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Milk production from primiparous Bunaji cows fed *Pennisetum purpureum* with or without supplements

J.A Akinlade*[1], J.W. Smith[2], A.A.Taiwo[3], I.O. Adekunle[4] and F.G. Akangbe[1]

[1]*Department of Animal Production and Health, Ladoke Akintola University of Technology PMB 4000, Ogbomoso, Nigeria.*

[2]*International Livestock Research Institute (ILRI) Humid/Sub-humid Programme, PMB 5320, Ibadan, Nigeria.*

[3]*Institute of Agricultural Research and Training, Obafemi Awolowo University, P.M.B 5029, Ibadan, Nigeria.*

[4]*Department of Soil Science, University of Agriculture, P.M.B. 2240, Abeokuta,, Nigeria.*

*Corresponding author. E-mail: akinslautech @ yahoo. com

Abstract

The feeding value of three supplements to a basal grass (Pennisetum pupureum) diet was investigated using sixteen Bunaji cows. The three supplements were Pueraria phaseoloides, Leucaena leucocephala and brewers dried grain (BDG). The rate of supplementation was 30% of the daily dry matter requirement. The experimental arrangement used was a completely randomized design and each diet was tested using four animals per diet for an experimental duration of 60 days. Parameters measured included feed intake, milk yield and composition. There was substitution effect of supplement intake on the basal grass diet intake. The intake of supplements enhanced ($P<0.005$) crude protein intake. The milk yields were low and values ranged from 1.1 to 2.6 kg (4% fat corrected milk/day). Supplementation increased ($P<0.05$) milk, fat and protein yields of the lactating cows. However, milk yields of supplemented groups were similar ($P>0.05$). Milk from animals fed Leucaena and BDG supplements had the highest fat 102.2 and protein 93.12 g/d contents. Milk fat contents were normal and similar ($P>0.05$) among the treatments. Low milk protein contents were recorded except for BDG supplement. It was concluded that the feeding of forage legumes enhanced milk production in lactating Bunaji cows.

Key words: Lactating Zebu cows, forage legumes, brewers dried grain, milk yield and composition.

Introduction

In West Africa, the development of peri-urban dairy production depends on the continued supply of feed for the indigenous breeds of cattle (Olaloku and Debre, 1992). Although productivity of Zebu cattle is low (Rege *et al.*, 1993), they constitute the majority of the national herd (RIM 1992). Thus, they contribute the major portion to the national milk production. Grass, the dominant forage in the natural pasture grazed by cattle in Nigeria cannot meet the energy and protein requirements of the animals (Adebowale, 1979, 1981) for sustained milk production especially in the dry season. Supplementing grass with concentrate feeds improves milk yield (Khalil *et al.*, 1992, Schuman, 1968.; Prasanpanich *et al*, 2002), but are expensive for sustainability. Brewer's grain is one of the less expensive protein supplements that have been used with success for dairy cattle production. It is rich in rumen undergradable protein (Clark *et al.*, 1987, Cozzi and Polan, 1994), lysine and methionine (Clarke *et al.*, 1987) the first two limiting amino acids required for milk production (Schwab *et al.*, 1976). Milk yield of Holstein cows supplemented with brewers' grain was better than soybean – supplemented group (Polan *et al.*, 1985). However, its use tends to be centered near breweries because of its high water content resulting in high transport cost (Phipps *et al.*, 1995) and high energy cost required for drying. Farm based supplementary feeds like forage legumes could be explored as cheaper alternatives. It is reported (Muinga *et al.*, 1992) that *Leucaena* supplementation increased dry matter intake, milk yield and live weight of crossbred dairy cows given *ad libitum Pennisetum purpureum.* Foliage of *Gliricida sepium* has also improved milk yield in cows given basal diet of crop residue (Perdock *et al.*, 1982). Although individual forage crops and forage substitutes have been evaluated, studies that combined and compared forage plants (trailing and tree) with well-known agro industrial by products such as brewers dried grain are scare. Therefore, the objective of this study was to determine the effect of supplementing grass (*Pennisetum purpureum)* with foliage of *Leucaena leucocephala* and *Pueraria phaseoloides* and brewers dried grain on feed intake, milk yield and milk composition of primiparous white Bunaji cows.

Materials and methods

Site

The study was conducted at the International Livestock Research Institute, Humid Zone Programme (International Institute for Tropical Agriculture campus) Ibadan, Nigeria (Latitude 7°30' N and Longitude 3°54'E). Annual rainfall averages 1250 mm and occurs from April to November with a marked dry season from December to March. The wet season can be divided into main –wet (April to July) and minor –wet (September to November) seasons. The area is located within the derived savannah ecological zone of Nigeria.

Animals and their management

Sixteen primparous white Bunaji (Zebu) cows of three years old and weighing 250±2.3kg with comparable milk production were considered when assigning the sixteen cows into four treatment groups of four animals each. They were selected from a herd of cows synchronized for oestrus using prostaglandin (PGF2α) and bred by a white Fulani bull. The calves were allowed to suckle their dams for the first three weeks post partum. The cows were individually stall fed in pens on dried and chopped grass hay (*Panicum* *maximum)* supplemented with cottonseed meal. Each pen had separate feed trough and a common water trough with the adjoining pen. At the commencement of the experiment, 22 days *post partum* the calves were separated from their dams. The experimental diets consisted of fresh and chopped (5 cm long) grass *(Pennisetum purpureum)* alone or with one of the three supplements *Pueraria phaseoloides*, *Leucaena leucocephala* and brewers dried grain. The grass was offered to cows in the un-supplemented group in two portions at 08.00 and 15.00 h. Supplements were offered first at 08.00 hour and then followed by grass at 15.00h. The rate of supplementation was 30% of the basal grass diet. Orts were removed daily at 07.30h. Salt mineralized block and water were provided for the cows in each pen. The dry matter (DM) content of the forages was monitored weekly by taking samples for DM determination. The daily DM allowance was adjusted accordingly. Similarly, the bi-weekly weight changes of the cows were monitored and the feed allowance handled as for the forage. Milk yield of the cows was measured daily and recorded.

Milking

Milking was done twice at 08.00 and 18.00h by manual extraction. The calves were kept away from their dams. Milk let down was initiated using the cows respective calves. The cows were washed daily with clean water. Their calves were tied beside them on their right sides. The calves were allowed to suckle for few minutes, and as soon as the calf was observed to be extracting the milk, (when the calf wagged the tail and had stopped pushing the udders) it was returned to the tie by another herder while the milker already seated on the left side of the cow continued the milking. On realizing that it was not the calf suckling, the cow withheld the milk and at this point, the calf was brought back and the process repeated as many times as possible until the cow no longer let down the milk. Samples were taken at each milking, bulked for the respective treatments for 60 days and kept in a deep freezer at -5° C until analyzed. The calves were fed with part of the extracted milk. Samples of the grass and supplements were taken weekly and bulked for chemical analysis. The experiment lasted for 60 days.

Chemical analysis.

The feed samples were ground through a 1.00 mm sieve and analyzed for crude protein (CP), neutral detergent fibre (NDF), calcium (Ca) and phosphours (P). Milk samples were analyzed for CP, Fat, Ca and P. Protein in feed and milk samples was determined by the Kjeldahl method (A.O.A.C.,1990), while milk fat was measured by the Gerbers method (Davis, 1959).Calcium and phosphorus in the samples were analyzed by wet oxidation method (A.O.A.C., 1990). Neutral detergent fibre in feed was determined by the method of Goering and Van Soest, (1991).

Statistical analysis

The experimental arrangement was a completely randomized design. Voluntary feed intake, milk yield and milk composition were subjected to analysis of variance techniques using General Linear Model (GLM) procedure (SAS, 1987). Differences between the treatment means were considered to be significant at ($P<0.05$).

Results

Chemical composition

The nutrient composition of the basal grass diet *(Pennisetum purpureum)* and the three supplementary feeds are shown in Table 1. The CP content of the supplement was generally high. The neutral detergent fiber (NDF) values of the samples were high (615 to 718 g/kg DM) except for *Leucaena leucocephala* with a mean value of 430 g/kg DM. The forage legumes were rich in calcium contents (8.8 to 22.9 g/kg DM).

Feed and nutrient intakes

The dry matter, crude protein and NDF intakes from the feeds are given in Table 2. Dry matter intake (DMI) from grass was highest ($P<0.05$) on grass alone diet. However, *Leucaena leucocephala* and brewers dried grain (BDG) treatments had similar ($P<0.05$) grass intakes. The DMI from the supplements differed ($P<0.05$), BDG being the most highly consumed (60.1g/kg $W^{0.75}$). Consumption of the supplements depressed grass intake and the value corresponded to the supplement-to-basal diet ratio. Total DMI was similar in lactaing Bunaji Zebu cows fed on grass diet and the BDG supplemented group. *Pueraria phaseoloides* treatment had the least ($P<0.05$) intakes of grass, supplement and hence total DMI. The total crude protein intake (CPI) varied ($P<0.05$) with the type of feeds. It increased from the grass diet (17.20 g/kg $W^{0.75}$). to BDG treatment (35.66g/ kg$W^{0.75}$). Similar amount for CP was consumed from grass diet and the *Pueraria* treatments. Inclusion of *Leucaena leucocephala* and brewers dried grain added substantially to the total crude protein intake in the group. Neutral detergent fiber intake was comparable between grass diet and BDG treatment on one hand and between *Pueraria and Leucaena* treatments on the other hand. However, intake from the former was higher than the later group.

Milk production and composition

The milk production and composition of the lactating Bunaji Zebu cows as influenced by the dietary treatment are given in Table 3. Milk yield was generally low, and ranged from 1.1 to 2.6

Table 1: Nutrient composition of experimental diets (%.)

Forage	CP	NDF	Ca	P
Pennisetum purpureum	9.0	70.8	0.88	0.21
Leucaena leucocephala	21.5	43.0	2.29	0.12
Pueraria phaseloides	17.0	65.0	1.46	0.10
Brewer's grains	19.2	61.5	0.28	0.17

CP = Crude Protein, NDF = Neutral Detergent Fiber, Ca = Calcium,

P= Phosphorus.

Table 2: Intake (g/kg of body weight) of dry matter (DM), crude protein (CP) and neutral detergent fibre (DF) of a basal diet of *Pennisetum purpureum* (PP) either alone or supplemented with *Pueraria phaseloides* (PUP), *Leucaena leucocephala* (LL) or brewer dried grain (BDG).

Intake	PP	PUP	LL	BDG	SED
DM					
Grass	191.8^{a}	128.5^{c}	134.4^{b}	134.4^{b}	24.3
Supplemented		37.5^{c}	49.0^{b}	60.1^{a}	17.3
Total	191.8^{a}	166.0^{c}	183.4^{b}	194.5^{a}	19.45
CP					
Grass	17.26^{a}	11.57^{b}	12.10^{b}	12.10^{b}	1.36
Supplemented	-	6.38^{c}	10.54^{b}	23.56^{a}	2.39
Total	17.26^{c}	17.95^{c}	22.64^{b}	35.66^{a}	5.78
NDF					
Grass	135.8^{a}	91.0^{c}	95.2^{b}	60.2^{d}	14.3
Supplemented	-	24.8^{b}	21.1^{b}	37.0^{a}	2.13
Total	135.8^{a}	115.4^{b}	116.2^{b}	132.1^{a}	12.6

Means within the same rows with different superscript differ (P<0.05).
SED: Standard Error of Difference.

Table 3: Milk yield and composition of primiparous lactating (Zebu) cows given basal grass *Pennisetum purpureum* supplemented with three feeds.

	PP	PUP	LL	BDG	SED
Production					
Milk (kg/day)	1.9	2.7	2.7	2.5	0.3
4% FCM (kg/day)	1.1^{b}	2.3^{a}	2.6^{a}	2.4^{a}	0.1
fat (g/day)	40.7^{d}	73.6^{c}	109.2^{a}	84.0^{b}	1.0
protein (g/day)	13.8	68.1^{b}	60.6^{c}	93.2^{a}	90.0
milk composition (%)					
fat	3.7^{b}	3.2^{c}	4.2^{a}	3.5^{b}	0.7
protein	1.25^{d}	3.2^{b}	2.3^{c}	3.9^{a}	3.5
ca	1.2^{a}	0.9c	1.1^{b}	0.5^{d}	0.1
P	0.6^{b}	1.5^{a}	0.5^{b}	0.5^{b}	0.5

Means within the same rows with different superscripts differ (P<0.05).
PP: *Pennisetum purpureum*
PUP: *Pueraria phaseloides*
LL: *Leucaena leucocephala*
BDG: Brewer Dry Grain
SED: Standard Error of Difference.

kg 4% FCM/day. Supplementation of grass with protein rich feeds significantly ($P<0.05$) increased milk production of the lactating Zebu cows. Milk yield of supplemented groups were similar. The fat and protein yields of the supplemented groups were higher ($P<0.05$) than those on the grass diet. *Leucaena leucocephala* gave the highest Ca. Milk fat contents obtained in this study were similar for the unsupplemented animals. All the dietary treatments except BDG had low milk protein contents. Pueraria treatment had the highest ($P<0.05$) milk phosphorus content.

Discussion

The chemical composition of the feeds showed that the CP contents were generally higher than 7-8% CP recommended by NRC (1980) for normal functioning of the rumen in which intake of dry matter would not be inhibited (Minson, 1980). Protein supplementation depressed the dry matter intake (DMI) from the grass. This was in contrast to the findings of Muinga *et al.*, (1993) that leucaena foliage did not affect the basal fodder consumption. Also in the present study, the total DMI from the grass diet was higher for most other groups. This is contrary to the report of Muinga *et al.*, (1993) that the total DMI was higher for cow that received the protein supplement. However, findings in this study are in line with some reports (Anindo and Potter [illegible]) on protein concentrate supplementation. [illegible] concentrate supplementation depressed voluntary intake of basal forage. Milk production [illegible] increased due to supplementation but the increase was limited, possibly, because of the low milk genetic potential of the experimental cows. The additional nutrients were probably used to replenish body reserves and not for milk synthesis. The milk yield recorded in this study compared favorably to those obtained in a study (Olaloku and Oyenuga, 1977) in which lactating Zebu cows grazed improved tropical grass/legume pasture mixture. However, the production levels were low when compared to feeding concentrates along side pasture to the lactating Zebu cows ([illegible] Schumann, 1968). The low production obtained suggested that the level of nutrients available in the feeds offered could not meet the nutrients required to sustain higher milk production. It was observed that the difference between the crude protein intake on grass diet and Pueraria treatment was not significant. This was despite the almost 100% difference in their milk, fat and protein yields and protein contents. This could be as a result of the quality of the protein available in *Pueraria phaseoloides* in terms of its being more balanced in amino acid profile in the rumen undegraded protein (Guilaume *et al.*, 1987). In addition, more energy was available in the Pueraria treatment given its lower NDF intake. This is supported by the result of Ruiz *et al.*, (1992) that reported decrease in milk with increasing dietary concentration. It was expected that BDG treatment should have more milk yield due to the higher protein consumed from it. However, the three supplemented groups had comparable milk yields. This could be due to the moderating influence of its higher NDF intake resulting in a lower metabolizable energy available for milk production (Ruiz *et al.*, 1992). Nevertheless, its higher crude protein intake reflected in its high milk protein content and yield. Gordon and peoples (1986) reported similar observation. The high fat content and yield from Leucaena treatment can be attributed to its lower NDF consumption hence high metabolizable energy intake. This is supported by the studies of Davis (1992).

Conclusion

The protein supplements enhanced the milk yield of lactating Bunaji Zebu cows. The use of forage legumes would reduce the cost of producing milk compared to that of brewers dried grains. This is because they can be obtained from the farm. However, it is necessary to explore further ways of enhancing the productivity of lactating white Fulani cows in terms of improved nutrient intake and utilization. This may be by providing small amount of concentrate feed. It is expected that the sale of milk will offset the additional cost. This may further enhance the growth of peri-urban dairy production in Nigeria.

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