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Original article

Sweet potato peels and its effect on feed and nutrients intakes of Uda lambs

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ABSTRACT

The study was conducted to evaluate the effect of feeding sweet potato peels on feed and nutrient intakes using sixteen Uda lambs with an average weight of 25.3kg in a Completely Randomized Design (CRD) experiment. The animals were allotted to four levels of sweet potato peels containing 0, 10, 20 and 30% which constitute the treatments designated 1, 2, 3 and 4 respectively. Treatment one had zero supplementation and served as the control. Data generated from the study were subjected to statistical analysis. Performance of the Uda lambs indicated that average dry matter intake, average daily weight gain, final weight gain and feed conversion ratio indicated no significant ($p>0.05$) difference between the treatments. However, significant variations were recorded between Treatment 2 and the rest of the treatments in terms of dry matter intake, crude protein intake, crude fibre intake, ether extract intake, ash intake and nitrogen free extract intake ($p<0.05$). The study showed that dietary inclusion of sweet potato peel in the diet of Uda lambs does not have any detrimental effect on the growth performance of Uda lambs under the condition in which the present experiment was conducted.

1. Introduction

The population of sheep and goats were estimated to be around 38, 500, 000 and 57, 600, 000 respectively (FAO, 2013). Africa has about 16.3% of the world's sheep population according to NRC (2007). In regards to the advancement of human civilization, Sheep was among the first domestic animals and play a significant role in ancestral agro-ecosystems (Gatenby, 2002). Being ruminants, sheep serve multifarious functions in the lives of both rural and urban livestock keepers in the provision of food, byproducts and income generation in both developed and underdeveloped countries (Gatenby, 2002). Thus, becoming an integral part of the global agricultural economy (Weaver, 2005) as the contribution of small ruminants to the economy of third-world countries can never be over-emphasis (NRC, 2007).

Small ruminants are reared in different agroecological systems in Nigeria contributing not only economically but also culturally. Small ruminants thrive well in areas where other activities are not possible and provide a cushioning effect in the period of drought. Sometimes it is called liquid assets because it can be converted into cash for urgent family needs (Faye and Alary, 2001).

Feed is one of the major problems of livestock production in Nigeria due to the existing competition between animals, industries and humans for conventional feed resources. The prices of conventional sources of feed have risen exorbitantly and feed cost accounts for about 60-70% of the total cost of production. This has necessitated the search for cheap alternative feed materials that can meet the nutritional requirements of farm animals. Thus, the need for farm or agro byproduct such as sweet potato peels, cassava peels, etc.

Tewe (1997) projected that the crop residue from sweet potato peels will be 4.72 metric tons by the year 2000. Sweet potato is a staple food in Nigeria and the peels are good sources of quality plant carbohydrates. As feed for ruminant animals in Nigeria, there is no much information on the mode of feeding, sources, the quantity used and effect of the sweet potato peels in regards to the performance of ruminant animals. Thus, this research was conducted in order to bridge the aforementioned knowledge gap.

2. Materials and methods

2.1. Experimental location

The experiment was conducted at the livestock teaching and research centre of Kebbi State University of Science and Technology. The study area is located on latitude 12°17'24.14" and longitude 4°28'1.57"E. The climate of the area is generally characterized by high temperatures (38°C to 42°C) usually between March and May and the area experiences harmattan wind between late November to early February with temperatures as low as 23°C.

2.2. Experimental feed source

The sweet potato peels that were used for this experiment were collected from Kebbi State metropolis and its environs, sundried, packed in a sack and stored. Other feed ingredients that were included in the diet were purchased from Birnin Kebbi Central Market Kebbi State.

2.3. Experimental feed preparations

Four isocaloric and isonitrogenous diets were formulated using graded levels of potato peel at 0, 10, 20 and 30% inclusion levels. The diets were designated as 1, 2, 3 and 4 were used to feed 16 experimental animals. Table 1 shows the gross composition and graded levels of potato pees fed to the experimental diets.

2.4. Experimental animals and their management

A total of 16 entire male Uda Lambs with an average weight of 19.0 ± 0.6 kg were purchased for the conduct of the present experiment. The animals were quarantined for four weeks, treated with Oxytetracycline HCL (broad-spectrum antibiotics), dewormed with Banmith 11® (12.5mg/kg body weight) and sprayed with Triatic® against ectoparasites. The experimental animals were managed intensively and group-fed with wheat offal, cowpea hay and mineral lick before the commencement of the experiment. To ensure adequate ventilation, less ammonia accumulation, adequate cleanliness of the experimental pens and minimum discomfort of the experimental animals, faeces and urine were removed on daily basis.

2.5. Experimental design and feeding procedures

A completely randomized experimental design (CRD) was used for this experiment (Steel and Torrie, 1980) where 4 animals were randomly allotted to each treatment (1-4) and each animal serving as a replicate. The animals were balanced for weight and housed in an individual disinfected pen (2m x 1m x 2m). Each group was fed according to the experimental diets, feed and water were offered ad-libitum. The experiment period lasted for 12 weeks.

Table 1
Gross composition of the experimental diets.

	Treatments			
	% Inclusion level of sweet potato peels (%)			
Ingredients	**1 (0%)**	**2 (10%)**	**3 (20%)**	**4 (30%)**
Maize	0	7	7	3
Groundnut Haulms	19	19	17	22
Cowpea Husk	19	15	16	15
Potato Peels	0	10	20	30
Wheat Offal	30	20	10	0
Soya Bean Meal	15	18	19	19
Rice Milling Wastes	16	10	10	10
Salt	1	1	1	1
Total	100	100	100	100
Calculated Energy (Kcal/kgME)	2102	2104	2010	2108
Calculated Crude Protein (%)	17.0	17.1	16.8	16.6
Calculated Crude Fiber (%)	20.3	20.0	19.1	18.2

2.6. Data collection

2.6.1. Live weight changes and feed intake

Initial body weight (IBW) and weekly body measurements were conducted according to the procedure described by Muhammed et al. (2016). Feed intake (FI) was recorded daily based on the amount of feed offered and the refusals collected.

2.6.2. Chemical analysis

Analysis of the proximate composition of the representative samples of the experimental diets and sweet potato peels according to the techniques outlined by the Association of Official Analytical Chemists (AOAC, 2000).

2.6.3. Statistical analysis

The statistical package for the social sciences (IBM SPSS, 2016) was used in the analysis of the data generated from the experiment. Analysis of variance (ANOVA) was applied and where significant differences exist, means were separated using Duncan multiple range test (DMRT). The probability value was set at $P<0.05$.

3. Results and discussion

3.1. Chemical composition of the experimental diet

The dry matter composition of the experimental diets varied between 90-94%. The crude protein content decreased slightly from 17.0 to 16.6 from diets 1 to diets 4 whereas nitrogen-free extract (NFE} increased. Crude fibre (CF) content decreased slightly with an increase in the level of sweet potato peels. The Ash content of all the experimental diets was comparable (Table 2).

3.2. Performance characteristics of Uda lamb fed graded level of sweet potato peels

Table 3 presents the results on the performance characteristics of Uda lamb fed graded level of sweet potato peels. Our results indicated no significant difference ($p>0.05$) between treatment means in dry matter intake

(DMI), feed conversion ratio (FCR), average daily weight gain (ADWG) and final body weight (FBW). Although statistically not significant, FBW, ADG and ADWG were numerically higher for animals fed diets containing a higher level of sweet potato peels.

Table 2
Chemical composition of the experimental diet.

Variables	Treatments 1	2	3	4	Sweet potato peels
Ether Extract	4.50	4.00	3.50	4.50	4.06
Crude Protein	17.00	17.10	16.80	16.60	4.64
Crude Fibre	21.30	21.00	20.10	19.20	3.80
Dry Matter	94.20	93.30	90.10	91.00	91.76
Nitrogen Free Extract	45.20	46.90	47.60	48.20	74.70
Ash	12.00	11.00	12.00	11.50	4.56

Table 3
Performance characteristics of Uda lamb feed graded level of sweet potato peels.

Variables	Treatments 1	2	3	4	SEM
Initial Body Weight (kg)	19.25	19.50	19.50	19.50	1.84
FBW (kg)	25.80	26.10	25.60	26.20	1.10
Weight Gain (kg)	6.55	6.60	6.10	6.70	0.77
ADWG (g/day)	78.00	78.60	72.60	79.80	9.14
FCR	9.48	12.76	9.77	9.30	1.82
Feed Intake (kg/day)	0.78	0.97	0.75	0.79	0.02
DMI as % Body Weight	2.85	3.49	2.64	2.74	0.13
Feed Intake (g/day)	780	970	750	790	18.63
D.MI (g/day)	734.50	904.10	675.60	719.20	14.78

3.3. Nutrient intake of Uda lambs fed sweet potato (*Ipomeabatata*) peels

The result of nutrient intake by Uda Lamb fed sweet potato peels are presented in Table 4. There was no significant variation in terms of dry matter intake, crude protein intake, crude fibre intake, ether extract intake, ash intake and nitrogen-free extract intake between all the treatments (p>0.05) except treatment 2 (p<0.05). The dry matter intake value ranges from 675.75 to 905.01 with treatment 2 having the highest (905.01) and treatment three having the lowest (675.75). The crude protein intake ranges from (126.00 to 165.87) with the lowest value (126.00) recorded for treatment 2. The crude fiber intake was higher (203.70) for treatment 2 and lower (150.75) for treatment 3. The ether extract intake value ranges from 26.25 to 38.88 and the ash intake ranges from 90.0 for treatment 3 to 106.7 for treatment 2. NFE intake follows a similar pattern where treatment 2 recorded the highest value and control (Treatment 1) (p<0.05).

Table 4
Nutrient intake of Uda lambs fed sweet potato (*Ipomeabatata*) peels.

Variables	Experimental diets with sweet potato peels inclusion 1	2	3	4	SEM
Feed Intake (g/day)	780^b	970^a	750^b	790^b	18.63
Dry Matter Intake (g/day)	734.76^b	905.01^a	675.75^b	718.90^b	14.7
Crude Protein Intake (g/day)	132.60^b	165.87^a	126.00^b	131.14^b	5.77
Crude Fibre Intake (g/day)	166.14^b	203.70^a	150.75^b	151.68^b	5.77
Ether Extract Intake (g/day)	35.10^b	38.88^a	36.25^b	35.55^b	1.563
Ash Intake (g/day)	93.60^b	106.7^a	90.00^b	90.85^b	1.795
NFE Intake (g/day)	352.00^b	454.93^a	357.00^b	380.78^b	6.01

Means along the same row with different superscript are significantly different (p<0.05).

3.4. Cost of feed and cost of feed per kg live weight gain

The result presented in Table 5 shows that the cost of feed/kg is higher for treatment 1 (₦60.50) followed by treatment 2, 3 and 4 having ₦55.80, ₦52.50 and ₦48.50, respectively. The cost of feed consumed per day was higher for treatment 2 (₦54.32) followed by treatment 1, 3 and 4 which cost ₦47.58, ₦39.75 and ₦38.71 respectively. Cost of feed per kg live weight gain was higher for treatment two (₦691.09) with treatment 1, 3 and 4 having cost ₦610.00, ₦547.52 and ₦485.09 respectively.

Table 5
Cost of feed and cost of feed per kg live weight gain.

	Treatments			
Cost (₦)	**1**	**2**	**3**	**4**
Cost of feed/kg (₦)	60.50	55.80	52.50	48.50
Cost of feed consumed (naira/day)	47.58	54.32	39.75	38.71
Cost of feed/kg live weight gain	610.00	691.09	547.52	485.09

1 USD= ₦345 (Nigerian Naira).

3.5. Proximate composition of the experimental diets

The crude protein content of the diets was higher than the 8% crude protein recommended by Northon (2003) for growing sheep and goats. Gatenby (2002) indicated 10-12% crude protein as a moderate level for ruminant production. However, the crude protein values in the present study fell within the crude protein requirement of 15-18% for growing lamb as reported by Church (1978) and ARC (1990). The energy and protein were similar across the treatments, this could be attributed to the Iso-nitrogenous and Iso-caloric nature of the experimental diets.

The dry matter value (90.10 to 94.20) obtained in this study was higher than the values of 87.61-87.71% observed by Ochepo et al. (2012) in diets containing sugar cane peels. The higher dry matter value might be attributed to the type of materials used in the diet formulation which were all dried. Higher dry matter suggests a good source of energy and roughage that could enhance rumination and prevent digestive upset in the rumen (Van Soest, 1994). The crude fibre values (19.20 to 21.30) reported in the present study were lower than the value of 31.30 to 33.60% obtained by Ahmed et al. (2007) when sugar cane baggase was ensiled with chicken manure. This could be as a result of the experimental material present in the ensiled mass. However, Wallace (1994) reported that lower fiber is better for growing animals due to low microflora present in their fore-stomach for efficient fiber degradation.

Ether extract values (3.50 to 4.50%) obtained from this trial were similar to those reported by Tukur and Maigandi (2010). The authors obtained EE values in the range of 4.3 to 5.5% when fattening rams were fed diets containing varying levels of FSD. The higher EE in the diets indicates fats content could give rise to a high concentration of volatile fatty acids (VFAs). This was also observed by Maigandi et al. (2002). Higher levels of EE may depress fiber digestion. McAllister et al. (1996) reported depression in fiber digestion when the fat level exceeds 5-6% in the ruminant ration.

The Ash values (11.00 to 12.00%) in the present study were within the range of 5.01-25.74% obtained by Okoruwa et al. (2016), but lower than 12.91 -19.54% reported by Garba et al. (2010) when *Guiera senegalensis* was fed to Yankasa rams as complete diets. The NFE values in the diets of the present study are comparable to the values reported by Muhammed et al. (2016) when ensiled FSD and cowpea hay were fed to fattening sheep.

3.6. Growth performance and nutrients intake of the experimental animals

There were no significant differences in all the performance parameters measured (p>0.05). Efficient utilization of nutrients that supply adequate protein and energy levels is required for optimum growth performance in livestock (Okoruwa et al., 2013). Thus, similarities in the performance parameters could be attributed to the same level of protein and energy in the animals' diet. No difference was recorded between the groups fed with 17% CP for 42 days in respect to feed consumption, live weight and daily live weight gain of growing lambs (Dabiri and Thonney, 2004). Also, our result is supported by the earlier findings by Fatufe et al. (2007) that the chemical and physical composition of a diet influenced the performance of ruminant animals.

Lack of significant variation in terms of dry matter intake, crude protein intake, crude fibre intake, ether extract intake, ash intake and nitrogen free extract intake between all the treatments (p>0.05) except treatment 2 (p<0.05). The results of voluntary feed intake and DMI show no variation statistically (p>0.05) among the treatments except treatment 2 that recorded a higher value compared to other treatments. This could be corroborated by the low level of potato peels being a major source of energy and earlier findings have reported that animals eat to satisfy their energy requirements (Garba et al., 2010), hence the higher intake recorded in treatment 2. Dry matter intake (675.75 to 905.05 g/day) was lower than those values observed by Garba et al. (2013) when the graded level of *Tamarindus indica* leaves was fed to Yankasa rams. Crude protein intake (126 to 165.87 g/day) was also lower compared to those values observed by Garba et al. (2013). The CFI values in this study (150.75 to 203.70 g/day) were higher than the values (138.87-142.19 g/day) reported by Muhammed et al. (2016). Higher feed intake is a good indication of proper utilization of the experimental diets (containing the graded level of sweet potato peels) by the animals, which could also be attributed to the aroma and palatability of the diets.

Ash and NFE intake were also higher than the findings of Garba et al. (2013). Ash content of a feed gives an idea about the inorganic or mineral content of such feed ingredients. EE intake recorded in these experiments was higher than what was obtained by Tukur and Maigandi (2010) when the graded level of FSD was fed to fattening ram.

3.7. Cost of feed and cost of feed per kg live weight gain

Cost of feed per kg live weight gain of animals in this study indicated that treatment A with 0% inclusion level of sweet potato peel had the highest cost (₦60.50), the lowest was obtained in treatment D (₦48.50) with 30% inclusion level of sweet potato peel.

This finding is similar to the report of Aruwayo et al. (2013), the authors reported a lower cost of feed per kilogram live weight gain in treatments with the inclusion of poultry litter waste treatment alone than the control treatment which has a higher cost of feed when in mixture with forestomach digesta. This signifies that the use of unconventional feed can reduce the cost of livestock production. Maigandi et al. (2002) opined that the reduction in the cost of feed with alternative feed resources could be attributed to the replacement of more expensive ingredients with cheaper and unconventional animal feed.

4. Conclusion

It was concluded that sweet Potato Peels are a potential feed ingredient in livestock feeding. Its inclusion in diets does not have a deleterious effect on the performance of Uda lambs. The study recommended that sweet potato peel shall be fully harnessed as a potential source of feed. More experiments should be carried out on sweet potato peels using different breeds and strains of sheep at a level above 30% to ascertain the optimum inclusion level.

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