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Milk Yield and Composition of Grazing White Fulani Cows Fed Poultry Waste-Cassava Peel Based Diets

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Abstract: The influence of supplementation of poultry waste-cassava peel based diets on milk yield and composition of White Fulani (Bunaji) cows were evaluated in this study. Four cows in 2nd parity and mid-lactation stage were fed 4 concentrate diets (A, B, C, D) consecutively in a 4x4 latin square arrangement. The diets were formulated from poultry waste, cassava peel, palm kernel cake, molasses, bone meal and common salt. The percent compositions of dried poultry waste (DPW) and cassava peel in the diets were 0, 56.5; 10, 53.5; 20, 43.5 and 30, 33.5 %, respectively. Each animal received each diet for 24 days. Daily feed intake (g/d), average daily gain (g/d), milk yield (g/d) and composition (%), feed conversion ratio (FCR) and fat – corrected milk (FCM) were determined for each cow per dietary regime. Results showed that feed intake and milk yield were not affected ($P>0.05$) by diets. FCM (kg) however, differed among treatments with diets A (0.21) and B (0.24) having similar ($P>0.05$) but higher FCM yields than diets C (0.07) or D (0.13). Milk protein (Nx6.38), butterfat (BF), total solids (TS), lactose, solids-not-fat (SNF), ash and energy contents of milk did not vary ($P>0.05$) significantly. Feed conversion ratio was 0.70 for diet B and this value was superior ($P<0.05$) to the corresponding values obtained for diets A (0.91), C (2.45) and D (1.56). The relationships between TS and energy ($r = 0.54$) and BF and energy ($r = 0.98$) were positive and significant ($P<0.05$). Non-significant ($P>0.05$) negative correlation existed between milk yield and TS ($r = -0.02$), milk yield and BF ($r = -0.04$), and milk yield and milk protein ($r = -0.23$). Milk yield was generally poor probably due to low level of supplementation.

Key words: Milk yield, milk protein, poultry waste

Introduction

In Nigeria, cattle provides more than 90% of the total annual domestic milk output (Walshe *et al.*, 1991) with the White Fulani or 'Bunaji' breed recognized as the principal producer (Adeneye, 1989). Unfortunately, the domestic output of about 407,000 metric tones of milk (Olaloku, 1999) from an estimated 14 million cattle (RIM, 1992) can hardly satisfy the dairy demands of an ever-increasing population of Nigerians (Ibeawuchi *et al.*, 2000). Poor nutrition (Adegbola, 2002) and low reproductive performance (Olaloku, 1999) have been highlighted as some of the major factors affecting milk production from our indigenous cattle breeds. The agro-pastoral system of cattle production in Nigeria provides nourishment for stock only on range and this present with difficulties especially in the dry season. The low nitrogen content of dry season fodder usually confer severe nutritional stress on ruminant livestock with the result that cattle grazing these poor quality forages without supplementation experience weight loss, delayed growth rate and decline in milk production (Otchere, 1986). The use of conventional feedstuffs such as maize, soya, groundnut cake etc, to enhance production has become inappropriate owing to their exorbitant costs and erratic supply (Akinmutimi, 2004). It is in this light that non-conventional energy and protein materials are presently being exploited for livestock and indeed for cattle production in Nigeria. Such materials usually would be nutritious, non-toxic, cheap, available, and generally acceptable to animals. It should also have no or low human utilization.

Poultry waste is a rich source of nitrogen (Jordaan, 2004; Lanyasunya *et al.*, 2006). Except for research purposes, its use in practical cattle and sheep and goat production in Nigeria is still not commonplace (Belewu and Adeneye, 1996; Adebowale and Taiwo, 1990). Cassava peel is also rich in metabolizable energy and very well degraded in the rumen (Smith, 1988). One of the reasons for the poor milk yield from our indigenous cattle breeds stems from inadequate supply of quality and sustainable diets all year round. This study therefore was designed to evaluate the milk yield and composition of grazing White Fulani cows supplemented with poultry waste-cassava peel based diets.

Materials and Methods

Dried poultry waste/cassava peel: Fresh poultry litter was obtained from caged layers reared at the Michael Okpara University of Agriculture, Umudike. The waste was sun-dried for 3-5 days to realize a moisture content of 10-12%. The product was subsequently milled, bagged and used as dried poultry waste (DPW). Cassava peels from 12-14 month old plants were

Table 1: Feed constituents and proximate composition of experimental diets

Ingredients (%)	A	B	C	D	DC	DPW
DCP	56.5	53.5	43.5	33.5		
DPW	0	10.0	20.0	30.0		
Palm kernel Cake	35.0	28.0	28.0	28.0		
Molasses	5.0	5.0	5.0	5.0		
Bone meal	2.5	2.5	2.5	2.5		
Common salt	1.0	1.0	1.0	1.0		
Total	100	100	100	100		
Analysed contents (%)						
Dry matter	88.25	84.15	85.90	85.25	90.20	93.00
Crude protein	7.44	9.19	9.63	9.64	3.25	26.60
Crude fibre	18.70	19.75	17.73	14.73	14.50	15.60
Ether extract	2.50	3.25	2.75	3.50	0.07	3.10
Ash	20.0	22.00	33.00	30.00	5.50	27.00
NFE	39.41	29.96	22.79	26.37	66.47	25.10
Energy (MJ/KgDM)	1.33	1.25	1.11	1.07	1.82	1.01

DCP = dried cassava peel. DPW = dried poultry waste (battery cage). NFE = nitrogen free extract

Table 2: Performance of White Fulani cows fed poultry waste-cassava peel based diets

	Diets				
Parameter	A	B	C	D	SEM
Mean BW (kg)	240.75	252.50	200.00	211.75	2.47
Feed intake (g/d)	507.21	484.22	514.44	545.81	2.31
ADG (g)	557.37^{b}	691.74^{a}	209.97^{d}	349.87^{c}	2.57
FCR	0.91^{c}	0.70^{d}	2.45^{a}	1.56^{b}	0.50

BW = body weight. ADG = average daily gain. FCR = feed conversion ratio. DPW = dried poultry waste

collected fresh from the commercial 'Garri' processing unit of the National Root Crop Research Institute (NRCRI), Umudike. The lot was sun-dried for 3 days to 10-12% moisture level, milled and used as dried cassava peel (DCP)

Lactation study: Four lactating White Fulani cows, in their 2nd parity, aged 3-4 years and weighing between 190-248 kg were selected from the University herd for this study. The animals were isolated in separate stalls between 0800-0900 hr each morning and fed the experimental diets before released for grazing. The diets A, B, C, D were formulated from palm kernel cake, molasses, bone meal and common salt and contained 0, 56.5; 10, 53.5; 20, 43.5 and 30, 33.5% DPW and cassava peels, respectively (Table 1). The 4 dietary regimens were fed consecutively to each animal in 4 phases. Each phase lasted for 24 days during which time each animal received 1 kg of an assigned ration per day. Drinking water was also freely provided. Feed intake was determined as the difference between daily feed offered and refusal.

Milk collection/measurements: Lactation for each cow was based on 305 days. Milk collection for the mid lactation phase was initiated on the 106th day for each cow and terminated on the 205th day post-partum. Milk was harvested between 0800-0900 hr daily by hand. The total amount of milk yielded per day was recorded as the morning daily yield of the cow. The daily milk yield was then estimated for each cow on the assumption that actual daily production of cows can be met if the animals were milked twice a day. Thereafter, based on the concept of fixed milk yield responses to changing milking frequency (Erdman and Verna, 1995), the constant 0.6596 was used as a weighting factor on the morning milk yield. Each day's milk (S) was estimated as:

$$S = M + 0.6596\ M$$

where M is the morning milk yield (once-a-day milking).

Prior to each day's milking, calves were separated from their dams at 1800hr on the evening preceding the day of milking and subsequently returned to their dams in the morning after milking. The quantity of milk harvested from a cow was measured using graduated glass cylinder and weighed back to the nearest gram.

Milk sampling: Samples from daily milk yield for each cow were analyzed for lactose content immediately after collection, then bulked and subsequently analyzed weekly for TS, BF, CP, SNF, ash and energy. The bulked samples were often stored in a refrigerator (-5^{o}C) until required for analysis.

Analytical procedure: Milk samples were analyzed for lactose, total solids, butterfat, crude protein (Nx6.38), solids-not-fat, ash and gross energy. Total solid was determined by drying about 5g of milk sample to a

Table 3: Milk production characteristics of White Fulani cows fed dried poultry waste-cassava peel based diets

	Diets				
Parameter	A	B	C	D	SEM
Total milk yield (kg)	9.24	11.23	3.98	5.97	0.29
Average milk yield (kg/d)	0.38	0.46	0.16	0.24	0.30
Total solids (%)	10.23	10.83	9.97	9.21	0.22
Crude protein (%)	3.58	3.46	3.48	3.54	0.11
Butterfat (%)	5.07	3.78	4.28	4.16	0.12
SNF (%)	5.71	6.29	4.59	6.47	0.29
Ash (%)	0.99	0.82	0.89	0.92	0.03
Lactose (%)	7.60	6.80	8.06	9.04	0.16
FCM (kg)	0.21a	0.24a	0.07b	0.13b	0.03
Solids corrected milk (kg)	0.17	0.15	0.06	0.11	0.01
Milk energy (MJ/kg)	2.01	1.53	1.69	1.74	0.04

ab Means on the same row with different superscripts differ significantly (P<0.05). SNF = solids - not – fat. FCM = fat corrected milk
SEM = standard error of the mean

constant eight at 105°C for 24 hrs. Lactose was determined by the Roesse Gottlieb method (AOAC, 1980). Milk protein (Nx6.38) was determined by the Semi-micro distillation method using Kjeldahl and Markhamps apparatus. Solids-not-fat was determined as the difference between total solids and butterfat. Milk energy Y (MJ/kg) was computed using multiple regression equation

$$Y = 0.386\ F + 0.205\ SNF + 0.236 \text{ (M.A.F.F., 1975)}$$

where F and SNF represent percentages of fat and solids-not-fat, respectively. Feed samples were analyzed for proximate components using AOAC (1990) methods. Fat corrected milk was determined using the equation

$$FCM = 0.4M + 15F \text{ (Maynard } et\ al.\text{, 1979)}$$

where M and F are the milk and fat yield of milk (kg), respectively, while solids-corrected milk (SCM) was estimated using the equation

$$SCM = 12.3F+6.56SNF- 0.0752M \text{ (Tyrell and Reid, 1965)}$$

where F, SNF and M also represent the fat , solids-not-fat and kilogram yield of milk , respectively.

Statistical analysis: The data obtained in the lactation study was subjected to analysis of variance (ANOVA) applicable to 4x4 latin square experiment (Steel and Torrie, 1980). Differences between means were determined using Duncan's Multiple Range Test (Duncan, 1955). Simple regression analysis was used to establish the degree of relationship between milk constituents.

Results and Discussion

The proximate composition of the feedstuffs and experimental diets are shown in Table 1. The proximate values obtained for DCP and DPW were comparable to values reported by Ahamefule (2005) and Ibeawuchi and Ahamefule (2006), respectively, for similar products.
The dry matter percent of the DPW based diets (B, C, D) compared favourably with the control A. The CP (%) content of diet A was slightly above the critical level of 7% for ruminants (Lanyasunya *et al.*, 2006) and improved from B-D just as DPW inclusion levels increased. Alhassan (1985) and Ahamefule *et al.* (2001) had earlier observed that adding DPW to concentrate formulations increased the CP in ruminant rations. The CF values, except for an occasional rise in B, declined from the control to diet D. The decreasing level of DCP in the respective diets is probably responsible for this. DCP is known to be high in CF (Smith, 1988). The energy contents of the experimental diets were also within comparable range with 1.33, 1.25, 1.11 and 1.07 MJ/kg DM as the respective values for diets A, B, C and D.
Table 2 shows the performance of White Fulani cows fed poultry waste-cassava peel based diets. Average daily intake (g/day) was higher for diets C and D but lower for diet B in relation to the control diet A. The differences however, were not significant (P>0.05). Average daily gain (ADG) (g/day) however, differed (P<0.05) among the diets. Diet B promoted the highest ADG, which differed significantly from values obtained for diets A, C and D. The superior performance of diet B over the other diets in this study is further buttressed by its significantly (P<0.05) low FCR value. The superior performance of animals fed diet B, in relation to others, may be attributed to the utilization pattern of the feed protein. The nutritive value of feed proteins lie to the extent of its convertion to microbial protein through effective utilization of ammonia produced in the rumen (McDonald *et al.*, 2002). This conversion is energy dependent (Lanyasunya *et al.*, 2006). Diet B which contained 10% DPW, may in contrast to other diets, influenced optimal release of ammonia and energy in the rumen for microbial protein synthesis. Lower or

Table 4: Regression equations and correlation coefficients between milk yield and various milk constituents of White Fulani cow

Parameter	Regression equation	SE	r	Sign.
Yield and TS	Y = 10.14 – 0.0005x	1.60	- 0.02	ns
Yield and BF	Y = 5.25 – 0.007x	1.25	- 0.04	ns
Yield and CP	Y = 3.76 – 0.002x	0.70	- 0.23	ns
TS and CP	Y = 4.68 – 0.12x	0.69	- 0.26	ns
TS and SNF	Y = 8.59 – 0.28x	1.89	- 0.23	ns
TS and Lactose	Y = 8.72 – 0.08x	1.22	- 0.12	ns
TS and energy	Y = 0.17 + 0.15x	0.38	0.54	*
BF and CP	Y = 3.54 – 0.01x	0.72	- 0.02	ns
BF and energy	Y = 0.31 + 0.33x	0.09	0.98	**

ns = not significant. * = P<0.05. ** = P<0.01

higher DPW inclusions as in diets A (0%), C (20%) or D (30%), may have yielded imbalance to the proportions of these substrates in the rumen, probably resulting in loss of ammonia through urea (Van Eename *et al.*, 1990), which negatively influenced protein utilization and subsequently weight gain in the subsisting animals.

The milk production characteristics of White Fulani cows fed diets containing DPW are summarized in Table 3. Average milk yield per day (kg) did not differ (P>0.05) for all treatments, but the mean yield of 0.32 kg obtained for cows in this study is far below the daily yield of 3.98 kg recorded for the same breed elsewhere (Olaloku, 1999). The disparity in values may be due to system of management, environment and period of study. Friesian cows maintained intensively in a Kenyan farm on 30% broiler waste based concentrate diet supported 10 kg of milk yield daily (Odhuba, 1986).

The total solids (%) ranged from 9.21 in diet D to 10.83 in diet B. A mean value of 10.09 was obtained in this study, which is below the range of 12.45-14.36 reported (Ibeawuchi and Umoh, 1990; Ahamefule *et al.,* 2003) for the same breed. Again, differences in nutrition and management could influence percent TS in milk (Mathewman, 1993).

Mean milk protein (Nx6.38) was not influenced by experimental diets (P>0.05). However, the average value of 3.52% presently obtained for white Fulani cows compared favourably with values reported for Friesian cattle (Akinsoyinu, 1981), and even for Bunaji x Friesian cattle in Nigeria (Ibeawuchi and Umoh, 1990). There were no significant (P>0.05) differences in the butterfat values among treatments. It was however observed that diet B, which promoted the highest daily production of milk (0.46 kg/day) also had the lowest BF concentration. This inverse relationship between yield and BF content of cow milk, was also reported by Ibeawuchi (1987).

Dietary treatments did not also affect (P>0.05) the percent lactose, ash, SNF and energy contents of milk. Fat-corrected milk yield (kg) differed (P<0.05) among the treatments. Diets A and B gave similar (P>0.05) but significantly higher (P<0.05) FCM yield than C or D. These values were far less than the value of 3.93 kg reported for White Fulani cattle in a government farm (Ibeawuchi, 1987).

The relationships between milk constituents are summarized in Table 4. Non-significant (P>0.05) negative correlation existed between milk yield and TS (r= - 0.02), milk yield and BF (r = -0.04), and milk yield and milk protein (r = -0.23). The relationship between TS and energy (r = 0.54) and BF and energy (r = 0.98) were positive and significant (P<0.05). These observations were in consonance with what has been reported (Ahamefule *et al.*, 2003) for the milk of White Fulani cow.

In conclusion, cassava peel and poultry waste could be effectively harnessed to provide cheap and sustainable supplement for grazing cows and other ruminants on range in Nigeria. The poor milk yield observed among the lactating cows was probably due to low intake of the supplemented diets. This arose due to the short duration of exposure of the experimental diets to the animals. Also, the present results were obtained from mid-lactation study. Studies with some ruminant species (goats) have shown that the greatest milk yield is obtained in early lactation (Akinsoyinu, 1974; Ahamefule, 2005). A full lactation study with intensive feeding regimen would probably improve the milk yield and composition of this indigenous large ruminant breed.

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