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Effects of Urea inclusion on characteristics of Silage blend of Sunflower and cassava peels

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Abstract
Silage-making has great potential to solve seasonal shortage of feed for ruminants in Nigeria by preserving excess forage produced during the wet season for use at the dry period. Furthermore, urea inclusion helps to improve fermentation properties and quality of silage. Therefore the main objective of this experiment was to assess the effect of urea treatment on quality of silage blend of sunflower and cassava peels. Sunflower and cassava peels were thoroughly mixed with varying levels of urea inclusion, compacted and ensiled for 21 days. After 21 days of ensiling period, silage samples were then opened and analyzed for chemical composition and fermentative characteristics. Results showed that crude protein (CP) ranged from 8.0% (0% Urea inclusion) to 9.10% (2.5% Urea inclusion). Nitrogen free extract (NFE) varied between 66.10 % and 67.80 % in 2.5% Urea and 1% urea silages respectively. The silages pH ranged between 4.0 and 4.8 with varying levels of greenish-brown colour and varying level of pungent aroma. The silages broke slowly when touched and remain in-destructible. It was discovered that increasing urea supplementation led to increased fermented pH of the silages. It was also observed that urea supplementation increased total crude protein of silage.
Keywords: *Sunflower, silage quality, chemical composition, ammoniation*

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I. Introduction

Livestock play a very crucial role in poverty alleviation, food and nutritional security for the country (Ngongoni *et al*., 2006, 2009; Odongo *et al*, 2010). However, fluctuations in both quality and quantity of feed make the sector unreliable and susceptible to high livestock mortality and low productivity (Vasta *et al*., 2008; Ngongoni *et al,* 2009). Therefore, there is need to conserve forage as silage for utilization in times of deficits, especially in dry season. The materials for making silage have been limited to cereals which lead to direct competition with humans. Therefore, there is need to ensile forages and fodders during time of surplus (especially during the wet season) and making them available during the dry season. Silage-making has great potential to solve seasonal shortage of feed for ruminants in Nigeria by preserving excess forage produced during the wet season for use at the dry period.

Ensiling is a forage/fodder-preservation technique based on the fermentation of lactic acid under anaerobic conditions. Forage plants are considered suitable for ensiling when they have the appropriate contents of dry matter and soluble carbohydrates, and buffer capacity values able to mitigate secondary fermentation losses (Trevisoli, 2014).

The proper compaction of the ensiled material, coupled with the plant characteristics, allows of the adequate fermentation and minimum nutritional losses during ensiling and after silo opening. Despite the nutritional value when ensiling, there may be display of undesirable characteristics such as reduced dry matter content and low palatability (Kamali *et al*., 2012). The excess soluble carbohydrates in some forage may lead to a pH decline to values below optimum, which stimulates secondary fermentations, culminating in loss of ensiled material in the form of gases and effluents (Pinho *et al*., 2014). Thus, the use of chemical additives like urea should be considered in the ensiling of some plant materials, in an attempt to reduce undesirable fermentation losses. Urea addition to these plant silages can control the alcoholic fermentation by increasing pH to the ideal range, which is

3.8-4.2 (Mc Donald *et al.*, 1991). Through the urease enzyme, urea is partially transformed into ammonia during the silage fermentation (Santos *et al.*, 2010). Ammonia has an antimicrobial power, inhibiting moulds and yeasts which are responsible for production of ethanol (Schmidt *et al.*, 2007). Urea addition during the ensiling can thus increase the aerobic stability of the silage by inhibiting the development of yeasts, which use lactic acid and residual soluble carbohydrates after the silo is opened (Schmidt *et al.*, 2014) and prevent the aerobic stability of the silages. In this way, urea might increase aerobic stability by controlling the development of these microorganisms. The use of urea, associated with a compaction density that enables the maintenance of anaerobiosis in the silo, will allow of the production of silages with lower fermentation loses and elevated aerobic stability. The objective of this work is to determine the effects of urea ammoniation at different levels of inclusion on silage blend of wild sunflower leaves and cassava peels.

II. Materials and Methods

Study Location

The experiment was carried out at the goat unit of the Teaching and Research farm, The College of Education, Lanlate, Oyo State. The experiment took place between July 2019 and September, 2019.

Silage making: sunflower leaves were harvested manually from the wild. The harvested leaves were wilted for 48 hours in order to reduce the moisture content and later chopped into 2-3cm length for ease of compaction and consolidation. Dried cassava peels were brought around the study area. All silages were prepared from 50% each of harvested and wilted sunflower with 50% dried cassava peels. Five urea levels (0%, 1.0%, 1.5%, 2.0% and 2.5%) with 3 replicates each of the treatment was carried out. Filling in mini silos and compaction was done simultaneously to eliminate inherent air. The silage was prepared in 50kg polythene bags in triplicate, the polythene bags were sealed and compressed with piles of heavy stones in 300litres drum. Fermentation was done for 21 days. The treatments were (50% sunflower +50% cassava peel+ 0% urea, 50% sunflower +50% cassava peel+ 2.5% urea, 50% sunflower +50% cassava peel+ 5% urea, 50% sunflower +50% cassava peel+ 7.5% urea and 50% sunflower +50% cassava peel+ 10% urea).

Experimental design

Complete randomized design

Determination of silage quality: Fermentation of the experimental silage was terminated and silage was opened after 21 days for silage quality characteristics were colour, aroma, texture, pH and temperature according to Babayemi and Igbekoyi (2008). Immediately the silage was opened, a digital thermometer was inserted to determine the temperature. Sub-samples from different points and depths were late taken and mixed together for dry matter determination by oven drying at 65^{o}c until a constant weight was achieved. The samples were later milled and stored in air-tight container until ready for chemical analysis. The pH of the sub-sampled silage was done by adding 100ml of distilled water to 25g of each treatment in a beaker and a pH meter glass electrode was inserted to determine the pH. Colour assessment was ascertained using visual observations with the aid of colour charts. The odour of the silage was relatively assessed by setting a five-man panel to determine whether fruity, pleasant, pungent or alcoholic.

Chemical and statistical analysis: Crude protein, crude fibre, ether extract and ash content of the silages were carried out in triplicate as described by AOAC (2000). The fibre fractions: acid detergent fibre (ADF), neutral detergent fibre (NDF) and acid detergent lignin (ADL) were determined according to Van Soest *et al.* (1991). Data were analysed by ANOVA using the procedure of SAS (SAS 2002). The significant means separated using the least significant difference of the same package.

III. Results and Discussion

Proximate composition of silage blends of Sunflower leaves and cassava peel (g/100g) on DM basis

Proximate composition of silage blends of Sunflower leaves and cassava peel is presented in Table 1, Dry matter (DM) range from 62.59% (Diet 4) and 84.57% (Diet and 4. It was observed that the silage has low dry matter content as a result of higher moisture content available in the sunflower leaves. This is in line with the findings of . increasing levels of Pineapple waste, the DM decreased.

Crude Protein on the other hand increased with increasing level of Urea. The CP values obtained were: 12.15%, 12.75%, 13.42% and 13.74% for Diets 1, 2, 3 and 4 respectively. Although, there

was no significant change among the treatments. In the case of Crude fibre CF, the values varied from 12.44% for diet 1 and 13.68% for diet 4. Ether extract in the respective Diets varied from 2.85 in Diet 4 and 5.51% in Diet 1. Ash contents of the diets ranges from 3.58 in Diet 4 and 6.06 in Diet 1 which is the control. The values obtained for NDF were between the range of 63.84 and 66.15%.

Table 1: Proximate composition of the experimental diets (g/100g) on DM basis

	T1	T2	T3	T4	T5
Cassava peel	50	50	50	50	50
Sunflower	50	49	48.5	48	47.5
Urea	-	1	1.5	2	2.5
Total	100	100	100	100	100
DM	29.80	29.50	29.35	29.80	29.05
Crude Protein	8.00	8.10	8.30	8.65	9.10
Crude Fibre	23.8	23.49	23.8	23.8	23.02
Ether Extract	6.15	6.04	6.00	6.15	6.15
Ash	18.95	18.63	18.95	18.31	18.15
NFE	67.75	67.80	67.75	67.75	66.10

Trt 1: 0% PW +68%CP Trt 2: 20% PW +48%CP
Trt 3: 40% PW +28%CP Trt 4 : 60% PW +8%CP

Physical characteristics of silage blends of sunflower leaves and cassava peels with varying inclusion of urea

Presented in Table 2 are the physical characteristics of silage blends of SFL and CP with varying levels of urea inclusion. The value obtained for pH varies from 4.0 and 4.8 for diets 1, 2, 3 and 4 respectively. Similarly, smell obtained for the silage blends were pungent all the diets. The values obtained for temperature of the silage blends ranged from 31.4 to 31.5. The colour of the silage blends was observed were all greenish brown. However, for all the parameters studied, there were significant differences.

Table 2: Physical characteristics of silage blends of sunflower and cassava peel with varying levels of urea inclusion.

Ingredient	TRT 1	TRT 2	TRT3	TRT 4
pH	4.8	4.3	4.1	4.00
Smell	Pungent	Pungent	Pungent	Pungent
Temp. (^{o}c)	31.5	31.6	31.4	31.4
Texture	Sticky	Firm	Firm	Strongly firm
Colour	Greenish brown	Greenish brown	Greenish brown	Greenish brown

Trt 1: 50% SFL +50%CP Trt 2: 50% SFL +50%CP
Trt 3: 50% SFL +50%CP Trt 4 : 50% SFL +50%CP

IV. Discussions

The physical properties of the silages are presented in Table 2. These characteristics (Color, moisture, odor and moldiness) help us to determine how well preserved silages are. Generally, in terms of acceptability of silage to animals, the most important physical characteristic is odor. The silage produced Diet 1 was light brownish as against silages produced from Diets 2, 3 and 4. The odor of the silages varied from pungent to strongly pungent with increase as urea inclusion in diets increased. The various silage colours obtained in the present study were close to the original colour of both feedstuffs and this is in agreement with the findings of Oduguwa *et al.* (2007). These physical features like odor and color were similar to works of Man and Wiltorsson (2002). All the silages retained their initial colour, which indicated good quality silage (Oduguwa *et al.*, 2007).

The temperature of fermentation varying from 31.4-31.5^{0}c was presumed to produce excellent silage (Muck, 1996). The temperature of silage with cassava peels were 20^{0}c and lower than

the range (25-270c) obtained by Babayemi (2009) in silage of Guinea grass. The temperature range appears to be the operating temperature for normal silage fermentation, good quality silage should be cooled at opening and at feed out phase having a normal room temperature (Mc Donald et al. 1995)

Total crude protein was found to increase with increased level of Urea inclusion. This is in line with the wok of Kang *et al*. (2018) who discovered increase in both crude protein and pH value of cassava top silage with increased urea inclusion.

The pH value of the silages was within the range of 4.0-4.8 classified to be pH for good silage (Menesses *et al*., 2007). Generally, pH is one of the simplest and quickest ways of evaluating silage quality. However, pH may be influenced by the moisture content and the buffering capacity of the original materials. Silage that has been properly fermented will have a much lower pH (be more acidic) than the original forage. Kung and Shaver (2002) in their interpretation of silage analyses stated that a good quality grass and legume silage-pH values in the tropics ranges between 4.3 and 4.7. The pH value of 4.0 obtained in this study was in agreement with 4.2 -5.0 reported by Babayemi (2009) and 4.3-4.7 by Kung and Shaver (2002). Moreover, lower pH of silage could result from higher lactic acid concentration in those silages. Cao *et al*. (2009) stated that lactic acid is the strongest acid in the silage, and its presence will decrease pH more effectively than other volatile fatty acids (VFAs).

V. Conclusion and recommendations

According to the results obtained in this study, urea treatment increased CP (though not significant) content of the silage blends of sunflower and cassava peels as compared with the untreated silage. Silage characteristics in terms of colour, aroma, texture, pH and temperature were similar among the silage and were within the acceptable properties of well-made silage.

Therefore, based on this study, it is concluded that addition of urea improved silage properties and quality.

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