Silage characteristics and preference of sheep for wet brewer's grain ensiled with maize cob

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Abstract

In order to meet the shortfall in feed supply and provide adequate nutrition for sheep during the dry season, wet brewer's grain (WBG) was ensiled with 0, 10, 20, and 30 % of crushed maize cob (MC). The physical characteristics, pH and chemical composition of the silage mixtures were determined at 21 days of ensiling. Acceptability and preference of sheep among the silage mixtures were determined in a cafeteria feeding trial using eighteen West African dwarf (WAD) sheep. The experimental design adopted was the completely randomized design.

The colour, smell and texture of the mixtures showed that all silages had acceptable physical attributes. The pH of silage varied from 3.40 – 3.80, indicating that the silage mixtures were adequately fermented. Silage scores however revealed that the best physical attributes were attained at 20 % inclusion of maize cob to WBG. Dry matter (DM) content of silage was 26.88, 31.44, 36.69, 43.50% while crude protein (CP) content was 23.44, 19.11, 14.00, and 12.00% for silage with 0, 10, 20 and 30% of maize cob respectively. Neutral detergent fibre increased from 40.33 - 62.67 % and acid detergent from 25.00 – 39.67% with increasing level of maize cob in the mixture. The coefficient of preference (CoP) and percent preference showed that WBG silage witn 10% MC was more acceptable and preferred by sheep than other silage mixtures. While physical attributes of silage showed that the optimum level of MC inclusion was 20%, animal preference indicate that this level was less acceptable to sheep. Sheep may require more time to adapt to higher levels of MC in the silage mixture.

Keywords: acceptability, agro-industrial waste, crop residue, dry season feed, small ruminants

Introduction

Small ruminants like sheep and goats form an integral part of rural livelihoods in the southwest of Nigeria where majority of households keep either sheep or goat for subsistence purposes. A serious constraint of livestock production in this region is inadequate year-round supply of quality feeds (Muhammad et al 2008). Scarcity of forage during the dry season and low energy density of available forage are major factors limiting the productivity of these animals (Olorunnisomo 2010). The dry season is characterized by weight loss, reduced milk yield and high reproductive failures among livestock (Malau – Aduli et al 2003). These challenges have a negative impact on the quality and amount of animal protein available for human consumption in this region. A judicious use of locally available feed resources like crop residues and agro-industrial by-products can improve the nutrition of these animals and boost livestock productivity in these parts. Agro industrial by products and crop residues are available in appreciable quantities and provides opportunity to maximize livestock production from feed resources not utilized by man (Preston and Leng 2009). Maize cobs and wet brewers' grain are of little commercial value and no dietary importance to human beings; hence they can be utilized by ruminants and converted into animal products at little cost.

Dehydrated brewers grain fed to lambs at 40% of the diet has been shown to result in good growth performance, high feed conversion and fatter carcasses (Bovolenta et al 1998). In other tropical and subtropical areas, higher levels of dried brewer's grains were successfully incorporated into sheep diets without depressing performance or digestibility (Baghdassar et al 1986, Aguilera-Soto et al 2007, Cabral Filho et al 2007). Wet brewers' grain can be ensiled and stored for long periods without altering its nutritive value for ruminant animals (Geron et al 2008). Although maize cob has very little nutritive value, it has been used as an absorbent in silage-making, fibre source and bulking material in ruminant diets (Ibhaze et al 2014).

The objective of this study was to evaluate the physical characteristics, chemical composition and acceptability of wet brewer's grain ensiled with different proportions of maize cob by West African dwarf sheep in the southwest of Nigeria.

Materials and Methods

Location

This study was conducted at the sheep unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria (7^0 27'N and 30^0 45'N) with a mean temperature of 27 °C and mean annual rainfall of 1350cm.

Treatments

Experimental treatments corresponded to silage made with wet brewer's grain and four levels of crushed maize cobs as follows:

- Wet brewer's grain + 0% maize cobs (MC0)
- Wet brewer's grain + 10% maize cobs (MC10)
- Wet brewer's grain + 20% maize cobs (MC20)
- Wet brewer's grain + 30% maize cobs (MC30)

Silage preparation and evaluation

Wet brewers' grain was obtained from Nigeria Breweries Plc. Ibadan while maize cobs were collected from maize producers around Ibadan metropolis. The maize cobs were crushed in a hammer mill with a mesh of 6mm diameter. Wet brewers' grain and maize cob were mixed in the proportion specified above and packed inside 120L plastic drums, compressed, weighted with a sand bag and covered with a plastic lid for the acceptability trial. Another set of silage was made inside 4L mini plastic silo for laboratory analysis. Samples of silage were taken from each mini-silo after 21days for physical characteristics, pH and chemical composition. The appearance, smell, texture and pH of the silage were judged by a 15-man panel that had experience with silage-making using a 0 – 5 scale as follows:

	0	1	2	3	4	5
Observation	Very bad	Bad	Going bad	Moderate	Good	Excellent
Colour	Very dark	Dark	Dark Brown	Deep brown	Brown	Light brown
Smell	Offensive	Poor	Almost pleasant	Fairly pleasant	Pleasant	Very pleasant
Texture	Slimy	Very soft	Soft	Moderately firm	Firm	Very firm
pH	>6.5	6.1 – 6.5	5.6 - 6.0	4.6 – 5.5	4.0 – 4.5	<4.0

Proximate composition of silage was determined following the general procedures of AOAC (1995) while detergent fibres were determined by procedures of van Soest et al (1991). Dry matter concentration in the silage was determined using a forced draught oven at 65°C and values obtained were corrected for loss of volatile compounds by multiplying with the correction factor of 1.056 (Fox and Fenderson 1978).

Acceptability study

Eighteen West African dwarf sheep (11. 2 ± 1.92kg) were used to evaluate the free choice intake of wet brewers' grain ensiled with different levels of maize cobs in a cafeteria style. The animals were housed together in a free stall with dwarf walls and concrete floors covered with wood shavings. All the animals were pre-conditioned to the experimental diets for a period of 4 days after which the animals were offered 4kg each (wet basis) of experimental diets daily for a period of 10 days. Fresh water was also offered daily on a free choice basis. Intake of silage was measured 2 hours after it was offered by deducting remnants from the amount of feed served and animals were allowed to graze for the rest of the day. The coefficient of preference (CoP) was calculated as the ratio of individual silage intake to average intake of all the silages while percentage of preference was calculated as the ratio of individual intake to total intake multiplied by 100. Silage was considered acceptable when the CoP is greater than one while ranking was based on percentage of preference.

Experimental design/statistical analysis

The experimental design adopted for this study was the completely randomized design. Data obtained were subjected to analysis of variance and significant means were separated by Duncan's multiple range tests using the procedures of SAS (1995).

Results and Discussion

The physical characteristics and pH of the silages are presented in Table 1. Addition of maize cob to wet brewer's grain (MC10, MC20 and MC30) changed the colour from brown to light brown. This was due to the white colour of maize cob which had a dilution effect on the brown colour of WBG. All the silages prepared had a pleasant and acceptable smell; however, smell of MC10 was judged to be more pleasant than others. The texture of MC0 which had no WBG was moderately firm while others (MC10, MC20 and MC30) with some level of maize cob were firm to very firm, showing that addition of maize cob to wet brewer's grain enhanced the texture of the mixture. This was due to the high level of structural fibres in maize cob which improved the general structure of the silage. Maize cob as a fibre source was also expected to enhance rumination in sheep fed these diets (Ibhaze et al 2014). The pH of the silages ranged from 3.40 – 3.80. These were within the acceptable range for good silage in the tropics (Bilal 2009, Nhan et al 2009). The pH of the ensiled mixtures increased with higher inclusion of maize cob. This suggests that the soluble carbohydrates responsible for fermentation of the silage were supplied by WBG rather than maize cob.

Table 1: Physical characteristics and pH of wet brewers' grain and maize cob silage at 21 days of ensiling

Parameter	MC0	MC10	MC20	MC30
Colour	Brown	Light Brown	Light Brown	Light Brown
Smell	Pleasant	Very Pleasant	Pleasant	Pleasant
Texture	Moderately firm	Firm	Very firm	Very firm
pH	3.40	3.50	3.50	3.80

MC0: Wet Brewers' gain alone, MC10: Wet brewers gain + 10% maize cobs, MC20: Wet brewers gain + 20% maize cobs, MC30: Wet brewers gain + 30% maize cobs

Silage score which was based on physical attributes and pH of the silages is presented in Table 2. The score for colour and texture of silage increased as the proportion of maize cob in the mixture increased whereas smell scores improved only up to 20 % inclusion of maize cob in the mixture. All silage mixtures had excellent pH scores since pH values fell below 4 which is considered excellent for tropical silages (Bilal 2009, Nhan et al 2009). Average score of the silage mixtures indicate that the best physical characteristics were achieved when maize cob formed 20% of the mixture.

Dry matter content of the silage increased as the proportion of maize cob in the mixture increased while crude protein content decreased (Table 2).

Table 2: Silage score (0 – 5 scale*) based on physical characteristic and pH value

Parameter	MC0	MC10	MC20	MC30	SEM	*p*
Colour	3.90^b	4.50^a	4.90^a	4.90^a	0.10	0.031
Smell	4.20^b	4.40^b	5.00^a	4.00^b	0.13	0.028
Texture	3.20^c	4.20^b	4.90^a	5.00^a	0.12	0.033
pH	5.00	5.00	5.00	5.00	0.16	0.030
Average score	4.08	4.53	4.95	4.73	0.14	0.034

**0 – very bad; 1 – bad; 2 – going bad; 3 – moderate; 4 – good; 5 – excellent*

a,b,c: means without common superscript are different at $p<0.05$

Table 3: Chemical composition of wet brewers' grain and maize cob silage

Parameter	MC0	MC10	MC20	MC30	SEM	*p*
Dry matter	26.9^d	31.4^c	36.7^b	43.5^a	0.45	0.048
Crude protein	23.4^a	19.1^b	14.0^c	12.0^c	0.31	0.042
Ether extract	6.00^a	5.60^a	3.40^b	3.01^b	0.30	0.034
Ash	4.35^a	3.85^a	3.08^b	2.98^b	0.17	0.031
Neutral detergent fibre	40.3^d	49.7^c	58.3^b	62.7^a	0.73	0.046
Acid detergent fibre	25.0^b	29.0^b	36.3^a	39.7^a	1.01	0.041
Acid detergent lignin	7.67^b	7.97^b	11.8^a	11.7^a	0.25	0.038

MC0: Wet Brewers' gain alone, MC10: Wet brewers gain + 10% maize cobs, MC20: Wet brewers gain + 20% maize cobs, MC30: Wet brewers gain + 30% maize cobs

a,b,c,d: means without common superscript are different at $p<0.05$

When the CoP is equal to or greater than 1, the diet is considered to be acceptable and when CoP is less than

1, the diet is assumed to be unacceptable to livestock. In this study, CoP of MC10 was greater than 1 while MC0, MC20 and MC30 had CoP less than 1 (Table 4). The implication of this is that sheep would accept WBG ensiled with 10% of maize cob and reject WBG silage with no maize cob or more than 20% of maize cob. As earlier noted, the CoP may not be a realistic measure of acceptability of diets by ruminants (Olorunnisomo and Fayomi 2012) since it does not take into consideration, the previous experience of the animals or the relative importance of changing dietary preference of livestock..

Table 4: Preference of West African dwarf sheep fed wet brewers grain ensiled with different levels of maize cobs

Parameter	MC0	MC10	MC20	MC30	SEM	*p*
Intake (kg, DM)#	1.30^b	1.93^a	1.36^b	1.22^c	0.08	0.030
Coefficient of preference	0.89^b	1.33^a	0.94^b	0.84^b	0.04	0.024
% Preference	22.4^b	33.2^a	23.2^c	21.0^d	1.22	0.044
Preference ranking	3rd	1st	2nd	4th	-	-

a,b,c,d: means without common superscript are different at $p<0.05$
#Free choice intake of silage by the animals was measured 2 hours after feed was offered. MC0: Wet Brewers' grain alone, MC10: Wet brewers gain + 10% maize cobs, MC20: Wet brewers gain + 20% maize cobs, MC30: Wet brewers gain + 30% maize cobs, SEM: Standard error of mean.

Acceptability of diets by livestock can also be measured as a percentage of total dietary intake. Percent preference appears to be a more realistic index of acceptability since it does not foreclose the possibility of changing dietary preference among livestock. Ikhimoya and Imasuen (2007) reported that small ruminants readily accept diets with which they have had previous experience while Provenza and Cincotta (1994) reported that pre-conditioning of small ruminants to a particular diet influence their choice among a variety of diets. In this study, the percent preference of sheep varied from 21.0 – 33.2 %. The order of preference was MC10 > MC20> MC0 > MC30. This shows that sheep preferred WBG silage with 10 – 20% maize cob to other silages. This may be related to the silage texture (mouth feel) which was enhanced by the addition of maize cob to the WBG silage. At 30% inclusion of maize cob, the silage may have become too coarse and less acceptable to the sheep due to the high content of structural carbohydrates.

Conclusions

- Addition of maize cob to WBG silage improved physical characteristics and dry matter content of the silage up to 20% inclusion.
- Protein content of silage reduced as proportion of maize cob in the silage increased while fibre components increased.
- Sheep preferred WBG silage with 10 - 20% maize cob.

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