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ORIGINAL RESEARCH ARTICLE

Physical characteristics, chemical composition and preference for elephant grass ensiled with wet brewers grain and gliricidia leaf by Sokoto Gudali cattle

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ABSTRACT

The ability of tropical grass silage to enhance productivity of cattle in Nigeria is often limited by its low protein content. In this study, elephant grass (EG) and Cassava peel (CSP) were ensiled with wet brewers grain (WBG) and gliricidia leaf (GL) in order to increase the protein content of the silage. Four isonitrogenous silage mixtures were prepared as follows: EG-control (60%EG + 38%CSP + 2%Urea); EG-WBG (40%EG + 19%CSP + 1%Urea + 40%WBG); EG-GL (40%EG + 19%CSP + 1%Urea + 40%GL); EG-WBG/GL (40%EG +19%CSP + 1%Urea + 20%WBG + 20%GL). The pH, physical characteristics and chemical composition of the silage mixtures were determined after 21 days of ensiling. Preference of the silages by cattle was determined using six Sokoto Gudali cows in a cafeteria feeding system. The pH of the silages ranged from 3.90 to 4.90 with EG-control having the lowest and EG-GL, the highest. Colour of silages varied from olive to deep green while aroma varied from pleasant to very pleasant. All silages had a firm texture. The crude protein content of silage ranged from 24.1% in control to 25.1% in EG-WBG while acid detergent fibre varied from 20.0% in EG-WBG to 28.9% in control. The coefficient of preference (CoP) varied from 0.65 to 1.38 while % preference varied from 16.4 to 34.6%. EG-WBG was the most preferred by cattle while EG-GL was least preferred. Wet brewer's grain and gliricidia can be used to improve protein content of tropical grass silage; however, the offensive smell of gliricidia may have to be masked with the more acceptable WBG.

Keywords: Cattle, Elephant grass, Gliricidia leaf, Silage, Wet brewers grain

INTRODUCTION

Silage-making has great potential to solve dry season shortage of feeds for ruminants in Nigeria and could play a key role in resolving the perennial conflict between pastoralists and farmers in Nigeria. Silage making is also crucial to the development of the dairy industry in Nigeria since it affords cattle farmers the opportunity to localize their herds and feed them in-situ. The nutritive value of silage prepared from tropical grasses is however limited by its low protein content (Olorunnisomo and Adesina, 2014) and performance of dairy animals fed solely on such silage is expectedly low. Hence, there is need to incorporate protein-rich additives into grass silages to improve their nutritive value for dairy cattle.

The current drive to popularise high-yielding fodder crops to boost smallholder dairy farming in Nigeria must be matched with appropriate fodder conservation technology like silage-making. Elephant grass is a high-yielding tropical fodder with high potentials for silage cropping due to its energy profile and good response to intensive cultivation. Cassava peel is a by-product of cassava processing that has been used extensively in ruminant feeding in Nigeria due to its high digestible energy relative to grasses. It also serves as a good source of fermentable carbohydrates in silages (Olorunnisomo, 2011; Olorunnisomo and Fayomi, 2012). *Gliricidia sepium* is a multi-purpose legume tree that is cultivated extensively in the tropics for green manure, live fence, firewood, coffee shade and fodder (Simons and Stewart, 2007). The leaf is high in protein (about 20% CP) and has been used as forage for

ruminants in tropical areas. Wet brewer's grain is a by-product of the brewing industry with relatively high protein and digestible energy content (Westendorf and Wohlt, 2002). Protein content of WBG range from 24 to 35% with an average of 29.6% (West et al.,1994; Westendorf and Wohlt, 2002) Since sundrying is difficult during the wet season when these feed materials are in abundance, ensiling might be the most practical method for conserving these materials for year-round feeding of cattle and other ruminants. Ensiling elephant grass with high-protein WBG and gliricidia leaf, provides opportunity to improve nutritive value of elephant grass silage for ruminant animals Hence, this study was designed to determine silage quality and chemical composition of elephant grass and cassava peel ensiled in mixtures with wet brewer's grain, and gliricidia leaf; and preference, of Sokoto Gudali cattle for the ensiled mixtures.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Dairy Unit of the Teaching and Research Farm (TRF), University of Ibadan which falls within latitudes 7^0 15^1 N and 7^0 30^1 N, and longitudes 3^0 45^1 E and 4^0 0^1E.

Silage Preparation

Fresh cassava peel (CSP) was collected from garri processors in Mokola area of Ibadan. Elephant grass (EG) and gliricidia leaves (GL) were harvested at 56 and 84 days of regrowth respectively from plots within the University of Ibadan. Wet Brewer's grain (WBG) was collected from the Nigerian Breweries in Ibadan. All materials except wet brewer's grain were chopped with an automated chopper to reduce the particle size to about 3cm to enhance compaction. Chopped EG and CSP were mixed with urea and WBG or GL to form the experimental diets as follows:

EG-control: 60%EG + 38%CSP + 2%Urea
EG-WBG: 40%EG + 19%CSP + 1%Urea + 40%WBG
EG-GL: 40%EG + 19%CSP + 1%Urea + 40%GL
EG-WBG/GL: 40%EG +19%CSP + 1%Urea + 20%WBG + 20%GL

The mixtures were packed inside 20-litre plastic drums, and compacted manually and sealed with polythene sheets. Sandbags were placed on the compacted mixtures to exclude air in the silage. Silage was kept until required for acceptability study. Another set of mixtures were ensiled in 4-litre mini silos in triplicates for quality evaluation and determination of chemical composition.

Silage Quality and Chemical Analysis

Silage inside mini silos were opened for quality assessment after 21 days. The quality parameters assessed were colour, smell, texture and pH. Samples were taken in triplicates for dry matter determination and chemical analysis. The pH of samples was determined by soaking 50g of silage material in 100ml of distilled water for 12 hours. The pH of the supernatant was read using a pH meter (Model: PHS-25, China).

Dry matter content of silages was determined by drying samples inside a forced- draught oven at 105^{o}C until constant weight was obtained. Results were adjusted for loss of volatile fatty acids using the methods of Fox and Fenderson (1978). Nitrogen content of silages was determined by the micro Kjedhal method following the procedures of AOAC (2005). Crude protein was calculated from nitrogen content by multiplying with the factor 6.25. Detergent fibre fractions were determined according to methods of Van Soest *et al*. (1991).

Acceptability Study

Six Sokoto Gudali cows weighing 300 to 350kg and about 3 years old were used to evaluate the free choice intake of the silages. The animals were selected from the University cattle herd which were already adapted to local conditions and in good state of health. An open paddock fenced with wires and devoid of grass or other sources of feed was used for the study. Experimental silages (20kg each) were measured into 4 different feeding troughs (2m x 6m each) which were placed apart from each other inside the paddock. The animals were given access to the silages daily for only 4 hour for a total of 14 days (Olorunnisomo and Fayomi, 2012). This was done to allow animals sufficient time to express their preference but not to satisfy their appetite due to the limited quantity of feed available. Consumption was measured by the difference between quantity of silage offered

and remnants after 4 hour. The coefficient of preference (CoP) was calculated as the ratio of individual silage intake to the average intake of all silages. Silage was considered relatively acceptable if CoP was greater than unity. Preference was calculated as the ratio of individual intake to total intake multiplied by 100 (Olorunnisomo and Fayomi, 2012).

Statistical Analysis

All data obtained were subjected to analysis of variance (ANOVA) and significant means were separated by Duncan's multiple range tests using the SAS (1995) procedures.

RESULTS AND DISCUSSION

The pH and physical characteristics of experimental silages are presented in Table 1. There were significant differences in the pH values of the ensiled mixtures. The least pH was recorded for silage without WBG or gliricidia (EG-control) and the highest for silage with gliricidia (EG-GL). A low pH indicates rapid fermentation and formation of organic acids (which in turn preserves the ensiled mass) while a high pH indicates poor fermentation and predisposes the ensiled mass to putrefaction.

Table 1: Silage characteristics of elephant grass ensiled with wet brewer's grain and gliricidia leaf

	Silages				
Parameters	EG-control	EG-WBG	EG-GL	EG-WBG/GL	SEM
pH	3.90^{b}	4.20^{ab}	4.90^{a}	4.40^{ab}	0.24
Colour*	Olive green	Olive green	Deep Green	Olive green	-
Aroma	Pleasant	Very Pleasant	Pleasant with slight gliricidia smell	Pleasant	-
Texture	Firm	Firm	Firm but wet	Firm	-

ab: means with different superscripts within the same row are significantly different (P< 0.05)
EG-control:60%EG + 38%CSP + 2%Urea
EG-WBG: 40%EG + 19%CSP + 1%Urea + 40%WBG
EG-GL: 40%EG + 19%CSP + 1%Urea + 40%GL
EG-WBG/GL: 40%EG +19%CSP + 1%Urea + 20%WBG + 20%GL
*Colour of elephant grass which was initially light green was used to judge the change in colour

Although all silages in this study had pH within acceptable range (Bilal, 2009; Nhan et al., 2009), the pH for EG-GL was a bit higher than other silages. This is indicative of high buffering capacity of gliricidia leaf which is typical of legume silages (Wilkins, 2001; Olorunnisomo and Fayomi, 2012). The addition of cassava peel to the mixtures provided sufficient soluble carbohydrates to surmount the resistance to pH change in gliricidia leaf.

The colour of the silages varied from olive to deep green. The addition of cassava peel (and wet brewer's grain) to the mixture is thought to have assisted the elephant grass component in maintaining its green colour during ensilage. The aroma of the silages ranged from pleasant to very pleasant, indicating well-made silage. EG-GL however, had a slight gliricidia smell which impacts negatively on its acceptability by cattle (Olorunnisomo and Fayomi, 2012). All silages in this study were firm in texture. This is probably due to the relatively high fibre content of the silage components.

The chemical composition of silage components and experimental silages is presented in Tables 2 and 3 respectively. The dry matter content of the forages (elephant grass and gliricidia leaf) is relatively lower than that of wet brewer's grain and cassava peel which are agro-industrial by-products. Crude protein in gliricidia leaf and wet

brewer's grain (protein sources) is much higher than in elephant grass and cassava peel which are regarded as energy sources. Expectedly, fibre fractions are higher in elephant grass and gliricidia forage than wet brewer's grain or cassava peel.

Table 2: Chemical composition (%) of elephant grass, wet brewer's grain and gliricidia leaf used in silage-making

	Silage components			
Parameters	Elephant grass	Gliricidia leaf	Wet brewer's grain	Cassava peel
DM (%)	18.6	17.0	26.8	32.2
CP (%)	7.80	24.5	25.1	5.10
NDF (%)	64.0	56.2	44.3	49.6
ADF (%)	39.4	35.5	21.4	22.8
ADL (%)	14.8	16.2	3.50	9.50

Table 3 shows that there were significant differences ($P< 0.05$) in dry matter content of silages which varied from 25.3 to 28.7%. The inclusion of wet brewer's grain appears to increase the dry matter content in the grass silage while gliricidia leaf reduced it. This may be a reflection of the higher dry matter content in wet brewer's grain compared to gliricidia leaf (Table 2). The protein content of the silages did not differ significantly from each other since they were formulated to be iso-nitrogenous using urea. The protein content of the silages is above the minimum required for effective rumen function and moderate production levels for ruminants (Milford and Haydock, 1965).

Table 3: Chemical composition (%) of elephant grass ensiled with wet brewer's grain and gliricidia leaf

	Silages				
Parameters	EG-control	EG-WBG	EG-GL	EG-WBG/GL	SEM
DM (%)	26.4^{ab}	28.7^{a}	25.3^{b}	26.9^{ab}	1.20
CP (%)	24.1	25.1	24.3	24.7	0.92
NDF (%)	52.1^{a}	38.4^{c}	48.7^{ab}	42.0^{b}	0.87
ADF (%)	28.9^{a}	20.0^{b}	23.9^{b}	21.8^{b}	1.15
ADL (%)	10.0^{ab}	8.50^{b}	11.0^{a}	9.10^{b}	1.20
GE (Kcal/g)	2.96	2.99	2.91	2.94	0.20

abc: means with different superscripts within the same row are significantly different ($P< 0.05$)
EG-control:60%EG + 38%CSP + 2%Urea
EG-WBG: 40%EG + 19%CSP + 1%Urea + 40%WBG
EG-GL: 40%EG + 19%CSP + 1%Urea + 40%GL
EG-WBG/GL: 40%EG +19%CSP + 1%Urea + 20%WBG + 20%GL

There were significant differences ($P< 0.05$) in the fibre fractions among the silages with control (elephant grass silage without WBG or gliricidia) having the highest fibre fractions and EG-WBG (silage with wet brewer's grain) having the lowest. This can be attributed to the low fibre components in wet brewer's grain (Table 2) which formed 40% of the EG-WBG mixture. In view of this and the high protein content, this silage mixture (EG-WBG) is expected to be more digestible than other silage mixtures in this study when fed to ruminant animals. The gross energy content did not differ significantly ($P > 0.05$) among the silages. With an average of 2.95 kcal/g of gross energy, these silages can sustain a satisfactory level of

production among small ruminants and indigenous cattle of Nigeria. The intake and preference of Sokoto Gudali cows for elephant grass ensiled with wet brewer's grain or gliricidia leaf after 4 hour (Olorunnisomo and Fayomi, 2012) of offer is presented in Table 4. Acceptability and preference of the animals for the silages were estimated using the coefficient of preference (CoP) and percent preference.

Table 4: Preference of Sokoto Gudali cows for elephant grass ensiled with wet brewer's grain or gliricidia leaf

	Silages				
Parameters	EG-control	EG-WBG	EG-GL	EG-WBG/GL	SEM
Intake (kg, wet basis)	3.18^{b}	4.66^{a}	2.39^{c}	3.40^{b}	0.97
Coefficient of preference	0.96^{b}	1.38^{a}	0.65^{c}	1.01^{b}	0.56
% Preference	23.89^{b}	34.57^{a}	16.37^{c}	25.17^{b}	2.73
Ranking	3rd	1st	4th	2nd	

abc: means with different superscripts within the same row are significantly different (P< 0.05)
EG-control:60%EG + 38%CSP + 2%Urea
EG-WBG: 40%EG + 19%CSP + 1%Urea + 40%WBG
EG-GL: 40%EG + 19%CSP + 1%Urea + 40%GL
EG-WBG/GL: 40%EG +19%CSP + 1%Urea + 20%WBG + 20%GL

There were significant differences (P < 0.05) in the intake and preference of cattle for the different silages. Animals showed a higher preference for grass silage containing wet brewer's grain than silage with gliricidia. This is thought to be related to the peculiar smell of gliricidia leaf which discourages intake by the animals (Olorunnisomo and Fayomi, 2012). Although animals used in this study had previous experience with gliricidia, the indication is that when presented with a choice, cattle will chose other feeds with better aroma than gliricidia. However, when WBG and gliricidia were included in the mixture in equal proportions, acceptability was greatly improved. The CoP and % preference for the silages followed a similar trend with EG-WBG being the most acceptable, followed by EG-WBG/GL, EG-control and lastly, EG-GL. The high preference for EG-WBG and EG-WBG/GL is linked to the pleasant aroma and palatability of wet brewer's grain which also had a masking effect on the gliricidia smell.

CONCLUSION

The pH and physical characteristics showed that all silages in this study were well-made and within acceptable range for tropical silage. Addition of wet brewer's grain and gliricidia leaf to elephant grass enhanced quality and protein content of the silage. Wet brewers grain improved intake and acceptability of the silage mixture by Sokoto Gudali cows while gliricidia leaf depressed intake and reduced acceptability. However, when both were included in equal proportions, the silage mixture was well accepted by the animals. It is therefore recommended that wet brewer's grain should be included in silage formulations that include gliricidia leaf in order to mask the offensive smell of gliricidia and enhance acceptability by cattle.

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