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**SILAGE QUALITY AND GROWTH PERFORMANCE OF WEST AFRICAN DWARF GOATS FED
MORINGA OLEIFERA LEAVES ENSILED WITH CASSAVA PEELS**

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ABSTRACT

Forage scarcity in the dry season is very challenging for ruminant production in the tropics. The utilization of browse species, particularly as silage can bridge this gap. This study assessed the potentials of Moringa oleifera leaves ensiled with varying levels of cassava peels as dry season feed for West African Dwarf (WAD) goats.

Different mixtures of Moringa oleifera leaves and cassava peels were ensiled and designated as follows: T1= 100% Moringa, T2= 60% Moringa + 40% Cassava peels, T3= 40% Moringa + 60% Cassava peels, T4= 50% Moringa + 50% Cassava peels, T5= 100% Cassava peels. Chemical composition and silage characteristics were investigated. 25 WAD goats with weights ranging between 4.83-6.90 kg were used in the growth study. Chemical composition of the silage diets showed that it contained 27.79 – 36.26 % dry matter (DM), 7.45 – 22.25 % crude protein (CP), 8.92 – 16.45 % crude fibre (CF), 2.55 – 7.01 % ether extract (EE), 6.10 – 10.08 % ash content, 42.40 - 68.14 % Nitrogen Free Extract (NFE). Appearance, odour and texture of the silage had acceptable physical attributes with pH values ranging from 3.53 – 5.80. Average daily feed intake (ADFI) and Feed conversion ratio (FCR) were not significantly ($P<0.05$) affected by diets while Average daily weight gain (ADWG) was significantly improved in T3 (40% M. oleifera + 60% cassava peels) than in others.

It was concluded that Moringa oleifera leaves silage with 40% cassava peels as additive elicited the best performance indices in WAD goats fed diets consisting of mixtures of Moringa oleifera leaves and cassava peels ensiled together in graded levels or alone.

Keywords: Feed Intake, Growth, *Moringa oleifera*, Silage, WAD Goats.

INTRODUCTION

Livestock productivity in the tropics has suffered major setback due to inadequate quantity and quality of feeds for animals especially during dry season (Peters, 1998). Tree fodders maintain higher protein and mineral contents during growth than do grasses, which decline rapidly in quality with progress to maturity (Aganga and Tshwenyane, 2003). Due to the deciduous nature and leaves-shattering of some of these tree fodders, silage making which has great potential to solve shortage of feed for small ruminants by preserving excess forage produced during the wet season for use at the dry period could be adopted. Protein content of *Moringa oleifera* leaves is high. They also contain high mineral value and high yield potential (Aregheore, 2002) and can be exploited for feeding animals during the dry season when forage is scarce. Low levels of fermentable carbohydrates in *Moringa oleifera* limit its use as a silage material, hence there is a need to mix with highly fermentable carbohydrate to enhance its silage value. Cassava peels contains readily fermentable carbohydrates and have been used as additive (Olorunnisomo, 2011) in grass silage fed to Red Sokoto goats. Ensiling moringa together with cassava peel presents an opportunity to preserve their nutrients and enhance their feeding value for small ruminants during the dry season. This study was therefore designed to assess the silage quality and growth performance of WAD goats fed *Moringa Oleifera* leaves ensiled with different levels of cassava peels.

MATERIALS AND METHODS**EXPERIMENTAL STATION AND DURATION**

The experiment was carried out at the Sheep and Goat Unit, Obafemi Awolowo University (OAU) Teaching and Research Farm, Ile – Ife located approximately between latitude 7° 31' N and 7° 33' N; and longitudes 4° 33' E and 4° 34' E (Amujoyegbe *et al.*, 2008). The experiment lasted Twelve (12) weeks.

SILAGE PRODUCTION AND EXPERIMENTAL DIETS

Moringa oleifera leaves were collected from plots within the Obafemi Awolowo University Teaching and Research Farm, Ile – Ife, Osun State. Fresh cassava peels were also collected from a cassava processing Unit within the OAU Teaching and Research Farm. They were chopped into bits using a forage chopper machine and then included in the silage mixture in levels as designated:

T1= 100% *Moringa oleifera*; T2= 60% *Moringa* + 40% Cassava peels; T3= 40% *Moringa* + 60% Cassava peels; T4= 50% *Moringa* + 50% Cassava peels; T5= 100% Cassava peels.

Mixture was packed, compacted and sealed in thick polythene bags to create an anaerobic condition for proper fermentation. The silage was ensiled for 21 days after which they were opened.

EXPERIMENTAL ANIMALS AND THEIR MANAGEMENT

Twenty-five growing WAD goats with average weight of 6.02 ± 0.88 kg were randomly assigned to the five experimental diets in a completely randomized design. There were 5 goats per treatment with each animal serving as a replicate. The goats were housed in open sided, well-lighted and adequately ventilated building with slated floor. The house was disinfected before the animals arrived. The animals were vaccinated against *Pestes des Petite Ruminantes*, quarantined and observed for any disease symptom for seven days. The goats were also dewormed and treated against ectoparasites using ivomec ® prior to the commencement of the experiment. Animals were feed at 5% of their body weight. Water was supplied *ad libitum*.

GROWTH PERFORMANCE DETERMINATION

Growth trial lasted twelve weeks. Each animal was weighed using hanging scale and weighing sack before the commencement of the study and subsequently were weighed weekly throughout the experimental period. Parameters measured included; feed refusal, feed intake and weight gain.

Determination of silage quality: After 21 days, the fermentation was terminated by opening the silage bags and silage quality characteristics (colour, aroma and texture) were assessed using the method of Babayemi (2009). Silage pH was determined according to the methods described by Falola *et al.* (2013). Colour assessment was carried out through visual assessment with the aid of a colour chart. Aroma of the silage was assessed by 5 different people. Sub-samples from the treatments and at different depths were taken and mixed together for dry matter determination by oven drying at 65°C until a constant weight was achieved. The samples were later milled and stored in triplicates in cellophane bags until needed for chemical analysis.

CHEMICAL ANALYSIS:

Crude protein, crude fibre, ether extract and ash of the silages were determined according to the methods of AOAC (1990). Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) and Acid Detergent Lignin (ADL) were determined using the procedure of Van Soest *et al.* (1991).

STATISTICAL ANALYSIS

All data were subjected to a one way analysis of variance (ANOVA) of SAS (1999) in a completely randomized design and treatment means, where significant, were separated using Duncan's Multiple Range Tests of the same package.

RESULTS AND DISCUSSION

The chemical composition of *Moringa oleifera* and cassava peels based silage diets are presented in Table 1. The Dry matter content and Nitrogen Free Extract (NFE) of silage increased as the proportion of the cassava peels in the silage increased while the crude protein, Fibre fraction and Ash reduced. The increased level of NFE and reduced crude protein in the silage mixture with increasing proportion of cassava peels indicate that the addition of cassava peels to *Moringa* based silage diets improved the energy at the expense of the protein. This is similar to the result obtained by Olorunnisomo and Adesina, (2013) when they assessed the preference of Zebu cows for *Moringa* leaves ensiled with different levels of cassava peels. The feed mixtures except T5 (sole cassava peels silage) with a CP level of 7.45% met the requirement for protein recommended for ruminants (10-12%) (ARC, 1980). This implies that animals fed high percentage of cassava peels would need protein supplementation to meet their requirement for maintenance and production.

Table 2 shows the silage characteristics of *Moringa oleifera* and cassava peels based silage diets. Appearance, odour and texture of the silage had acceptable physical attributes with pH values ranging from 3.53 – 5.80. Good silage usually preserve well of the original colour of the pasture or any forage (t'Mannetje, 1999). The greenish and dark spots colour of the silages showed that the original colours of the silage constituents were well preserved.

Table 3 shows the growth performance of WAD goats fed *Moringa oleifera* and cassava peels silage diets fed to WAD goats. Average daily feed intake ADFI (g) of diets were not significantly ($P < 0.05$) affected by silage diets. Final weight of goats in T2 was significantly higher in T2 than in T5, but similar in T1, T3 and T4.

The Average Daily Gain (ADG) obtained in this study (12.30 -19.05 g/day) is similar to values of 10.60 - 24.60 g/day reported by Okolo *et al.*, (2012) for WAD goats fed graded levels of cashew nut shell with some other non-conventional feed stuff. They are also similar to the range of 14.88-21.43 g/day reported by Asaolu *et al.*, (2012) for WAD goats offered dried leaves of *Moringa*, *Gliricidia* and *Leucaena* as supplement to a basal diet of cassava peels. Animals fed silage diets consisting of a mixture of 40% *Moringa* and 60% cassava peels elicited the highest ($P < 0.05$) weight gain (19.05) compared to others. Result appears to suggest an associative effect of the combination of *Moringa* and cassava at this level which gave the best ADG beyond which values were observed to decline. FCR were similar in diets.

Table 1: Proximate composition of *Moringa oleifera* and cassava peels based Silage diets fed to WAD goats

Parameters	T11	T2	T3	TT4	T5
Moisture	6.28	3.71	3.75	4.00	2.38
Dry matter	27.83	30.40	27.79	28.06	36.26
Crude fibre	16.45	12.75	11.94	15.70	8.92
Crude protein	22.25	16.50	12.75	14.38	7.45
Ash	10.08	9.40	7.95	8.66	6.10
Ether Extract	2.55	6.81	6.45	6.64	7.01
NFE	42.40	50.79	57.17	49.62	68.14
<i>Fibre fractions</i>					
NDF	53.17	36.60	45.43	48.69	32.78
ADF	40.04	25.88	30.30	36.55	17.92
LIGNIN	12.02	10.78	11.90	17.82	5.98

T1= 100% Moringa, T2= 60% Moringa + 40% Cassava peels, T3= 40% Moringa + 60% Cassava peels T4= 50% Moringa + 50% Cassava peels, T5= 100% Cassava peels;

Table 2: Silage characteristics of *Moringa oleifera* and cassava peels based silage diets.

Parameters	T1	T2	T3	T4	T5
Appearance	Greenish + dark spots	Greenish brown + dark spots	Greenish brown + dark spots	Greenish brown + dark spots	Brown
Odour	Pleasant with faint acidic smell	Pleasant with fruity smell	Pleasant with fruity smell	Pleasant with fruity smell	Pleasant with fruity smell
Texture	Firm and moist	Firm and moist	Firm and moist	Firm and moist	Firm and moist
pH	4.80	3.95	3.82	3.86	3.53
Temp (°C)	29.20	28.60	28.80	28.70	29.30

T1= 100% Moringa, T2= 60% Moringa + 40% Cassava peels, T3= 40% Moringa + 60% Cassava peels

T4= 50% Moringa + 50% Cassava peels, T5= 100% Cassava peels.

Table 3: Growth performance of WAD goat fed *Moringa oleifera* based silage diets

Parameter	T1	T2	T3	T4	T5	SEM	P-value
ADFI (g)	138.64	143.05	138.33	138.34	130.86	0.3624	0.520
Initial weight (kg)	6.13	6.90	6.07	6.17	4.83	0.3560	0.533
Final weight (kg)	7.50 ^{ab}	8.17 ^a	7.67 ^{ab}	7.23 ^{ab}	5.87 ^b	0.3397	0.284
TWG (kg)	1.37	1.27	1.60	1.06	1.04	0.108	0.880
ADG (g/day)	16.31 ^b	15.11 ^b	19.05 ^a	12.62 ^c	12.38 ^c	0.0013	0.340
FCR	8.50	9.47	7.26	10.96	10.57	0.3624	0.520

^{a,b,c}; Means within rows with different superscript are significantly different (P<0.05); T1= 100% Moringa, T2= 60% Moringa + 40% Cassava peels, T3= 40% Moringa + 60% Cassava peels T4= 50% Moringa + 50% Cassava peels, T5= 100% Cassava peels; ADFI - Average Daily Feed Intake; ADG - Average Daily Gain; TWG - Total weight gain; FCR - Feed Conversion Ratio

CONCLUSION

The study concluded that 40% *Moringa Oleifera* leaves ensiled with 60% cassava peels as additive elicited the best performance indices in WAD goats fed *Moringa oleifera* and cassava peels based silage diets.

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