Journal of Agriculture, Environmental Resources & Management

Journal of Agriculture, Environmental Resources and Management
ISSN2245-1800(paper) ISSN 2245-2943(online)
5(6)1022-1320; **Dec**.2023; pp1151-1159

www.saerem.com

Effect of time and Potential of fortified plantain pseudostem (Musa Paradisiaca) ensiled with corn chaff as supplemental feed for WAD goats;

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ABSTRACT

This study was conducted to investigate the effect of time on fortified plantain pseudostem ensiled with corn chaff, physico chemical characteristics and potential of plantain pseudostem silage as supplemental feed for WAD goats. Fortified plantain pseudostem with corn chaff were prepared and allowed to undergo fermentation process for 12 days in twelve-week trial. The inclusion rate of plantain pseudostem was arranged at T_i (0%),T_2(25%), T_3 (50%) and T_4 (75%). The silage was opened and analysed before quality assessment and volatile fatty acids were determined at 0, 3, 6, 9, and 12 days. Results showed that dry matter (%) of silages ranged between T_1 and T_4(91.72-92.97),Crude protein (g/100g) was higher in T_2 (14.67) thanothers. The appearance, odour, texture and pH of the silages in T_2 –T_4 had acceptable physical attributes and pH value on T_2. For TVA (Total Volatile Acids) on day 0, T_1 ranged significantly (P< 0.05) from 3.377 to 3.456, on day 3; T_1. ranged from 4.057 to 4.118. On day 6, it ranged from 4.109 to 4.237. Also on Day 9, itranged from 4.246 to 4.327 while on Day 12, it ranged from 4.678 to 4.251.TVA increases along with the period of fermentation. Acetic acid was at highest level for treatment Ion day 12 (1.87%) and the least was recorded on day 0 for treatment 3, T_3 (0.756)for lactic acid which is very important in determination of silage quality.It is concluded that fortified/treated plantain pseudostem ensiled with corn chaff gave the best result on Day 12 and have potential as supplemental feed for ruminants in terms of nutritional and physico-chemical properties. It is therefore recommended thatplantainpseudostem as crop residue should be used as supplemental feed in ruminant nutrition; this will also help in reducing agricultural wastes that can result in environmental pollution.

Keywords: Plantain pseudostem, silage, corn chaff, supplemental feed, WAD goats.

INTRODUCTION: Inadequacy or scarcity of animal feed resources is one of the major constraint limiting the development of livestock production in many developing countries, and is predicated upon irregular access, both quantitatively and qualitatively to feed resources. It is of paramount importance to devise strategies for ensuring regular supply of quality feedstuff to ruminant animals. All efforts in research has been directed towards improvement and supplementation of grasses with crop residues or agro industrial by-products. Other forms of interventions are conservation of grasses, legumes, and crop residues in the form of hay, straw and silage (Babatunde, 2016 and Adesogan,2019)

Silage making is an important tool for farmers in preservation of surplus feed during the wet season in ensuring all year round availability of feed. (Ighaze et al., 2015). Many researchers have worked on different crop residues and their conservation as silage. Inclusion of additive, such as probiotic complex (molasses, urea, yeast) helps to improve silage quality and animal performance. Molasses, sugar beet, bagasse and most recently sugar cane have been used as fermentation stimulant. Other additives such as

wheat offal (Akinwande,Mako & Babayemi, 2011), poultry litter, citrus pulp and cassava peels (Falola,Alasa & Babayemi, 2013) have been documented as ensiling material, however cost and availability are often limiting factor. Plantain pseudostem is rich in carbohydrate, fibre, vitamins and minerals. After harvesting plantain, the whole stem waste away; therefore there is need to convert this crop residue to useful material such as animal feed (Adedotun, 2013). This study was therefore, designed to investigate the suitability of fortified plantain pseudostem as fermentable carbohydrate, fibre and mineral source for ruminant animal.

Materials and Methods

Location and site description: The experiment was carried out at the Teaching and Research Farm of Niger Delta University, Wilberforce Island, Amassoma Located at Longitude 50° and 60°N and Latitude 60° and 70°E of the equator. The mean temperature is 24.0°C – 38.0°C. The mean annual rainfall is between 2000-2483mm. The Soil is sandy loam in texture with an average ph of 5.5. Climatologically, there are two seasons i.e. the rainy season (April to October) and the dry season (November to March). (BSM,2023)Ministry of Land and Survey. Bayelsa State is bounded in the North, Imo State, on the South by the Atlantic Ocean in the West by Delta and on the East by Rivers State.

Duration of experiment: The experiment was conducted from February to May, 2023.

Sampling Method

Completely Randomized Design

Silage Production: Plantain pseudostem was collected from Amassoma and its environs, corn chaff were sourced from commercial pap producer, molasses, urea and yeast were purchased from agro allied store in Yenagoa, Bayelsa State. The plantain pseudostem collected were wilted and used. They were chopped into smaller pieces to aid compaction, mixed with corn chaff and probiotic complex at varying inclusion rate; T1 (0% P. P, 100% C. C) T2 (25% P.P, 75% C.C) T3 (50% P.P, 50% C.C) and T4 (75%P.P, 25%C.C). The mixture were packed, compacted and sealed in a thick polythene bag to create an anaerobic condition for proper fermentation. The silage was opened at interval of 0, 3, 6, 9 and 12 days and samples were taken for analysis between February to May, 2023.

Physico-Chemical Parameters: Physico-Chemical parameters assessment of silages were determined as described by Kilic (1986) and Abegunde(2017) the appearance of the silage in terms of colour was assessed using a colour chart. The smell and texture of the silage were adjudged by six individuals while the ph of the silage was determined with the aid of ph. meter.

Proximate composition: Samples of each silage diet were taken and oven dried at 65°c until constant weight was obtained for volatile fatty acid determination of different day interval. The samples were analysed for their dry matter, crude protein, crude fibre, ash, Nitrogen free Extract according to the standard procedure by A O AC (2000).

Statistical Analysis: All data collected were subjected to analysis of variance (ANOVA) using the procedure of SAS (1999).
Significant treatment mean values were compared using the Duncan Multiple Range Test of the same package outlined by Obi (2021).

Results and Discussion

Table 1.0 PROXIMATE COMPOSITION OF THE EXPERIMENTAL DIETS

Parameter		T1		T2		T3	T4	SEM
Dry matter		91.72[b]	92.97 [a]	91.96 [b]	92.86 [a]	0.02		
Crude protein	8.88 [c]		14.67 [a]	10.16 [b]	10.03 [b]	0.01		
Crude Fiber		25.37 [a]	22.98 [c]	24.30 [b]	22.00 [d]	0.02		

Either extract	1.87 [b]	2.07 [a]	1.84 [b]	1.94 [ab]	0.01	
Ash	15.17 [b]	9.97 [c]	15.98 [a]	8.95 [d]	0.02	
NFE	40.43[b]	43.28[d]	39.68[c]	49.94[a]	0.02	
NDF	66.12 [a]	60.97 [d]	65.27 [b]	62.56 [c]	0.02	
ADF	44.33[b]	40.37 [d]	45.00 [a]	41.73 [c]	0.02	
ADL	21.15 [b]	18.53 [d]	22.17 [a]	19.07 [c]	0.02	
Cellulose	23.18	21.84	22.83	22.66	0.02	
Hemicellulose	21.79	20.60	20.67	20.83	0.02	

Source: University of Ibadan, 2023

Table 1.0 showed the proximate composition of the experimental diet

There was significant difference among the treatments($p< 0.05$)

The Dry matter ranged from91.72 to 92.97 with the highest figure on T2. The CP ranged from 8.88 to 14.67 with the highest value in T2.The crude Fiber ranged from 22.00 to 25.37 with the highest in T1.Ether extract ranged from 1.84 to 2.07 with the highest in T2.Ash ranged from 8.95 to 15.98 with the highest in T3. Lowest NDF (60.97) was recorded in T2, Lowest ADF (40.37) was recorded in T2.Also cellulose and hemicellulose had their lowest values in T2.

Table 1.0- The dry matter of the silage showed that utilization of low protein feed by ruminant improved when urea is added to such feeds (Khampa and Wanapat, 2006). The dietary treatment had significant ($p<0.05$) influence on the dry matter intake of the animals The dry matter of the experimental diet also compared favourably with the values reported by (Fajemisin *et al*., 2017) (91.26-91.69) when West African dwarf goats were fed with urea- molasses treated cassava peel diets. The crude fibre ranged from 22.00 to 25.37% with highest value recorded on T1 (control diet) the fibre ranged was well above the critical level of 12.6% for a suitable diet for ruminant animal. The crude protein ranged from 8.8%- 14.67% with the highest value recorded on diet 2 (25% pp). The crude protein of the diets were more than the critical 7% CP recommended for ruminant animals by McDonald *et. al*., (2001). It implied that the crude protein (CP) content of the diets was adequate to support the goats during growth, and reproduction. The values obtained in this study were similar to the values of 9-12% reported by Aregheore, 1998 in a study on the nutritive value of dry ripe plantain peels as replacement of maize for goats. The highest value of 14.67% was recorded on diet 2 with the 25% inclusion of plantain pseudostem . It could be as a result of fortification with probiotic complex on the plantain pseudostem. The value of ether extract obtained in this study (1.84-2.07) was similar to the values (2.16- 6.68%) reported by Ogofure and Emogbene (2016) for plantain peel and Omotoso,2021 for cassava peel but different from the value reported by Maria, 2016. The values were also similar to the values of (1.06-5.58) reported by Ogofure and Emogbene(,2016), . Higher values than these recorded can lead to quick spoilage of animal feed due to rancidity. The ash values ranged from 8.95- 15.98. This is an indication that the experimental diets contained enough mineral to support the growth and physiological function of WAD goats. High crude protein makes it a suitable feed ingredient since protein is an expensive nutrient in animal feed. Low ether extract indicate the shelf life of the feed. High fibre makes it a suitable feed for ruminant since they can utilize fibre sources better. High ash content indicates availability of mineral which are essential for life. The crude fibre ranged from 22.00- 25.37 with T1

having the highest fibre (25.37). The fibre content observed in this experiment were similar to 22.00% reported by Bake, Adejumo and Sadiku, (2013). High level of crude fibre has been acknowledged by Adesogan(2019), to be inversely related to feed digestibility and nutrient availability.

The NDF and hemicellulose content decreased and increased again with T2 having the lowest value. This was due to degradation of its fibre component during ensiling or fermentation,Olafadehan and Adebayo (2016) previously thought that the reduced fiber content in ensiled cassava peel and threshed sorghum tops was caused by fiber degradation by particular anaerobic bacteria during fermentation and ensiling.However, ADF and cellulose increased from T2 to T3. The lowest value of e experimental diets ranged from 91.72-92.86 and this is similar to the values reported by Aregheore (1998) where dry matter of plantain peel fed to goats ranged from 55.62 to 90.38% The values obtained from this study is also similar to the values reported by Adedeji *et al*., (2018) where goats were fed with urea treated wild cocoyam. Their values ranged from 90.67 to 90.97.

Table 2.0 ANALYSES OF THE VOLATILE FATTY ACIDS OF THE SILAGE AT DIFFERENT TIME INTERVAL

VFAS	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12
PH	0.500^{a}	7.000^{b}	6.500^{ab}	6.250^{ab}	6.00^{ab}
TVA	3.420^{a}	4.076^{b}	4.197^{bc}	4.299^{d}	4.407^{d}
VALERIC	0.020^{a}	0.045^{b}	0.062^{a}	0.568^{b}	1.070^{c}
ACETIC	0.828^{a}	1.040^{b}	1.278^{bc}	1.445^{c}	1.538^{c}
LACTIC	1.048^{a}	1.161^{b}	1.179^{bc}	1.200^{cd}	1.219^{d}
BUTYRIC	0.200^{a}	0.373^{a}	0.705^{b}	0.788^{b}	0.865^{b}
PROPIONIC	0.072^{a}	0.581^{ab}	0.858^{bc}	1.168^{c}	1.189^{c}

Source: Beketin, 2023.

There was significant difference among the treatments (P< 0.05).

The total valeric acid increased as the fermentation process increased with the lowest value (3.420) on Day 0 to (4.407) on Day 12.The Valeric acid recorded the lowest value (0.020) on Day 0 while the highest value (1.070) was recorded on Day 12.The Acetic acid had its lowest on (0,828)on Day 0 while the highest (1.538) was recorded on Day 12.Lactic acid had its lowest value (1.048) on Day 0 and its highest (1.219) on Day12.Butyric acid followed the same trend,lowest value(0.200) on Day 0 while (0,865) been the highest was recorded on Dsay 12. Propionic acid had its lowest value (0.072) on Day 0, while the highest value (1.189) was recorded on Day 12.

Table 2.0 shows analysis of the volatile fatty acids of the silage at different time interval.
For TVA (Total Volatile Acids) on day 0, T_1 ranged significantly (P< 0.05) from 3.377 to 3.456, on day 3; T_1. ranged from 4.057 to 4.118. On day 6, it ranged from 4.109 to 4.237. Also on Day 9, it ranged from

4,246 to 4,327 while on Day 12, it ranged from 4.678 to 4.251.TVA increases along with the period of fermentation. Acetic acid was at highest level for treatment I on day 12 (1.87%) and the least was recorded on day 0 for treatment 3, T_3 (0.756)for lactic acid which is very important in determination of quality silage, highest was recorded for treatment I on day 12 (1.245%) for butyric acid, highest was also on Day 12 for treatment I (1.18%) and the least recorded on day 0 for treatment I. propanoic acid had its highest value on day 12 for treatment I, while the least was recorded on day 0 for treatment I.

For lactic acid, the result also agreed with Oyeyinka *et. al*. (2019) and Adesogan *et al.*(2019) who reported that the longer the fermentation period, the higher the production of lactic acid in banana silage pseudostem. Highest value for lactic acid was recorded on day 12 for treatment I (0%pp, 100%cc). This could be as a result of temperature increase over the fermentation period. The result also agreed with Ajayi *et al.*(2019) who reported that the level of volatile fatty acids (butyric, acetic, lactic and propionic will be high if the fermentation is poor.

They reported that the most undesirable is butyric and acetic but lactic acid improves silage quality over the period of fermentation. It was also observed that the longer the fermentation period, the higher the nitrogen content. Nitrogen increased significantly ($p< 0.05$) from day 0 (0.2115).

Day 3 (0.2797) Day 6 (0.3140, Day 9 (0.3563) and Day 12 (0.3805). The result agreed with Jouany(1981) who reported that recommended values for assessing quality of corn and grass silage is based on important parameters such as Ph, Nitrogen, lactic acid and acetic acid. He also reported that the lower the ph, the better the quality of the silage. Low ph inhibits bacteria activity. The lowest ph was recorded on day 12(5.0) Omotoso *et al.*, (2021) in their study revealed lactic acid, which is largely generated by lactobacilli, is an important sign of high-quality silage fermentation and successful preservation. It was stressed that lactic acid should be the dominant acid in excellent silage since it is stronger than other acids like acetic, propionic, and butyric acid and is primarily responsible for lowering the pH of the silage. It was said that fermentation leading to lactic acid formation leads in low dry matter and energy loss during storage.

Furthermore, the literature stated that NDF (Neutral Detergent Fiber) and ADF (Acid Detergent Fiber) are more realistic indices of feeding value that should be used when evaluating forages and developing feed regimens. It went on to say that NDF is a predictor of voluntary intake because of its contribution to bulk or fill, and that lower NDF levels are desired because NDF normally increases as forages develop. From Day 0 to 12, NDF decreased significantly ($p<0.05$). Also ADF, there was significant ($P<0.05$) decrease as the day increased. The same trend was observed for ADL. This was in agreement with Oyeyinka *et al.*, (2019), Ajayi *et al.*, (2019) who reported that as the period of fermentation increases, the NDF and ADF values decreases.

Table 3.0 PHYSICO CHEMICAL CHARACTERISTICS OF THE SILAGE

Parameter	**T_1**	**T_2**	**T_3**	**T_4**
Colour	Brownish	Brownish	Slightly brown	Greyish

Odour	Brewery	Fruity	Alcohol	Alcohol
Texture	Wet Firm	Moist firm	Moist firm	Moist
pH	6.0	5.0	6.0	6.0
Temperature	34	34	34	34

Source: Beketin, 2023

Table 3.0 shows the physico chemical parameter of the silage as follows; Appearance from T_I to $T_{4\ indicated}$ the colour' Brownish for T1, chocolate for T2, slightly brown for T3 and brownish. Grey for T4. For the odour Brewery, fruity and alcohol. Texture; wet firm to moist firm. pH was the same (6.0) for T1, T3 and T4 while only T2 had 5.0. Temperature was the same for all treatments (34^0C). The report obtained from this study is similar to the one reported by Adesogan, (2019) on silage quality, dry matter intake and digestibility by West African dwarf sheep of Guinea grass (*Panicum maximum*). Good silage always exhibit original colour of the ensiled material hence the brownish and chocolate colour could be as a result of proportion of plantain pseudostem to corn chaff.

This was in order as the prevalent brown/chocolate was the colour of pseudostem after wilting. The fruity smell is an indication of good quality silage and well preserved as reported by (Oduguwa *et al*, 2007, Maria ,2016). All the silages had firm textures, though with varying moisture content. It could be due to inclusion of corn chaff. This agrees with the findings of Ososoya and Olorunisomo (2015) when they reported better texture in brewers waste silages ensiled with corn cobs. The lowest ph value was observed in T2 (5.0) which is an indication of good silage (Abegunde *et al.*, 2017). The result also agrees with the findings of Maria, (2016) when he reported similar physico-chemical parameters in banana silage.

In general, pH is a simple and quick approach for determining silage quality. However, the moisture content and buffering capability of the original materials might have an impact. Fermented silage often has a lower pH (is more acidic) than unfermented silage (Abegunde *et al.*, 2017).

Conclusion: To assess good quality silage, The lactic acid,butyricacid ,aceticand propionic acid values must be low.The low values indicated good fermentation and with the aid of probiotic complex, the duration of fermentation was reduced.Also, the physico chemical parameters in this study gave good properties of good silage; therefore treated/fermented plantain pseudostem has potential as feed supplement for ruminant animal.

Recommendation: I therefore recommend the use of probiotic complex as feed additive to hasten the

fermentation process of silage as supplemental feed for ruminant animal especially during dry season.

Also further research should be carried out on other crop residues that can be combined with plantain pseudostem as suitable feed for livestock.

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