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Research Article

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Quality Evaluation & Acceptability of Silage Combinations of Maize Cobs, *Moringa oleifera* Leaves and Cassava Peels and Its Effects on Blood Parameters of West African Dwarf Bucks

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Abstract

This experiment was conducted to determine the physical, proximate compositions and acceptability of silage combination of maize cobs (MC), *Moringa oleifera* leaves (MOL) and cassava peels (CPL) and its effects on blood profile of West African Dwarf bucks. The experiment was conducted by ensiling different proportions of maize cobs and *Moringa oleifera* leaves with cassava peel and urea to form T_1, T_2, T_3 and T_4, respectively. After 21 days, the silages were evaluated for their physical characteristics, acceptability and proximate compositions. The haematology and serum analysis of WAD bucks fed the silage treatments were also determined in a completely randomized design (CRD). All the data collected were analysed using descriptive statistics and analysis of variance (ANOVA) at 5% level of probability ($\alpha_{0.05}$). All the silages have acceptable physical attributes for good silage except for T_4. The crude protein (CP) ranged from 9.02 (T_1) - 26.25% (T_4). The coefficient of preference, (CoP) ranged from 1.06 (T_3) to 0.85 (T_4). Parked Cell Volume (%) ranged between 22.24 (T_4) to 33.46 (T_2) while the Total Protein (TP, g/dL) was significantly Thigher (13.04) in T_4 compared to other silage treatments. It is therefore concluded that silage T_2

had all the physical and proximate attributes that enhanced the production of WAD bucks without any negative effect on their blood parameters.

Introduction

The dry season period has always being a critical and challenging period for ruminant production especially in the tropics. During the dry season, the native rangelands and crop residues available for ruminants after crop harvest are usually fibrous and devoid of most essential nutrients essential for ruminant production [1]. Resulting in weight losses, low birth weights, lowered resistance to disease, and reduced animal performance [2]. However, forage preservation in form of hay or silage ensures adequate provision of forage materials to ruminants all year round [3]. Silage is not weather dependent and can be used to conserve forages at any time during the year unlike hay that is weather dependent. *Moringa oleifera* leaves have been well documented as multipurpose browse plant for all classes of livestock. However, there is paucity of information on its nutrient composition and acceptability by ruminants when ensiled with other agricultural by-products such as maize cobs and cassava peels. Moreover, dietary components have significant effects on blood components and such blood constituents are widely used in nutritional evaluation and animals [4]. This study was therefore designed to determine the physical characteristics, proximate composition and acceptability of silage combinations of maize-cobs, *Moringa oleifera* leaves and cassava peels and its effect on blood parameters when fed to WAD bucks.

Materials and Methods

Study Location

The experiment was carried out at the sheep and goat unit of Teaching and Research Farm, Osun State University, College of Agriculture, Ejigbo, Osun state, Nigeria.

Experimental Animals

A total number of sixteen (16) male West African dwarf goats (bucks) of average weight of 10±0.5Kg were used for this experiment. A total number of eight (8) WAD bucks were randomly selected from the herd for acceptability study while all the bucks were later distributed randomly into the four silage treatments for the 70 days feeding trial prior to blood samples collection.

Silage Production

The silages were prepared in triplicates in twelve (120 litres capacity) plastic containers, with three of the containers containing one of the four treatments compressed with heavy bags of sand (i.e. each of the treatments were prepared in three 120 litres capacity plastic containers), for acceptability and growth studies. While another set of silages were prepared in duplicates in eight (4 litres capacity) plastic containers, with two of the containers containing one of the four treatments compressed with weights (i.e. each of the treatments were prepared in two 4 litres capacity plastic containers), for laboratory analysis. Fermentation

was done for 21 days. During fermentation process, it was ensured that the silos were air tight by proper compaction and consolidation of ensiled materials. This ensures the production of lactic acid bacteria which is an indication of good silage.

The Proportion of Ensiled Material for Silage Production

Four experimental diets which consisted of:

Treatment1: ensiled 70% maize cobs + 20% cassava peels + 10% urea

Treatment 2: ensiled 35% maize cobs + 35% *Moringa oleifera* + 20% cassava peels + 10% urea

Treatment 3: ensiled 50% maize cobs + 20% *Moringa oleifera* + 20% cassava peels + 10% urea

Treatment 4: ensiled 70% *Moringa oleifera* + 20% cassava peels + 10% urea

Evaluation of the Physical Characteristics of Silages

I. Temperature: The temperatures of the silages were taken by dipping a thermometer inside the silage masses and keeping it in place for five (5) minutes.

II. Colour: Silage colour was assessed by the use of a colour chart.

III. Odour and Texture: These were assessed by a 5-man panel. This was done to guide against bias attitude from a one-man assessor since the involved qualitative variables are on the nominal, rather than the ordinal, scale.

IV. pH: These were determined by taking about 25g from each treatment samples and mixing with 100ml of distilled water for one hour then agitated for two minutes [5]. After which the pH was determined by standard procedure by inserting a pH meter glass electrode into the supernatant for 1-2 seconds [6]

The Silages were also observed for the presence of mold.

Proximate Analysis

The samples were milled in the laboratory using hammer mill of 1mm sieve and chemical analysis was carried out to determine the proximate compositions (dry matter, crude protein, ash, ether extract and nitrogen free extract) of the samples as described by [6].

Acceptability of Ensiled Maize Cobs, *Moringa oleifera* Leaves and Cassava Peels by Wad Bucks.

The acceptability study was carried out by introducing 1kg each of the four silages to eight selected experimental animals on a cafeteria basis so that each animal had free access to each of the silages in the trough as described by [5]. The positions of the silages were changed daily to prevent bias which occurs as a result of an animal sticking to a trough. The intake of each of the silages was measured by deducting the orts (remnants) from the total amount of silage offered. Silage preference was determined using the Coefficient of Preference (CoP), calculated from the ratio between the intake of each individual silage and the average intake of the five silages [7] and [5].

$$Coefficient\ of\ Preference(CoP) = \frac{Intake\ of\ individual\ silage}{Mean\ intake\ of\ the\ five\ silages}$$

If CoP is <1, the silage is poorly accepted, but if it is >1, the silage is well accepted [7].

Blood Sample Collection and Evaluation

Five days prior to the end of 70days growth study, blood was collected from all the experimental animals in the morning before feeding. 5ml of blood sample was collected from jugular vein puncture into labeled sterile universal bottles containing anti-coagulant (Ethylene di amine tetra acetic acid, EDTA) for blood haematological analysis using standard procedures [8]. Another 5ml of blood sample were collected into labeled sterile sample bottles without ant-coagulant for serum biochemical determination using standard procedures as reported by [9]

Experimental Design

The design for the experiment was Completely Randomised Design (CRD)

Statistical Analysis

All the data collected were analysed using descriptive statistics and analysis of variance (ANOVA) with the procedure of [10]. Statistically significant observed means were compared using LSD of the same package at 5% level of probability.

Results

The physical attributes of the ensiled maize cobs, *Moringa oleifera* leaves and cassava peels as shown in terms of colour, texture, odour, temperature and pH are shown in Table 1. The colour varied from brownish white (T_1) to greenish brown (T_2) and to light green (T_3 and T_4). In terms of texture, all the silage treatments were firm except T_4 that has firm but wet texture. All the silage combinations were characterized with fruity smell except T_4 which had alcoholic smell. The temperature of the silage treatments ranged from 27.0 °C in T_3 to 29.0°C in T_4 and the pH ranged from 4.08 in T_1 to 5.04 in T_4

Table 1: *Physical Characteristics of Ensiled Maize-Cobs, Moringa oleifera leaves and Cassava Peels*

Quality Indication	Silage Treatment			
	T_1	T_2	T_3	T_4
Colour	Brownish white	Greenish brown	Light green	Light green
Texture	Firm	Firm	Firm	Firm but wet
Odour	Fruity	Fruity	Fruity	Alcoholic
Temperature	28.0°C	27.2°C	27.0°C	29.0°C
pH	4.08	4.54	4.50	5.04

The dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and nitrogen free extract (NFE) of ensiled maize cobs, *Moringa oleifera* leaves and cassava peels are presented in Table 2. There were significant differences ($P<0.05$) in all the parameters measured across the dietary treatments. The dry matter was significantly highest (28.02) in T_1 and lowest (20.77) in T4. The crude protein (CP) ranged between 9.02 (T_1) and 26.25 (T_4) while the crude fibre (CF) were 37.04, 26.22, 22.05 and 17.78 in T_1, T_2, T_3 and T_4 respectively. Ether extract (EE) was significantly higher in T_3 (6.04) and T_4 (7.74) compared with T1 (1.84) and T_2 (2.03). Ash content also followed the same trend with ether extract. The nitrogen free extract (NFE) was significantly highest in T_2 (54.34) and lowest in T_3 (42.81) and T_4 (42.21).

Table 2: *Proximate Composition of Ensiled Maize-Cobs, Moringa oleifera leaves and cassava peels*

Parameters (%)	**Silage Treatment**				**SEM**
	T_1	T_2	T_3	T_4	
Dry Matter	28.02^a	25.78^b	21.24^c	20.77^c	2.84
Crude Protein	9.02^d	12.64^c	22.87^b	26.25^a	1.47
Crude Fibre	37.04^a	26.22^b	22.05^c	17.78^d	3.07
Ether Extract	1.84^b	2.03^b	6.04^a	7.74^a	0.68
Ash	4.48^b	4.77^b	6.23^a	6.02^a	0.24
Nitrogen Free Extract	47.62^b	54.34^a	42.81^c	42.21^c	4.67

$^{a, b, c, d}$: Means within the same row with different superscript are significantly different ($p<0.05$)

The coefficient of preference of ensiled Maize Cobs, *Moringa oleifera* leaves and cassava peels by West African Dwarf bucks is shown in Table 3. In the present study, T_3 had the highest CoP (1.06) followed by T_2 (1.05) and T_1 (1.04) respectively while T_4 had the value of 0.85, which was less than unity.

Table 3: *Dry Matter Intake and Coefficient of Preference of WAD Bucks fed Ensiled Maize-Cobs, Moringa oleifera Leaves and Cassava Peels*

Treatment	Mean Daily Consumption of WAD Buck (g/Dm)	Coefficient of Preference (CoP)
T_1	516.23[a]	1.04[a]
T_2	522.86[a]	1.05[a]
T_3	524.07[a]	1.06[a]
T_4	420.20[b]	0.85[b]
SEM	40.65	0.36

[a, b]: Means within the same column with different superscripts are significantly different ($p< 0.05$)

Table 4 showed the haematological parameters of WAD bucks fed silage combinations of maize cobs, *Moringa oleifera* leaves and cassava peel. There were significant differences in packeds cell volume (PCV), Haemoglobin (Hb) and red blood cell (RBC) of WAD bucks across the dietary treatments. PCV(%) values were similar in T_2 (33.46) and T_3 (32.02) but significantly higher compared with T_1 (25.26) and T_4 (22.24). haemoglobin concentration (Hb, g/dL) was significantly higher in T_2 (12.22) compared with T_1 (9.47), T_3 (10.28) and T_4 (8.24) respectively while the red blood cell (RBC,× 103/ML) values were similar and significantly highest in T_2 (12.68) and T_3 (12.02) and lowest in T_4 (9.04). However, there were no significant differences in white blood cell, lymphocyte, neutrophils and monocytes of WAD bucks fed the dietary treatments.

Table 4: *Heamatological parameters of WAD bucks fed silage combination of maize cobs, Moringa oleifera and cassava peel*

PARAMETER	T_1	T_2	T_3	T_4	SEM
Parcked Cell Volume (PCV%)	25.26[b]	33.46[a]	32.02[a]	22.24[c]	4.64
Haemaglobin (Hb,g/dL)	9.47[b]	12.22[a]	10.28[b]	8.24[c]	1.08
Red Blood Cell (RBC,×106/ML)	11.04[b]	12.68[a]	12.02[a]	9.02[c]	0.86
White Blood Cell (WBC,×103/ML)	10.33	13.64	11.22	10.04	1.36
Lympohytes (LYM,%)	53.00	56.00	54.00	59.00	5.00
Neutrophils (NEUT,%)	45.00	40.00	43.00	26.00	2.00
Monocytes (MONO,%)	1.00	2.00	3.00	2.00	0.08

[a, b, c]: means witin the same row with different superscript are significantly different ($P<0.05$)

Table 5 shows the serum biochemical indices of WAD bucks fed silage combination of maize cobs, *Moringa oleifera* leaves and cassava peel is shown in table 2. There were significant ($P<0.05$) differences in total protein (TP,g/dL), urea (mg/dL) and glucose Mg/dL) levels WAD bucks across the dietary treatments. The total protein was significantly highest in T_4 (13.04) and lowest (5.04) in T_1. The urea level was highest 9.03 in T3 and significantly lowest in T_1 (7.94) and T_2 (7.80), respectively while the glucose level was significantly

higher in T_2 (90.00), T_3 (90.00) and T_4 (90.00) compared with T_1 (85.00). However, no significant (P<0.05) differences was found in albumin, creatinine and cholesterol levels of WAD bucks fed the dietary treatments. Albumin level ranged between 1.90 (T_1) and 2.36 (T_4). Creatinine (mg/dL) were 0.90 (T_1), 1.00 (T_3) and 0.90 (T_4), respectively while the cholesterol level (mg/dL) ranged between 68.82 (T1) and 69.93 (T_4), respectively. The blood glucose level was significantly higher in T_2 (90.00), T_3 (90.00) and T_4 (90.00), respectively compared to T_1 (85.00)

Table 5: *Serum biochemical indices of WAD bucks fed silage combination of maize cobs, Moringa oleifera leaves and cassava peel*

PARAMETERS	T_1	T_2	T_3	T_4	SEM
Total Protein (g/dL)	5.04^{d}	7.94^{c}	10.23^{b}	13.04^{a}	2.27
Albumin (g/dL)	1.90	2.05	2.09	2.36	0.07
Urea (mg/dL)	7.94^{c}	7.80^{c}	9.03^{a}	8.25^{b}	1.01
Creatinine (mg/dL)	0.90	1.00	1.00	0.90	0.02
Glucose (mg/dL)	85.00^{b}	90.00^{a}	90.00^{a}	90.00^{a}	8.26
Cholesterol (mg/dL)	68.82	69.00	69.24	69.93	5.52

$^{a, b, c, d}$: means witin the same row with different superscript are significantly different (P<0.05)

Discussion

Physical Characteristics of Silages

The observed colour in the results indicates that the silages preserved the original colour of ensiled materials. This agrees with the report by [3] which states that good silage usually preserves the original colour of pasture.

The textures of the silages were firm, except for T4 which had a firm but wet texture which might be due to the 0% inclusion of maize cobs in the treatment. The texture also agrees with the report by [3]. [5] also reported that this range values of 4.0-5.0 as an ideal pH range for the growth and activities of lactic acid bacteria. The temperature recorded during this study was between 27.2 and 29.0°C and the results were similar to those reported by [5] who reported a range of 28.30 - 29.10°C. [5] also reported that the range is ideal for the production of silages and a higher value leads to caramelization of sugars, leading to the darkening and deterioration of the forages.

The recorded odour for the experiment was mainly fruity, except for T_4 which had an alcoholic smell which might be due to the absence of maize cobs in the composition of the silage.

The range of values for dry matter (DM) in the present study is similar to the value reported by Moran [11] on silage fed to dairy cattle. The crude protein (CP) and ether extract (EE) increased with increased inclusion of *Moringa oleifera* leaves in the silage, an indication of potential of *Moringa oleifera* as forage plant with high crude protein value while dry matter (DM) and crude fibre (CF) decreased with increased inclusion of *Moringa oleifera* leaves in the silage. The crude protein (CP) values recorded in the study were all above the critical value of 8.0% recommended for small ruminants [12]. The inorganic content of the feed (Ash) was highest in T_4, an indication of high minerals and some other impurities in the silage [12].

Acceptability

T_1, T_2 and T3 silage treatments were well accepted by West African dwarf bucks. However, T4 was not well consumed by the experimental animals with the coefficient of preference lower than unity. The low acceptability of T_4 might be due to its alcoholic odour. Many factors may affect the free choice intake of feed by ruminant animals and among those factors are the chemical composition and the physical form of the feed [5].

Haematology parameters of WAD bucks fed silage combination of maize cobs, *Moringa oleifera* and cassava peel

The parked cell volume (PCV) values obtained in this study were within the range of 21-35% reported for WAD goats by [8] and also close to the range values of 25.96-29.78 reported by Okoruwa [14] for WAD goats fed feed containing locust bean pulp with melon husk. In contrast, [13] reported higher values of 36.9% and 35.5% for clinically healthy WAD goats and sheep, respectively. It implies that, all the animals on the four experimental diets were not anaemic. The haemoglobin range in this study fell within the range of 7-15g/dL and 7.04- 9.87g/dL reported by [8] and [14], respectively but higher than values of 5-6g/dL obtained by [15] for goats fed fungi-treated Jatropha curens kernel cake rations. The implication of this is that WAD buck fed ensiled maize cobs, *Moringa oleifera* and cassava peels are capable of supporting high oxygen carrying capacity blood in the goats for better oxidation of ingested food and subsequent release of energy for the other body functions as well as transport of carbondioxide out of the body of animals [16]; [17]. Red blood cell (RBC × 10^6/ML) counts observed in this study were similar to the range of 9. 20 - 13.50 reported by [18]. This implies that there would be adequate transport of oxygen and carbon dioxide in the body. Red blood cell indices aid in the characterization of anemia [19]. The white blood cell (WBC) of all the animals across the dietary treatments was within the normal range for healthy WAD goats reported by [20]. This is an indication that goats fed dietary treatments were free of diseases infection and also absence of toxic substance in the diets. Lymphocytes values were within the range of 50-70% as reported for healthy goats by [21]. The higher neutrophil level in this study shows that the bucks seem to possess protective system, thereby providing a rapid and potent defense against any infection. The monocyte values were within the range of 1- 4% as reported by [21]. Monocytes are essential for immune system as they are precursors of macrophages and essential for cell immunity responses [22].

Serum Parameters of Wad Bucks Fed Silage Combinations of Maize Cobs, *Moringa oleifera* and Cassava Peel

The higher value for total protein level in T4 was due to the high inclusion of *Moringa oleifera* which contain high level of nitrogen content. It implies that the higher the level of *Moringa oleifera* inclusion, the higher the total protein [23]. Low urea nitrogen implies that most of the nitrogen intake by animals were used while releasing very few as waste. The high glucose level in the blood indicates the presence of sugar in all the dietary treatments. The albumin, creatinine, and cholesterol were all within the normal range as reported by [23]. High level of creatinine is an index of tissue wastage during the process of body metabolism when the feed is converted to energy due to the injury to the kidney [24]. In the present study, the creatinine values are within the normal range which means there was no tissue wastage. Normal albumin level in this study in an indication good liver condition since liver is the site of production of albumin [24]. Serum glucose is directly connected to energy metabolism and usage in ruminant animals. The values obtained were within the normal range of values reported by [8] for clinically healthy goats and the values obtained shows that silages supplied adequate amount of energy to the experimental animals. The values of blood cholesterol level were within the value of 30.10 to 82. 08mg/dl reported by [25] fed WAD goats on diets containing different protein level. This implies that the fat produced was well utilized for cell membrane, bile salt production as well as a precursor for sex hormone [26]

Moreover it has been reported by [27] that *Moringa oleifera* leaf is rich in protein, vitamins and minerals, especially iron, a precursor of red blood. Also, [28] investigated the efficacy of *Moringa oleifera* leaves extract as a booster in patients with Iron deficiency anemia.

Conclusion

Results from this study showed that all the silages have acceptable physical characteristics of good silage. The crude protein contents of all the silages were above the recommended minimum critical value of 8% recommended for small ruminant by [12] and all the silages were well accepted except for Treatment 4. However, silage T_2 (35% maize cobs + 35% *Moringa oleifera* + 20% cassava peels + 10% urea) had all the physical and proximate attributes that can enhance the production of WAD goats and the silage was accepted by WAD bucks without any negative effect on the haematology and serum biochemical indices of West African Dwarf bucks.

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