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Chemical Composition and Quality Attributes of Meat from West African Dwarf Goats Fed some Browse Species Supplemented with a Concentrate Diet

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Abstract **Original Research Article**

Twenty (20) yearling west African dwarf goats were used in a study to determine the effects of some browse plants and a supplement diet on the chemical composition and some quality attributes of meat obtained from the goats The experiment lasted for 63 days after an adjustment period of 7 days, the goats were served water ad Libitum. Gmelina (T1), Tamarind (T2), Neem (T3) and Teak (T4) after wilting for 24 hours were fed at 300g/goat/day 2 hours before the concentrate. The supplement was fed at 100g /goat/day. At the end of the feeding trial three (3) goats from each treatment were slaughtered, bled, eviscerated and dressed and there after 60g of meat were cut from the thigh of each of the slaughtered goats and used for the determination of their chemical composition and quality attributes. The experimental design was a completely randomized design , significant means were separated using SPSS version 23.0, 2015 edition, samples of the meat, concentrate diet and the browse plants were analyzed for their proximate composition using the methods outlined by AOAC(2000). There were no significant ($P<0.05$) differences in the values for daily concentrate intake, ash, moisture, pHi and pHu. Total daily feed intake ranged from 252.50 – 386.00g, and were significantly ($P<0.05$) different. Fat content values ranged from 4.45 – 10.05%, and were significantly ($P>0.05$) different protein content values had a range of 18.40 – 23.15% and showed significant ($P<0.05$) differences values for drip loss, cooking losses, initial and ultimate pH were all significantly ($P>0.05$) different. The drip loss values ranged from 5.20 – 8.20%, while the cooking loss values were 18.00 – 23.75%, values for both parameters were significantly ($P<0.05$) different It was concluded that Gmelina (T1) produced goat meat with the best nutrients and quality parameters. Gmelina (T1) at 300g/goat /day as well as bambara nut waste and cereal spent grains based supplement diet were therefore recommended for feeding yearling West African dwarf goats for improved meat quality.

Keywords: Concentrate, Browse, Diets, Quality, Meat, West African Dwarf Goats.

INTRODUCTION

Goat meat (Chevon) serve as a major source of meat in developing countries, while it is less popular in western countries, nevertheless the perception about goat meat is changing due to the health benefits of the consumption of lean meat with reduced fat and cholesterol content [1]. Carcass fat content is generally low in goat meat, fat accretion occurs much less in the growth process compared with other species of ruminants. Goats have much less sub-cuteanous and intramuscular fat than sheep, they however have more fat in the abdomen , whilst sheep typically have about 30 percent of their body as fat; goats nave as little as 10 percent, the age and sex of the animal affects the quantity of fat deposited, older goats have more fat and females have more fat than males [1]. The nutrition of goats have been reported to reflect in their meat quality [3, 4, 2]. In regions where eating goat meat is very popular ,people mention the distinct flavor and palatability as major reasons for preferring goat meat (chevon) to mutton or beef, the value of a goat carcass depends on the quality of edible parts available for sale.

The inability of ruminant livestock farmers to feed their animals with high quality forages all year round remains the most wide spread technical constraint facing ruminant productivity in the developing nations [5]. Contemporary ruminant feeding in a developing country like Nigeria is partly geared towards searching for inexpensive readily available feed resources, can partly or wholly replace the scarce and expensive feed stuffs and inadequate forages [6].

Since grasses and legume which constitute a major proportion of forages, which are the basal feed for ruminants, are usually in short supply during the long dry season, there is need therefore to feed ruminants with leaves (browse) from trees, especially those that are evergreen and also do not bear fruist/seeds that are in direct use by man. Consequently this study was therefore designed to study the effect of four (4) browse species (Gmelina, Teak, Tamarind and Neem) on the chemical composition and quality attributes of meat from West African dwarf goats, Given the health challenges faced the world over today, the need to search for feed materials that can help in the dry season feeding of goats and at the same time produce high quality and health promoting meat can not be overemphasized.

MATERIALS AND METHODS

Experimental Location

The feeding trial was carried out at the Small Ruminants Unit of the Livestock Teaching and Research Farm, Department of Animal Production, Kogi State University, Anyigba, which lies on Latitudes 7^0 $15^{1'}$ and 7^0 29'N of the equator and Longitudes 7^0 11^1 and 7^0 32^1 East of the Greenwich Meridean [7]. It is located in the derived Savannah zone of Nigeria. The annual rainfall ranges between 1400mm –1500mm with about 6-7 months of rainfall. The ambient temperature ranges from 25 ^{0}C to 35 ^{0}C with the highest in March and April [8].

Experimental Feed Materials, Preparation, Animal Management and Experimental Procedure

The experimental feed materials were bambara nut offal, Cereal spent grain (from millet), table salt, bone-meal and Gmelina (Gmelina arborea), Tamarind (Tamarindus indica), Neem (Azadirachta indica) and Teak (Tectona grandis) leaves. All the feed components were sourced from Anyigba and its environs. The browse leaves were harvested from Kogi State University, Campus, Anyigba.

Twenty (20) yearling West African dwarf bucks with weight range of 9.80 kg to10.30 kg and aged about 12 months, were sourced from Anyigba and its environs. They were conditioned to stability by feeding them adequately for 1 week. The animals were treated with Ivomec at 0.25 mL/goat to control both endo and ecto parasites. The animals were ear-tagged for identification and were randomly divided into 4 treatments of 5 animals each. The experiment lasted for 63days, after an adjustment period of seven (7) days. Animals in treatments T_1, T_2, T_3, and T_4 were fed Gmelina, Tamarind, Neem and Teak leaves respectively at 300 g/goat/day on cut and carry basis, after wilting for 24 hours. All the animals were given water ad libitum. Daily feed intake was calculated from differences between absolute feed served and leftover. At the end of the feeding trial, three (3) animals were slaughtered from each treatment and 60 g of flesh was cut off from the thigh of each of the slaughtered goats, 20g of flesh each were cut off and analyzed for their proximate values, carcass pH was taken on the left side of the Carcass at the same point on the longissimus thoracis of lumborum between 5th and 6th rib [9]. The initial pH (pHi) was taken 30 minutes post mortem and the ultimate pH (PHu) was taken 24 hours postmortem, these were taken using penetrating electrode of a portable pH meter , the probe was calibrated with 4 and 7 standard buffer solutions before and after every reading the electrode was thoroughly washed with distilled water and cleaned with cotton towels. The drip loss was determined using 40g of the meat, the meat samples were placed in a container on the supporting mesh and sealed to prevent air from entering the container, after 24 hours the samples were removed from the containers, bloated dry and weighed again, drip loss was expressed as percentage of initial weight as outlined by Berri et al., [10].

$$\text{Drip Loss} = \frac{\text{Initial Sample Weight} - \text{Weight of Sample after 24 hours chilling}}{\text{Initial Weight}} \times 100$$

The cooking loss was determined by putting 30mm x 30 mm of the meat from each goat carcass from each treatment in a plastic bag and cooking it to an internal temperature of 91C [11] the samples were left to cool to room temperature , the bags were opened and free juice drained [12], the cooked sample (B)was weighed and expressed as a % of the sample before cooking (A) [13].

$$\text{Cooking loss (\%)} = \frac{(A-B)}{A} \times 100$$

Table-1: Composition of Concentrate Diet (Dry matter %)

Bambara nut offal	46.00
Cereal Spent Grains	46.00
Rice Offal	4.00
Bone Meal	3.00
Table Salt	1.00
Total	100
Calculated Nutrient Content Crude Protein	18.80
Crude Fibre	19.70
Metabolizable Energy	2860.00

Proximate Analysis

Samples of supplement diet, browse leaves and meat were prepared for analysis of their proximate composition. The protein content of the samples was determined by Kjeldahl method. Ether extract, crude fibre and ash content determination were according to standard procedure [14]. The nitrogen free extract (NFE) was calculated by subtracting the sum of the percentages of crude fibre, ether extracts, crude protein and ash from 100.

Experimental Design and Statistical Analysis

The experimental design was a completely randomized design (CRD). Data were analysed by a one way analysis of variance (ANOVA) and treatment means were compared and separated, where there were significant differences using least significant difference (LSD). With the aid of SPSS [15] Statistical package for social science version 23.0.

RESULTS AND DISCUSSION

Table-2: Proximate Composition of Browse Leaves and Concentrate Diet (% DM)

Nutrients	Treatments				
	T1	T2	T3	T4	Concentrate
Crude protein	10.05	12.35	9.50	9.85	18.25
Crude fibre	11.30	11.80	13.10	14.85	18.20
Nitrogen free extracts	34.15	33.00	31.80	34.00	52.00
Ether extracts	2.50	3.00	2.75	2.90	2.50
Ash	7.00	6.15	5.15	6.00	5.05
Dry matter	65.60	66.20	62.30	67.35	96.00
Moisture	34.40	33.80	37.70	32.60	4.00

Feed Intake Records of Experimental Goats

The feed intake of the experimental goats is presented in Table-3, the daily concentrate intake range of 97.50 -100g which did not show significant (P< 0.05) difference and daily feed intake range of 252.50–386.00g which were significantly (P> 0.05) different were lower than 75.33–94.43g and at par with 253.00 – 399.87g reported by Oyibo et al., [16] who fed browse plants to growing West African Dwarf Goats, the daily browse intake ranged from 152.50 – 288.00g, this range whose values were significantly (P<0.05) different were higher than 134.22 – 245.44g reported by Ocheja et al., [17] for growing West African dwarf goat fed some browse species. These discrepancies could be due to differences in the formulation of the concentrates and the forages fed to the goats as well as the classes /ages of the goats used for the feeding trial.

Table-3: Feed Intake of Experimental Animals

Parameter	Treatment				
	T_1	T_2	T_3	T_4	SEM
Daily Concentrate intake	98.00	100	97.50	99.00	0.01
Daily Browse intake	288.00a	152.50^{d}	198.00^{c}	190.00^{b}	21.50
Total Daily feed intake	386.00^{a}	252.50^{b}	295.50^{c}	289.00^{c}	22.00

a, b ,c, = Means on the same row with different superscripts differ significantly (P<0.05).
SEM = Standard Error of the Means

Chemical Composition of Meat from West African Dwarf Goats fed Some Browse Plants

The proximate composition of meat from West African dwarf goats fed some browse plants is presented in Table-4, the moisture and ash contents were not significantly (P< 0.05) different. The fat values ranged from 4.45% (T2) – 10.05 % (T1), the fat content of T1 (10.05%) was at par with 10% optimum fat content for goat meat reported by Steele [2] and appears to be the most suitable fat content to facilitate flavor, juicyness, tenderness and palatability. Carcass fat content and composition are influenced by age, sex, breed, body weight and dietary factors [18] the relatively low carcass fat content in goats affects the conversion of muscles to meat and hence, meat quality [19]. Goat meat with less sub cuteanous fat are most prone to moisture losses and cold shortening subsequent to chilling, this may lower the meat quality and the dressing percentage, cold shortening in lean goat carcasses can be better managed or prevented by electrical stimulation of the carcass as well as post mortem aging or blade tenderization [11]. The protein content ranged from 18.40–23.15% and showed significant (P<0.05) differences, T1 (Gmelina) had the highest protein content the values were similar to 21.80 – 22.65% reported by Ocheja et al., [4]. For growing West African Dwarf goats fed cashew nut shell based diets as supplement to bamboo leaves. This similarity may be coincidental.

Table-4: Chemical Composition of Meat from West African Dwarf Goats Fed Some Browse Species (%)

Parameters	Treatments				
	T_1	T_2	T_3	T_4	SEM
Protein	23.15[a]	18.40[b]	20.00[b]	19.80[b]	1.20
Fat	10.05[a]	4.45[c]	7.50[b]	7.65[b]	1.02
Ash	0.86	0.97	0.96	0.89	0.49
Moisture	63.60	65.10	64.60	64.65	0.87

a, b ,c = Means on the same row with different superscripts differ significantly (P<0.05).
SEM = Standard Error of the Means.

Chemical Composition and Some Quality Attributes of Meat from West African Dwarf Goats fed Some Browse Species

The chemical composition and some Quality attributes of meat from West African Dwarf Goats feed some browse species is summarized in Table-5. Initial pHi and ultimate pHu were both not significantly (P>0.05) different, this was in line with the report of Budimir et al., [20] who reported no significant(P>0.05) differences 24 hours post slaughter in lambs slaughtered 40- -60 days and attributed this to the strength of the myofibrils within 24 hours post slaughter.

The pHu range of 5.75 – 6.10 were lower (less acidic) than the range of 5.2 – 5.8 reported by Boughani and Araba [21]. Simela et al., [22] reported a pHu range of 5.8 – 6.2, the high pHu values of goat meat suggests that goats are generally more prone to peri mortem stress. Goat carcasses with lower pHu tend to be more tender with lower shear force value and better calorimetric values [22] than those with a high pHu the susceptibility of goats to peri mortem stress is apparently associated with the excited nature of goats, pHu may affect several objective and sensory quality characterstics of meat ie colour, water holding capacity, thus it is accepted and used as the main indices of meat quality commercially.

Drip loss values (5.20 – 8.10%) were significantly (P<0.05) different, the values were at par with 5.50 – 7.50% reported by Ocheja et al., [23] for West African dwarf goats fed cashew nut shell based diets, drip losses from goat meat have been reported to be as high as 8% [24], this tends to lower the dressing percentage. The cooking loss ranged from 18.00% - 23.75%, the values were significantly (P<0.05) different, Cooking losses from goat meat tends to be high (35%) and this detracts from the sensation of juiciness, cooking losses contributed at least in part to the perception of consumers that goat meat is less juicy than lamb or mutton [24] this result also agreed with that obtained by Choi et al., [12] who reported that differences in diets affects cooking losses of Korean goats fed different browses.

Table-5: Quality Attributes of Meat from West African Dwarf Goats feed some Browse Species

s	Treatments				
	T_1	T_2	T_3	T_4	SEM
Drip loss (%)	5.20[b]	8.10[b]	7.30[b]	7.35[b]	0.99
Cooking loss (%)	18.00[b]	23.75[a]	23.00[a]	23.30[a]	2.00
pH (initial)	6.70	6.62	6.65	6.60	0.75
pH(ultimate)	5.75	6.05	610	5.85	0.63

a, b = Means on the same row with different superscripts differ significantly (P<0.05).
SEM = Standard Error of the Means.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Gmelina (T1) was most palatable to the goats and hence recorded the highest daily browse intake and hence total feed intake. Meat from Goats from T1 (Gmelina) had the best array of nutrients. T1 (Gmelina) produced goat meat with the best meat Quality

Recommendations

Gmelina leaves at 300g/goats/day supplemented with bambara nut and cereal spent grain based concentrate diet is recommended for feeding yearling West African dwarf goats especially during the long dry season for improved meat quality.

Further studies should also be carried out using other classes of ruminants such as sheep and cattle

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