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EFFECTS OF FRUITS PEELS AS AN ADDITIVES ON ENSILING QUALITIES OF GAMBA GRASS (*Andropogon gayanus*)

***[1]M. Dahiru., [2]S.L. Abdurrahaman [2]A.M. Umar., [1]Y. Muhammad., [1]A.S. Muhammad., [1]H.M Rahama., [1]H. Halilu and [1]B. Abdullahi**

[1]Department of Animal Health and Production, Binyaminu Usman Polytechnic, P.M.B. 013 Hadejia, Jigawa State, Nigeria
[2]Department of Animal Science, Federal University Dutse, P.M.B. 7156, Dutse, Jigawa State, Nigeria
*Corresponding author email and phone number: mansurdahiru@bupoly.edu.ng (+234 706 147 2838)

ABSTRACT

The research was conducted to evaluate the ensiling qualities of Gamba grass (*Andropogon gayanus*) with Orange (*Citrus sinensis*), Watermelon (*Citrillus lanatus*) and Pineapple (*Ananas comosus*) peels as silage additives. *Andropogon gayanus* was sole ensiled (0% peels) as control (T1). However, it also ensiled with the peels of *Citrus sinensis*, at 2% (T2), 4% (T3), 6% (T4), *Citrillus lanatus* at 1% (T5), 3% (T6), %5 (T7) and *Ananas comosus* at 1% (T8), 3% (T9) and 6% (T10) levels of inclusion respectively, making ten (10) treatments and were replicated three times in a completely randomized design. Means were separated using Fisher's Least Significant at probability level of 0.05. The *Andropogon gayanus* was harvested and chopped into 1 to 2 cm manually. The chopped grass was combined with each of the fruit's peels based on treatments and ensiled for 3weeks in silos at room temperature. They were evaluated for colour, aroma, pH, proximate composition, energy and minerals content. The results revealed that there were significant ($P<0.05$) differences in all the parameters evaluated. The pH values decrease to acidity with increase in the levels of peels inclusion. In term of minerals contents T1 and T7 were superior in Mg, Ca and Na compared to other treatments. In conclusion, addition of fruits peels in *Andropogon gayanus* silage improved qualities and it is therefore recommended that, only *Citrus sinensis* peels can be added up to 6%, while the remaining peels should not exceed 3%, because it may result in poor quality silages with rancid aroma.

Keywords: Additives, *Andropogon gayanus*, ensiling, fruits and nutritive value.

INTRODUCTION

One of the limiting factors in ruminant production is inadequate and low quality of feedstuff during the dry season in the semi-arid zone of Nigeria (Abdurrahaman *et al.*, 2018b). Scarcity of forages is the major challenge to snowballing ruminant productivity in developing countries more especially Nigeria. In most of these countries, the natural pastures which are the predominant basal diets are usually scarce in the dry season and characterized by fibrous and lignified nature with the attendant low nutritive values, resulting in limited intake, nutrient digestibility and utilization (Vincent *et al.*, 2015). Silage additives are natural or industrial products added in either large or small quantities to the forage or grain mass with the aim of controlling the preservation process so that the nutrients present in the original fresh forage can be preserved as much as possible and to ensure that the growth of lactic bacteria predominates during the fermentation process, producing lactic acid in quantities high enough to ensure a good silage (Abdurrahaman *et al.*, 2018b).

Additives promote production of desirable lactic acid to lower the pH of silage, these include; fermentable carbohydrates (sugar sources such as molasses, sucrose, glucose, citrus pulp, pineapple pulp, sugar beet pulp etc.), enzymes (celluloses, hemicelluloses and amylases) and inoculants such as Lactic acid bacteria (Abdurrahaman *et al.*, 2018 b). The research evaluated the effects of inclusion levels of Orange (*Citrus sinensis*), Watermelon (*Citrillus lanatus*) and Pineapple (*Ananas comosus*) peels as fermentation stimulants on the silage qualities of Gamba grass.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Department of Animal Health and Production, Binyaminu Usman Polytechnic, Hadejia, Jigawa State. Hadejia lies in the Northern-eastern part of the state with latitudes $12^0\ 13^l$ - $13^0\ 60^l$ N and longitudes $9^0\ 22^l$ - $11^0\ 00^l$ E (Garba *et al.*, 2016). The climate of the area is semi-arid. It is characterized by long dry season and a short wet season from June to September. The temperature is 27.2 - 30.0^0C, while the total annual rainfall ranges from 600 to 762mm, the regional vegetation falls within the Sudan Savannah type with extensive open grassland and few scattered trees (Dahiru *et al.*, 2022). The environment is conducive to different species of livestock production such as cattle, sheep, goats, rabbits, donkeys, horses and poultry (JARDA, 2012). Crops grown in the region includes millet, rice, sorghum, maize, cowpea, groundnut, watermelon, tomato, soya bean, sesame and so many other tree crops. Commercial agricultural products include grain of cereals and pulses, horticultural crops and livestock.

Experimental Design and Data Analysis

The experiment was layout in a completely randomized design (CRD) with ten (10) treatments; Sole *Andropogon gayanus* (0% peels) as control (T1), *Citrus sinensis* peels at 2% (T2), 4% (T3), 6% (T4), *Citrillus lanatus* peels at 1% (T5), 3% (T6), %5 (T7) and *Ananas*

comosus peels at 1% (T8), 3% (T9) and 6% (T10) levels of inclusion respectively and were replicated three times as shown in Table 1.

Data collected were analyzed with Analysis of Variance (ANOVA) using of GenStat (2014) package and the differences between means were separated using Fisher's Least Significant at probability level of 0.05.

Table 1: Treatments Combination with Different Fruits Peels in Rated Levels of Inclusion as Silage Additives

Treatment	Grass and Peels (%)			
	Andropogon gayanus	***Citrus sinensis***	***Citrillus lanatus***	***Ananas comosus***
T1	100 (Control)	-	-	-
T2	98	2	-	-
T3	96	4	-	-
T4	94	6	-	-
T5	99	-	1	-
T6	97	-	3	-
T7	95	-	5	-
T8	99	-	-	1
T9	97	-	-	3
T10	94	-	-	6

Silage Preparation

A field re-growth Gamba grass (*Andropogon gayanus*) was sampled at soft dough stage, when the inflorescences is about 96% and 74% fresh green leaves and about 37% brown senescence leaves below the mid stem. Whole Gamba was cut manually using a sickle 4-8cm from the ground level in order to avoid soil contamination and wilted for about 10hours before chopping. The Orange (*Citrus sinensis*), Watermelon (*Citrillus lanatus*) and Pineapple (*Ananas comosus*) peels were collected from the fruits sellers in Hadejia Central Market. The harvested Gamba grass were chopped 1-2cm length.

Addition of the chopped three different fruits peels were done at different percentage rates per weight of the fresh chopped Gamba grass and were ensiled in laboratory silage bottles (1000ml) as shown in table 1. Each of the treatment combinations were ensiled in silo and compressed until filled to the brim for appropriate compaction. Grease was applied to the lids before screwed back tightly to provide anaerobic environment which is suitable for fermentation. The silos were kept at room temperature for 21 days.

Physical Evaluation of the Silage

After 21 days' fermentation, the contents of the silos were examined physically and scored for colour. Each silo was opened, the content from the top 1-2cm of the silo was remove out to prevent possible contamination by the grease used as air sealant, forceps were used to take samples from the middle of the bottles and the content scored for aroma on a subjective score of 1 to 4 by three independent scorers as shown in Table 2.

Table 2: Description of Colour and Aroma Rating used as Indices of Silage quality

Rating	Colour	Aroma
1	Dark or deep brown	Putrid or rancid
2	Light brown	Pleasant
3	Pale yellow	Sweet
4	Yellowish green	Very sweet

Source: Abdurrahaman *et al*., (2018a).

pH was determined using digital pH meter by diluting 10g of the sample with 50ml of distilled water. However, sub-samples were taken from the prepared silages for proximate and minerals analysis.

Proximate Composition and Energy Content of *Andropogon Gayanus* Silage with Different Fruits Peels

Samples from each replicate of the treatment were grounded to pass 1mm screen using Tecator Cyclotec 1093 sample mill. Proximate analysis was done to determine nitrogen (N) for crude protein determination (N×6.25), crude fibre (CF), ether extract (EE), nitrogen free extract (NFE) and ash according to AOAC (1999). Organic matter (OM) was calculated as the difference between Dry matter and ash. Energy was calculated using Pauzenga (1985), Ca, Mg and Na were also analyzed according to AOAC (1999).

RESULTS AND DISCUSSIONS

pH, Colour and Aroma of the Prepared Silages

Table 3 shows the pH, colour and aroma of the resultant silages. There were significant differences ($p<0.05$) in pH values of the evaluated silage. The pH obtained in this research varied from 3.93 in T10 to 5.05 in T1. The results obtained with the exception of T1 and T2 all other treatments have pH values within the recommended range of 4.22 to 4.70 (Abdurrahaman *et al.,* 2018b). The resultant silage indicated a relationship between pH and aroma, the silage with the lowest pH T10 has a rancid aroma while as the pH alkalinity increases the aroma becomes rancid.

Table 3: pH value, Colour and Aroma of the Prepared Silages

Treatments	pH	Colour	Aroma
T1	5.05^{a}	4	4
T2	4.81^{b}	3	2
T3	4.55^{e}	3	3
T4	4.30^{g}	3	4
T5	4.73^{d}	2	2
T6	4.48^{f}	2	2
T7	4.20^{h}	1	1
T8	4.75^{c}	2	2
T9	4.20^{h}	2	2
T10	3.93^{i}	1	1
SEM	**0.10**		

[a, b, c, and d] Means with different superscripts along column s differ significantly at ($P < 0.05$) Colour: 4= Yellowish green, 3= Pale yellow, 2=Light brown, 1= Deep brown. Aroma: 1 = Putrid, 2 = Pleasant, 3 = Sweet, 4 = Very sweet.

pH is one of the quickest and simplest ways of evaluating silage quality. Kung and Shaver, (2002) reported that silage with pH values range between 4.3 - 4.7 has a good quality and aroma. Most of the pH values showed a linear increase with the inclusion of fruits peels. Most of the treatments have pH values within the recommended rate. This is in line with the report of Leterme *et al.* (1992), who recorded an increase in silage pH when pressed sugar-beet pulp was ensiled with molasses and urea, laying hen excreta or soybean meal and related or attributed such increase to buffering capacity as a result of ash and ammonia from the uric acid hydrolysis. However, Akinwande *et al.* (2011) reported higher pH of 9.26 when Water Hyacinth was ensiled without additives. Baba *et al.* (2010) recorded a range of 5.51 – 7.21 pH when *Pennisetum pedicellatum* (Kyasuwa) hay was ensiled with varying proportions of poultry litter. Quality of silage can also be evaluated through colour and aroma (Wattiaux, 2000). The colours obtained in this research were close to the original colour of the materials used for the silages. This observation agrees with the results of Oduguwa *et al.* (2007) and Babayemi *et al*. (2010) using similar procedure though with different feed materials.

Table 4: Nutritional potential of *Andropogon gayanus* before ensiling

Parameters Evaluated	*Andropogon gayanus* Forage
%DM	90.05
%CP	10.12
%CF	28.28
%EE	3.89
%ASH	2.40
%NFE	30.98
%OM	87.65
Energy Kcal/kg	1789
Ca (ppm)	15.65
Mg (ppm)	13.78
Na (ppm)	11.57

Proximate Composition and Energy Content of *Andropogon gayanus* Silage with Different Fruits Peels in Rated Levels of Inclusion as Silage Additives

Table 5 shows proximate compositions and energy content of the resultant silage with statistically significant differences ($P<0.05$). Dry matter varied from 81.57% in T4 to 97.90% in T8. Crude Protein (CP) ranged from 13.55% in T10 to 19.02% in T5. All the

treatments had CP values within the recommended range. The CF, EE, ASH, NFE and OM varied at different levels of peels inclusion. Energy varied from 1662 Kcal/kg in T3 to 2665 Kcal/kg in T8.

Table 5: Proximate composition and Energy content of *Andropogon gayanus* Silage with Different Fruits Peels in Rated Levels of Inclusion as Silage Additives

Treatments	%DM	%CP	%CF	%EE	%ASH	%NFE	%OM	ENERGY Kcal/kg
T1	91.92^{i}	16.04^{d}	45.01^{a}	6.21^{c}	9.55^{c}	23.18^{j}	82.37^{b}	1920^{h}
T2	93.95^{g}	13.91^{h}	37.31^{c}	4.39^{d}	12.18^{a}	32.11^{g}	81.77^{c}	2010^{g}
T3	96.37^{d}	14.45^{g}	45.08^{a}	2.15^{h}	11.50^{b}	26.84^{i}	84.87^{a}	1662^{j}
T4	81.57^{j}	16.60^{c}	41.33^{b}	2.70^{g}	9.50^{d}	30.23^{h}	72.07^{d}	1906^{i}
T5	93.12^{h}	19.02^{a}	30.43^{h}	4.37^{d}	8.81^{f}	84.30^{f}	37.36^{i}	2384^{c}
T6	94.17^{f}	13.97^{h}	34.00^{e}	3.80^{e}	9.05^{e}	85.12^{e}	39.45^{h}	2225^{f}
T7	96.30^{e}	16.81^{b}	32.53^{g}	7.74^{a}	8.76^{g}	87.53^{d}	34.14^{j}	2462^{b}
T8	97.90^{a}	15.89^{e}	29.00^{i}	7.32^{b}	5.98^{i}	91.92^{a}	41.13^{g}	2665^{a}
T9	96.73^{b}	14.79^{f}	32.93^{f}	3.80^{e}	5.48^{j}	91.25^{b}	43.00^{e}	2382^{d}
T10	96.48^{c}	13.55^{i}	35.50^{d}	3.30^{f}	6.18^{h}	90.30^{c}	41.39^{f}	2238^{e}
SEM	**0.31**	**0.29**	**0.36**	**0.28**	**0.23**	**0.38**	**0.44**	**27.62**

$^{a, b, c, and d}$ Means with different superscripts along columns differ significantly at ($P < 0.05$) DM = Dry Matter, CP = Crude Protein, CF = Crude Fibre, EE = Ether Extract, ASH = Ash, OM = Organic matter, NFE = Nitrogen Free Extract

Addition of *Citrillus lanatus* Peels at 1% to Gamba grass resulted a silage with highest %CP compared to other silage mixtures. The result of this study regarding the CP content was higher than that reported by Abdurrahaman *et al.* (2018a) and within the range of what was reported by Abdurrahaman *et al.*, (2018b). The crude protein of the resultant silages met the protein requirement for small ruminant production (Abdurrahaman *et al.*, 2017).

Mineral contents of the Prepared Silages

There were significant differences statistically ($P < 0.05$) in the Mg, Ca and Na contents of the resulted silages. T1 and T7 were the superior in Mg, Ca and Na compared to other treatments. Whereas; T8 and T3 were the least in Mg, Ca and Na.

Table 6: Mineral contents of *Andropogon gayanus* Silage with Different Fruits Peels in Rated Levels of Inclusion as Silage Additives

Treatments	Mg (ppm)	Ca (ppm)	Na (ppm)
T1	55.35^{a}	21.68^{g}	22.91^{d}
T2	52.91^{b}	19.63^{h}	20.86^{e}
T3	40.83^{e}	19.46^{i}	15.33^{i}
T4	45.26^{d}	19.65^{h}	17.76^{f}
T5	37.51^{f}	46.00^{b}	28.15^{c}
T6	29.31^{i}	44.10^{c}	28.03^{c}
T7	36.18^{g}	49.20^{a}	30.39^{a}
T8	17.83^{j}	36.17^{e}	17.57^{g}
T9	51.08^{c}	30.17^{f}	30.05^{b}
T10	31.27^{h}	36.22^{d}	17.19^{h}
SEM	**0.03**	**0.11**	**0.04**

$^{a, b, c, and d}$ Means with different superscripts along columns differ significantly at ($P < 0.05$)

The mineral contents evaluated were higher than the values reported by Abdurrahaman *et al.*, (2018a) for Gamba mixed with three tropical legumes forages (Groundnut, Watermelon and Cowpea) This showed that feeding of these silages may not require macro minerals supplementation.

CONCLUSION AND RECOMMENDATION

It is concluded that, addition of fruits peels in Gamba grass silage improves its qualities and recommended that only *Citrus sinensis* peels can be added up to 6% while the remaining peels should not exceed 3%, because it may result in poor quality silages with rancid aroma.

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