intake

observed could probably be due to the fact that the goats were exposed to the same ambient temperature and that the level of inclusion does not have any positive effect on daily water intake. Feed intake was observed to be positively correlated with water intake. This was in agreement with Renold and Lindahi (2003) who reported that dry matter intake is correlated strongly with water intake in goats. The ratio of water to feed intake obtained was lower than those of Daramola and Adeloje (2004), who reported that the ratio of water to dry matter intake of goats fed maize cob diet ranges from 2.96:1 to 7.04:1. Winchester and Morris (2009) reported that the ratio of water intake increases with an increase in ambient temperature. (Abioja *et al.*, 2010) reported a positive correlation between water drunk and feed intake in young and old West African Dwarf goats (r=0.620). The negative correlations observed between water intake with feed conversion ratio (FCR) was not in agreement with the report of (Abioja *et al.*, 2010) who reported positive significant correlation between water intake and feed conversion ratio (FCR) for West African Dwarf goats (P<0.05, r=0.316). As the ambient temperature declines, the animal losses more heat to the environment and more energy are required to maintain a constant body temperature through increased feeding (Abioja *et al.*, 2010).

The percentage carcass weights were higher than the 29 % obtained by Owen *et al.*, (1999). The lowest carcass value observed at 30% maize cob inclusion may be as a result of increased level of maize cob which resulted into increased fiber content of the diet.

The better performance by goats fed 20% maize cob inclusion level in weight of carcass, weight of hind limb, weight of ribs and weight of hind leg over control may probably be due to better utilization of feeds by the animals in the group and a positive effect of maize cob in the diet. Significantly ($P < 0.05$) heavier liver and longer GIT observed by animals fed 20% maize cob compare to the control group, may be due to effect of maize cob in the diet.

Based on this results, it can be concluded that animals fed 10 % inclusion levels of maize cob diet had the highest correlation coefficient between water intake and feed intake and between water intake and ambient temperature. Ambient temperature has significant positive correlation on water intake and feed intake. Goats fed 20 % maize cob diet performed significantly better in weight gain and feed conversion ratio compare with other treatment groups The carcass characteristics of Savanna Brown goats were observed to be better at 20 % inclusion of maize cob in the diet. Therefore 20 % inclusion of maize cob in the diet of Savanna brown goats is recommended.

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