Original Research Article

Milk Yield and Feed Conversion of Sokoto Gudali Cows Fed Elephant Grass Ensiled with Cassava Peel

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Abstract

Year-round availability of feed is a major concern for dairy farmers in many parts of the tropics. Silage making is a reliable means of providing feed for dairy cattle during periods of forage scarcity. In this study, Elephant grass (EG) (*Pennisetum purpureum*) was ensiled with cassava peel (CSP) at 0, 10, 30 and 50% levels of inclusion on a wet basis. At 21, 42 and 63 days of ensiling, silage samples were taken for chemical analysis and the remaining materials were fed to four lactating Sokoto Gudali cows for a period of 84 days using a Latin square design. Dry matter (DM) content of silage mixtures increased from 18.22 to 28.70% as level of CSP in the silage mixture increased while crude protein (7.33 to 6.08%) and crude fibre (32.80 to 23.95%) decreased. Dry matter intake of cows, milk yield and feed conversion ratio (FCR) varied ($P < 0.05$) with inclusion of cassava peel in the silage mixtures. Dry matter intake of cows increased from 2.56 to 3.84% of body weight (BW) and milk yield from 2.90 to 6.70 kg/d as proportion of CSP in the grass silage increased. Feed conversion ratio of cows ranged from 2.08 to 3.23 and improved with inclusion of CSP in the silage. These results show that addition of cassava peel to Elephant grass silage improved intake and milk production in Sokoto Gudali cows fed Elephant grass silage.

Keywords: cassava peel; dairy production; intake; *Pennisetum purpureum*; silage, tropical regions; zebu cattle.

INTRODUCTION

Milk production from cattle in tropical regions is often limited by inadequate supply of feed on a year-round basis. Indigenous cattle generally depend on grass-dominated pastures with surplus forage during the wet season and scarcity during the dry season. Yield and nutritive value of tropical grasses decline sharply as dry season approaches (Babayemi et al., 2009), leading to reduced feed intake, weight loss, and poor milk production from cattle raised in extensive production systems (Smith, 2001). Silage-making is a common means of preserving surplus forage which could be fed to livestock during periods of scarcity (Wong, 2000).

Elephant grass (also known as Napier grass) is a high yielding fodder often fed to cattle fresh or as silage in cut-and-carry systems (Sowande et al., 2008). It is found in most parts of the humid tropics where it is usually rejected by ruminants while grazing but readily accepted when chopped and stall-fed. Elephant grass is a valuable feed resource for ruminants during the dry season and forms the basis for feeding dairy cattle in many farms in East Africa (Anindo and Potter, 1986).

Cassava peel is a waste from processing cassava root (*Manihot esculenta*) which is used extensively as a feedstuff in Nigeria (Ahamefule, 2006). Although it has a low protein content, its high starch content makes it a cheap and valuable source of energy (Onua and Okeke, 1999).

The presence of hydrocyanic acid in CSP (Bradbury et al., 1999) poses a serious risk to livestock. However, when it is ensiled, concentration of this compound is reduced to safe limits for livestock feeding (Asaolu, 1988; Okeke et al., 1985). Ensiling elephant grass with CSP has been shown to improve its acceptability and feeding value to ruminants (Olorunnisomo, 2011; Olorunnisomo et al., 2012).

The objective of this study was to evaluate the chemical composition, intake, milk yield and feed conversion ratio of Sokoto Gudali cows fed elephant grass ensiled with increasing levels of cassava peel in a humid tropical environment.

MATERIALS AND METHODS

Location

The study was conducted at the Dairy Unit of the Teaching and Research Farm, University of Ibadan, Nigeria (7° 27'N and 3° 45'E) with mean temperature of 27 °C and average annual rainfall of about 1250 mm.

Silage Preparation and Chemical Analysis

Elephant grass was harvested from a renovated fodder plot at the University of Ibadan using a machete. The grass was cut at 10 weeks of regrowth at a height of 60 cm from the

ground. Fresh CSP were collected from a cassava processing unit in Ibadan. The grass was chopped to an approximate length of 3 cm while CSP was chopped to a length of 1.2 cm using an automated forage chopper (Locally fabricated by S. Ola Eng. Works, Ibadan). The chopped materials were mixed on a wet basis in the proportions specified below. The mixtures were packed into 120 L plastic drums lined with polythene sheets, compressed, sealed and weighted with a sand bag. The drums were finally covered with a plastic lid until silage samples were required for chemical analysis or animal feeding. Silage samples were taken at 21, 42 and 63 days of ensiling (representing days at which the silos were opened to feed animals), oven dried, composited and stored for chemical analysis. Experimental treatments correspond to four silage mixtures as follows:

- Elephant grass alone (EG100)
- Elephant grass + 10% CSP (EG-CSP10)
- Elephant grass + 30% CSP (EG-CSP30)
- Elephant grass + 50% CSP (EG-CSP50)

Proximate composition of dried silage samples was determined using the general procedures of AOAC (2005) while detergent fibre fractions were determined using the procedures of Van Soest et al. (1991). DM of silage was determined by drying 500 g of samples in a forced-air oven (Model DHG-9109A, Shanghai Meditry Instrument Co., Ltd.) at 60 °C for 48 h and values obtained were corrected for loss of volatile compounds by multiplying with the correction factor of 1.056 (Fox and Fenderson, 1978). A concentrate feed mixture consisting of maize, wheat offal, palm kernel cake, fishmeal, salt, dicalcium phosphate, and a vitamin-mineral premix was also prepared to meet the basic nutrient requirements of the cows.

Milk Production Study

This study lasted 84 days using four early lactation Sokoto Gudali cows weighing 384 ± 9.26 kg in a Latin square arrangement. All cows calved within 8 days of each other such that animals were at similar stage of lactation at switch-over periods. Ten days prior to commencement of feeding trial, animals were treated against endoparasites and ectoparasites using ivermectin (IVOMEC®, Merial Limited,

Duluth, GA.). Animals were housed in individual pens (3×4 m) and fed one of the four experimental diets for a period of 21 d. Seven days were allowed for adjustment to the new diet at switch-over periods and experimental measurements were taken within 14 days. Animals were exercised daily by walking to the milking shed which was situated at 100 m from the experimental shed. Animals were offered 1 kg of concentrate/ head /d during milking. Fresh water was offered free choice. Silage was offered twice daily at 08:00 h and 17:00 h and intake was estimated as the difference between silage offered and refused. Milking was done by hand twice daily at 07:00 h and 16:00 h in the presence of the calf. Milk let-down was stimulated by suckling the calf for 5 minutes after which the cow was milked. Weight of the calves was taken before and immediately after suckling to estimate milk intake by the calf. Calves were separated from cows after milking and part of the milk collected was fed back to the calves using a nipple-bottle. Milk yield was calculated as the summation of milk off-take and intake by the calf.

Experimental Design/Statistical Analysis

A 4×4 Latin square design was adopted for this study. Data obtained were subjected to analysis of variance and means were separated by Duncan's multiple range tests using the SAS (1995) procedures.

RESULTS AND DISCUSSION

Silage Characteristics

Silage characteristics of elephant grass ensiled with different levels of cassava peel is summarized in Table 1. This result was discussed by Olorunnisomo (2011) in a study with cattle and goats at the same location.

Composition of Diets

The chemical composition of the silage mixtures is shown in Table 2 while the composition of the concentrate diet is shown in Table 3.

Table 1. Silage characteristics of Elephant grass ensiled with cassava peel at 21 days

Variable	EG100	EG-CSP10	EG-CSP30	EG-CSP50
Appearance	Pale green	Pale green with little brown and white speckles	Light green with many brown and white speckles	Light green with many brown and white speckles
Smell	Pleasant	Pleasant	Pleasant	Very pleasant
Texture	Firm but wet	Firm but wet	Firm	Very firm
pH	4.70	4.56	4.10	3.75

EG: Elephant grass (*Pennisetum purpureum*), CSP: cassava peels at 0, 10, 30 or 50 percent inclusion

Table 2. Chemical composition of elephant grass and cassava peel silage

Variable (%)	Fresh EG	Fresh CSP	EG100	EG - CSP10	EG - CSP30	EG - CSP50
Dry matter	18.05	34.05	18.22	20.57	24.29	28.70
Crude protein	7.95	5.06	7.33	7.06	6.95	6.08
Crude fibre	35.50	10.55	32.80	29.50	25.54	23.95
Ether extract	1.05	1.18	1.00	1.05	1.07	1.06
Ash	6.24	6.46	6.30	6.32	6.36	6.40
Nitrogen free extract	49.26	76.75	52.57	56.07	60.08	62.51
Neutral detergent fibre	70.01	28.50	69.00	62.00	53.75	46.25
Acid detergent fibre	43.00	16.80	42.00	38.50	33.00	30.75

EG: elephant grass (*Pennisetum purpureum*), CSP: cassava peels at 0, 10, 30 or 50 percent inclusion

Table 3. Ingredient and proximate composition of concentrate diet

Ingredient composition	%	Proximate composition	%
Maize	20	Dry matter	92.54
Wheat offal	40	Crude protein	18.78
Palm kernel cake	36	Ether extract	3.30
Fish meal (72%)	4	Crude fibre	19.04
Salt	1.0	Ash	8.00
Dicalcium phosphate	0.5	Nitrogen free extract	50.88
Premix*	0.5		

Premix* contained: vitamin A (20 000 00IU); vitamin D3(20 000 00IU); vitamin E (20g); magnesium (100g); manganese (50g); iron (60g); zinc (50g); copper (8g); iodine (2.5g); cobalt (1g) per ton of feed

Table 4. Intake, milk yield and feed conversion ratio (FCR) of Sokoto Gudali cows fed elephant grass- cassava peel silage

Variable	EG100	EG-CSP10	EG-CSP30	EG-CSP50	SEM
Intake					
Silage intake (kg/d, DM)	8.36 ^d	9.58 ^c	10.68 ^b	12.93 ^a	1.91
Concentrate intake (kg/d, DM)	1.00	1.00	1.00	1.00	0.09
Total intake (kg/d, DM)	9.36 ^d	10.58 ^c	11.68 ^b	13.93 ^a	2.08
DM intake (% BW)	2.56 ^c	2.70 ^c	3.33 ^b	3.84 ^a	0.16
Milk yield					
Milk off take (kg/d)	1.90 ^d	2.80 ^c	3.30 ^b	4.60 ^a	0.09
Milk taken by calf (kg/d)	1.00	0.90	1.10	1.10	0.06
Total Milk yield (kg/d)	2.90 ^d	3.50 ^c	4.70 ^b	6.70 ^a	0.10
Feed conversion ratio					
(intake/milk yield)	3.23 ^a	3.02 ^a	2.48 ^b	2.08 ^c	0.08

EG: elephant grass (*Pennisetum purpureum*), CSP: cassava peel at 0, 10, 30 or 50 percent inclusion.

abcd: means with different superscripts within the row are significantly different ($P < 0.05$)

Dry matter and nitrogen free extract (NFE) increased as the proportion of CSP in the silage mixture increased while the crude protein and fibre fractions decreased. The chemical composition of the silage mixtures was largely a reflection of the composition of elephant grass and CSP (Table 2). Hence, the rise in DM and NFE concentration as proportion of CSP in silage mixtures increased can be adduced to the higher concentration of these fractions in CSP compared to elephant grass. Reduced crude protein and fibre fractions can also be adduced to the same reasons. This result is consistent with that of Zanine et al. (2010) who reported

a reduction in fibre fractions of elephant grass silage with the addition of cassava scrapings and Oliveira (2008) who reported a decrease in NDF and ADF content of elephant grass ensiled with cassava meal. Nitrogen free extract represents the more digestible carbohydrate fraction of feeds while fibre components represents the less digestible fraction (McDonald et al., 2002). The increase in NFE and reduction in fibre components of silage as CSP increased in the silage mixture should improve digestibility and energy utilization in the diet. The crude protein value for the silage mixtures ranged from 6.08 to 7.33%. This is within the limits of 6 -7%

minimum protein content for ruminant diets set by Milford and Haydock (1965) for effective rumen function but much lower than the minimum 10 – 12% of protein recommended by ARC (1980) for ruminant diets. This indicates that crude protein is a limiting nutrient in the silage mixtures and needs to be supplemented with other sources in order to meet protein requirements for lactating animals.

Dry Matter Intake

The DMI and performance of lactating cows fed Elephant grass ensiled with CSP are presented in Table 4. There were increases ($P < 0.05$) in silage intake by the cows as proportion of CSP in the silage mixture increased, indicating that animals in this study had preference for grass silage containing CSP. Earlier studies at the same location indicated that cattle with no previous experience with CSP showed initial aversion to grass-CSP silage but later, after introduction of CSP and cassava-based diets, the same animals showed consistent preference for grass-CSP over grass silage alone (Olorunnisomo, 2011; Olorunnisomo and Fayomi, 2012). Total DM intake varied significantly across the treatments and increased with increasing level of cassava peel in the silage mixture. The average DM intake (% BW) of cows fed different silage mixtures in this study was 3.1%, which was higher than the values of 2.2 – 2.3% BW obtained in other studies where Elephant grass was fed to cattle (Grant et al., 1974; Muinga et al., 1992; Gwayumba et al., 2002). The higher DM intake obtained in this study may be due to lower NDF content in these silages (46.2 - 69.0%) compared to a typical Elephant grass diet (71 -78%), and the addition of CSP which the animals relish.

Milk Yield

Milk yield of Sokoto Gudali cows fed silage mixtures increased ($P < 0.05$) as proportion of CSP in the mixture increased. The highest milk yield of 6.70 kg/day was observed in cattle fed silage with the highest proportion of cassava peel (EG-CSP50). Considering that this diet has the highest concentration of NFE (soluble carbohydrates) and lowest fibre fractions, it may be inferred that nutrient digestibility and nutrient utilization by cows was highest when this diet was offered. The extent of improvement in milk yield of Sokoto Gudali cows when CSP was included in the grass silage diet is illustrated in Figure 1. When cassava peel formed only 10% of the grass silage, milk yield increased by 21% and when it formed 30% of the silage mixture, milk yield increased by 62%. However, at 50% inclusion of cassava peel in the silage mixture, milk yield of the zebu cows sharply increased by 131%. This observation may be due to improved energy utilization in the silage diet with inclusion of cassava peel. Daily milk yield in this study varied between 2.90 and 6.70 kg/day. This is comparable to milk yield of 4.24 and 6.27 kg/day reported by Alphonsus et al. (2011) for Bunaji and Friesian × Bunaji cows, respectively; and 4.46 - 6.66 kg/day reported by Tadesse and Dessie (2003) for Zebu and their Holstein-Friesian crosses.

Feed Conversion

Feed conversion ratio (FCR) which is a measure of efficiency of feed utilization in cattle, varied ($P < 0.05$) among the silage treatments. Animals fed grass silage with

Figure 1. Percent increase in milk yield with increasing level of CSP in grass silage

50% CSP had the lowest value (2.08) while animals fed grass silage (without cassava peel) had the highest value (3.23). Although there was no difference in FCR of grass silage and grass silage with 10% CSP, the trend observed shows that efficiency of feed utilization improved with increasing level of CSP in the grass silage. This result indicates that economic production of milk from Sokoto Gudali cows can be enhanced with incorporation of high proportions of CSP into Elephant grass silage.

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