QUALITY, MICROBIAL AND PROXIMATE COMPOSITION OF CASSAVA PEELS ENSILED WITH BREWERS' SPENT GRAINS

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Abstract

The use of preserved feedstuff in form of silage is a very good strategy to improve livestock performance during seasonal shortages. This study was conducted to determine the quality and microbial composition of cassava peels (CPL) ensiled with brewers' spent grains (BSG). The proximate composition of the feedstuffs was also determined. The ensiled mixtures were: 100 % (CPL) (T1), 50 % (CPL) + 50 % (BSG) (T2) and 40 % CPL + 60 % BSG (T3). The pH decreased with increasing levels of BSG inclusion (3.89 – 3.76). Odour of silage was generally alcoholic. The result showed that the silages were of good quality. Bacteria were significantly different from each other in the three treatments and detected to be low (0.63×10^7 cfu g^{-1}) in T3 and significantly ($p<0.05$) high (19.6×10^7 cfu g^{-1}) in T1 silages. Fungi were significantly ($p<0.05$) low (1.38×10^6 cfu g^{-1}) in T1 and equal ($p>0.05$) in the other two (3.0×10^6 cfu g^{-1}). Overall, bacteria were more than fungi in all silages. Crude protein values ranged from 6.27 – 15.75 g/100g and this increased significantly ($p<0.05$) with increasing levels of BSG inclusion. There were significant differences ($p<0.05$) between the silage materials before and after ensiling. This was also evident in crude protein (CP), crude fat, ash and nitrogen free extract where there were significant ($p<0.05$) differences amongst the treatments. This study showed that inclusion levels of 50 % and 60 % BSG could be a better alternative to sole cassava peel for ruminants.

***Keywords:** Cassava peels, brewers' spent grains, bacteria, fungi*

Introduction

Livestock production in the tropics is greatly hampered by shortage of forage/fodder during the dry season. To tackle this problem, man can apply different strategies such as the utilization of by-products and storing forage from wet season surplus (Llano *et al.* 2008). It has been proved that a rational use of by-products eliminates the myth that supplementation may be carried out through imported cereals and that their use as food for animal production may contribute to the conservation of the environment (Ojeda and Cáceres, 2002). One of the by-products, cassava peels, are regarded as waste and usually discarded and allowed to rot. This abundant waste product, (can be used as a basal diet, source of energy and low in nitrogen content [2-3 %]) unless upgraded, cannot sustain growth, production and reproductive function in ruminants. Fermentation has been used to enhance the nutritive potentials of cassava and its wastes for both human and livestock consumption (Aro, 2008). Brewers spent grain is a by-product of beer brewing consisting of the materials that remain after grains have been fermented (Daccord, 1996). This study was designed to determine the silage quality, microbial population and proximate composition of cassava peels ensiled with brewers' spent grain.

Materials and Methods

Experimental site

The experiment was carried out at the small ruminant unit of the Department of Animal Science, University of Uyo, Uyo, (Akwa Ibom State) Nigeria between September and November, 2010.

Feed materials/Formulation

Cassava peels were collected from Nsukara Offot in Uyo, and the Brewers' spent grain was bought from the Champion Breweries Plc., Uyo. The cassava peels were air dried for two days while the brewers' spent grains were utilized in the wet form. The feed stuffs were mixed for silage into three treatments: 100% CPL (T1), 50% CPL + 50% BSG (T2) and 40% CPL + 60% BSG (T3) at 10 kg weight for each. Salt was added at 0.20% per treatment. A 20-litre plastic container was used for the silage preparation with each silo lined with polythene sheets. The ensilage lasted for 21 days.

Silage Quality

Sub-samples were taken from the three different treatments and used for quality assessment. The temperatures in the silo were taken by dipping to about 30 cm depth a laboratory thermometer inside each treatment for 2 – 3 minutes. Colour assessment was via visual observation and colour charts. The pH of each treatment (sample) was determined using a pocket pH meter (Hanna portable metre).

Enumeration of Micro-organisms

Fresh samples of each ensiled treatment weighing 1 g was taken and passed through logarithmic dilution to the sixth factor. Inocula were taken from the sixth factor dilution and plated out on sterile molten growth medium (Neutral Agar and Sabouraud dextrose Agar) for 24 hours and 120 hours respectively. Colonies that grew were counted and enumerated according to Harigan and McCane (1990).

Proximate analysis and Statistical analysis

Fresh samples of the feed materials were oven dried at 70 ^{0} C for 48 hours and then ground. The dried and ground samples of both unensiled and ensiled were used for proximate analysis. Crude protein, crude fibre, ether extract and ash in the samples were determined according to methods of A.O.A.C (1990).

All data collected were subjected to a one way analysis of variance using SAS (1999) computer software package and treatment means were compared and separated using the Duncan's Multiple Range Test (Duncan, 1955). The statistical design was Completely Randomised Design (CRD).

Results and Discussions

Table 1 presents the quality parameters of the ensiled feed materials. It was observed that the golden brown colour of the three silages was close to the original colour of the feed materials and this was in agreement with the findings of Oduguwa *et al.* (2007). This was probably as a result of the inclusion of brewers' spent grains. The odour noted in this study was generally alcoholic with T3 silage mixture being much stronger than the others. The result (odour) obtained in this study was comparable with that of several authors (Menenses *et al.* 2007; Oduguwa *et al.* 2007; Jianxin, 2002), who reported that the end product (good silage) had a pleasant/fruity smell. The pH ranged from 3.76 to 4.63. The values showed a trend decreasing with increased inclusion of brewers' spent grains. The result obtained here was higher than that recorded by Oduguwa *et al.* (2007) of pH 3.2. The result was also lower than the range (4.5 – 5.5) as reported by Menenses *et al.* (2007), classified to be pH for good silage except for T1 with a value of 4.63.

Table 1: Quality of ensiled cassava peels with brewers' spent grains

Parameters	Treatments		
	100% CPL	50%CPL+50%BSG	40%CPL+60%BSG
Colour	Light brown	Golden brown	Golden brown
Odour	Alcoholic	Alcoholic	Alcoholic (strong)
Texture	Semi-dry and firm	Damp and firm	Damp and firm
Temperature(^{0}C)	27.0	28.0	29.5
pH	4.63	3.89	3.76

The microbial count of the ensiled feedstuffs is presented in Table 2. As observed in this study, 100 % CPL silage recorded the highest significant ($p<0.05$) bacterial count (19.6×10^7 cfu g^{-1}) while 60 % BSG inclusion recorded the lowest bacterial count (0.63×10^7 cfu g^{-1}). A trend could be observed as the bacterial population decreased with increased inclusion of brewers' spent grains (T1>T2>T3). However, the reverse was the case as regards fungi population. The T1 silage recorded the lowest fungal count/population (1.38×10^6 cfu g^{-1}) while others (i.e. T2 and T3) recorded the same ($p>0.05$) figures (3.0×10^6 cfu g^{-1}) and significantly ($p<0.05$) higher than T1.

Table 2: Microbial population of ensiled cassava peels with brewers' spent grains

Silage	Bacteria	Fungi
100 % CPL	$19.6^a \times 10^7$ cfu g^{-1}	$1.38^b \times 10^6$ cfu g^{-1}
50 % CPL+50 % BSG	$8.0^b \times 10^7$ cfu g^{-1}	$3.0^a \times 10^6$ cfu g^{-1}
40 % CPL+60 % BSG	$0.63^c \times 10^7$ cfu g^{-1}	$3.0^a \times 10^6$ cfu g^{-1}
SEM	0.68	0.18

a, b, c = means on the same column bearing different superscripts differ ($p<0.05$) significantly.

The proximate composition of cassava peels mixed with brewers' spent grains before and after ensiling is presented in Table 3. As observed from the table, the dry matter (DM) content of the feedstuffs decreased after ensiling and differed significantly ($p<0.05$) from each other before and after ensiling even in other parameters (CP, Crude fat, Ash and NFE) except crude fibre where there were no differences ($p>0.05$) both before and after ensiling also. The value for DM of T1 in this study (31.10 %) was lower than that reported by Babayemi *et al.* (2010) of 31.78 % for 100 % CPL silage. The crude protein content of T1 remained the same after ensiling (i.e. 6.27 %) while it reduces in T2 (14 % to 10.50 %) and T3 (19.25 % to 15.75 %) probably as a result of proteolysis (Obua, 2005) and this reduction was observed in the crude fibre contents before and after ensiling; this may be as a result of breakdown of fibres by the microorganisms present in the ensiled mass. The CP value obtained in this study was higher than the minimum protein requirement of 10 – 12 % recommended by ARC (1985) for ruminants in T3 while T1 was low (6.27 %) and T2 was within the ARC range.

Conclusion

This study reveals the nutritional potential of cassava peels ensiled with brewers' spent grains for feeding ruminants. The nutritional assessment has shown that ensiling technology is probably an alternative method that can provide a well preserved product/feed at a low cost for longer periods of time for our animals during droughts. An *in vivo* study or animal feeding trial is recommended to actually see if the animals can optimize these potentials.

Table 3: Proximate composition of cassava peels ensiled with brewers' spent grains

Treatments					
Parameters	**100%BSG**	**100%CPL**	**50%CPL+ 50%BSG**	**40%CPL+ 60%BSG**	**SEM**
Before ensiling					
Dry Matter	25.80^{c}	34.30^{a}	32.10^{ab}	29.90^{b}	1.02
Ash	4.41^{b}	9.13^{a}	9.19^{a}	8.62^{a}	0.66
Crude Protein	29.75^{a}	6.27^{d}	14.00^{c}	19.25^{b}	0.72
Crude Fibre	6.98^{a}	10.53^{a}	9.63^{a}	10.64^{a}	0.42
Crude Fat	17.58^{a}	9.68^{c}	12.09^{b}	12.36^{b}	0.76
NFE	41.28^{b}	65.62^{a}	63.61^{a}	50.81^{b}	0.58
After ensiling					
Dry Matter	Nd	31.10^{a}	24.10^{b}	29.40^{a}	0.76
Ash	Nd	6.13^{b}	4.00^{c}	8.28^{a}	0.13
Crude Protein	Nd	6.27^{c}	10.50^{b}	15.75^{a}	0.41
Crude Fibre	Nd	9.30^{a}	8.33^{a}	8.96^{a}	0.66
Crude Fat	Nd	7.45^{b}	9.89^{a}	9.98^{a}	0.17
NFE	Nd	69.62^{a}	65.98^{b}	55.34^{c}	0.12

a, b, c = means on the same row bearing different superscripts differ ($p<0.05$) significantly.
Nd –Not determined

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