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Early Lactation Milk Yield and Composition of Muturu, N'dama and White Fulani Cows Managed Semi-Intensively in a Hot-Humid Environment

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Abstract: The early lactation milk yield and composition of 9 cows consisting 3 each of Muturu, N'dama and White Fulani were investigated in a 15 week study. The animals in their first parity were selected from a mixed herd managed semi-intensively in a university farm. The cows grazed natural pasture consisting mainly of Panicum maximum, *Calapogonium mucunoides*, *Centrosema pubescence* and other forages from 0900-1500 h daily. Each in-dam received in addition 1 kg day^{-1} of 17% CP concentrate supplement formulated from maize offal, soya cake, etc. The concentrate regimen was initiated 2 weeks pre-partum and ended 16 weeks post-partum. The animals were milked once a day (0700-0800 h) and values obtained were corrected for two-milking-a-day production. Daily milk yield was quantified and bulked weekly per animal per breed. Lactose was determined in daily milk samples while bulked samples were analysed for Total Solids (TS), Butterfat (BF), Solids-Not-Fat (SNF), Crude Protein (CP) and ash. Simple linear regressions were used to quantify relationships between yield and milk constituents and within milk constituents in the 3 cattle breeds. Results showed that milk yield differed ($p<0.05$) significantly among breeds and was 24.14, 36.52 and 66.85 kg in 105 days for Muturu, N'dama and White Fulani, respectively. Total solids, SNF and ash values (%) for the respective breeds (11.56, 8.63, 0.74; 12.87, 10.01, 0.80 and 11.46, 8.87, 0.71) also differed ($p<0.05$) significantly, while BF, CP and lactose contents of milk were not affected ($p>0.05$) by breed. Milk yield was negatively correlated to TS and BF in Muturu, N'dama and White Fulani cows ($p<0.05$, R = −0.13, −0.10, −0.70; −0.48, −0.89, −0.90). Significant ($p<0.05$) positive correlations existed between CP and SNF (R= 0.58; 0.69; 0.69) and CP and BF (R = 0.73; 0.57; 0.66) while the relationship between Lactose and TS ($p>0.05$, 0.19; 0.41; 0.30) was non-significant in the respective breeds. Lactose and SNF (R = 0.32, 0.54, 0.23), CP and TS (R = 0.45, 0.56, 0.47) and BF and TS (R = 0.24, 0.09, 0.74) were also positively correlated; significance levels were however inconsistent with breeds.

Key words: Early lactation, milk, SNF, CP, TS, BF

INTRODUCTION

Consumption of milk and milk products is not a common practice among rural dwellers in Nigeria. Despite the fact that 'Government' imports large consignment of dairy products yearly, the grassroots inhabitants who constitute over 90% of the entire population seldom derive from these largesse, primarily due to indigence and low financial empowerment. Nigeria's annual domestic milk production stands at about 407,000 metric tones (Olaloku, 1999) from an estimated 20 million cattle (FAO, 2000) and 19 million goats (RIM, 1992). Cattle however, provide more than 90% of the total annual domestic milk output (Walshe *et al*., 1991).

The cattle breeds found in Nigeria consist mainly of the zebu-White Fulani (also known as Bunaji) which is recognized as the principal milk producer (Adeneye, 1993) the West African Shorthorn-N'dama and the Nigerian Shorthorn-Muturu. Other breeds like the Sokoto Gudali and Ketekou also exist (The former is also a zebu while the latter is a shorthorn resulting from a cross between the N'dama and the Muturu). Though these cattle breeds are principally kept for beef, the husbandmen/herdsmen usually harvest milk from them-especially from the White Fulani whose herds are scattered all over the country. The milk harvested is consumed by the cattle keepers and their families while any excess is sold to enhance family income.

The dairy performance of White Fulani cattle in Nigeria is well documented (Walshe *et al*., 1991; Ndubueze *et al*., 2006) for N'dama and Muturu however, the lactation performances are not quite commonplace probably because very few herds of these ruminant livestock exist in Nigeria. Before now, a lot of myth

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surrounded the Muturu, it was considered sacrilegious to kill or eat its meat and as a result very few villagers kept or reared them. In the eastern part of the country where they were mostly found, they were before now, reserved mostly for sacrifices and religious rites for pagans and traditionalists, while in some communities they were kept as status symbols for influential chieftains. N'dama on the other hand is not indigenous to Nigeria. It was imported into Nigeria from Senegambia in 1939 because of its close semblance to Muturu (Starkey, 1984). It was assumed that since trypanotolerant; it would interbreed with Muturu to sustain substantial level of production in the rainforest belt where tse-tse fly infestation was a limiting factor to the performance of the zebu breed (Blench, 1985). Whereas the White Fulani herds can be spotted across the country owing to the transhumant production system where the Fulani herdsmen trekked them around in search of fodder, the N'dama and Muturu are found only in Government farms and in pockets of small populations in the eastern part of the country.

There is dearth of information on early lactation performances of White Fulani, N'dama and Muturu cows. Individual breed performances in small holder cattle units in Nigeria before now were either not recorded or made available. Efforts therefore, were made in this study to compare the early lactation milk yield and compositions of these three cattle breeds managed semi-intensively in a hot humid environment.

MATERIALS AND METHODS

Environment of study: The study was carried out at the Livestock Unit of Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State of Nigeria. Umudike bears the co-ordinate of 5°28' North and 7°31' East and lies at an altitude of 122 m above sea level. Located within the tropical rainforest zone, the environment is characterized by an annual rainfall of about 2177 mm. The relative humidity during rainy season is well above 72%. Monthly ambient temperature ranged from 17-36°C. March is the warmest month with an average temperature range from 22-30°C.

Animal management: Nine lactating dams in their first parity, comprising three Muturu, N'dama and White Fulani cows, respectively, were selected from the University (mixed) herd and used in this study. The animals which were semi-intensively managed, grazed natural pasture during the day (0900-1500 h) and were returned to shed in the evening (1600 h) where each in-dam received a 17% CP concentrate supplementary ration at the rate of 1 kg animal^{-1} day^{-1}. The forage grazed comprised mainly of *Panicum maximum*, *Calapogonium mucunoides*, *Centrosema pubescens* and others while the concentrate ration was formulated from maize offal, soya cake, palm kernel cake, brewers dried grain, bone meal and common salt (Table 1). The concentrate regimen was initiated at 2 week pre-partum and terminated at 16th week post-partum. The animals were routinely dewormed using Fenbendazole (quarterly and bimonthly in the dry and rainy seasons, respectively) while ectoparasites were controlled monthly by spraying with Pfizona. The animals had liberal access to fresh clean water.

Table 1: The contents and proximate composition of the concentrate diet

Ingredients	Composition (%)
Maize	54.00
Palm kernel cake	15.00
Ground nut cake	13.00
Brewers dry grain	15.00
Bone meal	2.00
Common salt	1.00
Total	100.00
Analysed compositions (%)	
Dry matter	89.40
Crude protein	17.10
Crude fibre	5.63
Ether extract	4.60
Nitrogen free extract	56.02
Ash	6.05
Energy (kcal g^{-1})	3.27

Milk sampling/measurements: The 9 lactating cows were weekly sampled within the 15 week study period. Lactation for each cow was based on 305 days. Milk collection for the first lactation phase for each cow was initiated on the 7th day post partum (after colostrums) and terminated on the 112th day of lactation. Milk was harvested between 0800-0900 h 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 Verner, 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 1800 h 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 each cow was measured using graduated glass cylinder and weighed back to the nearest gram.

Analytical procedure: Samples from daily milk yield for each cow were analysed for lactose content immediately after collection, then bulked and subsequently analysed weekly for TS, BF, CP (N×6.38), SNF, ash and energy. The bulked samples were often stored in a refrigerator (-5°C) until required for analysis. Total solids were determined by drying about 5 g of milk to a constant at 105°C for 24 h. Lactose was estimated from fresh samples by Marrier and Boulet (1959) procedure. Butterfat was obtained by the Roese-Gottlieb method (AOAC, 1980). Milk protein (N×6.38) 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. Feed samples were analysed for proximate components using AOAC (1990) methods.

Statistical analysis: The data obtained on milk yield and compositions of the 3 ruminant breeds were subjected to Analysis of Variance (ANOVA) procedure (Steel and Torrie, 1980). Significant means were separated using Duncan's Multiple Range Test (Duncan, 1955). Simple regression analysis was used to define degree of relationships between yield and milk constituents and between milk constituents in each of the cattle breeds.

RESULTS AND DISCUSSION

The constituents and proximate composition of the concentrate diet offered to lactating cows are given in Table 1. The Crude Protein (CP) content of the diet (17%) falls within the range (15-17%) recommended for first-early-lactating-low-producing dairy cows (Linn, 1995). Although, the dry matter consumption of each animal on range was not determined, the cows were subjected to a liberal stocking rate of 1 AU (Animal unit) per 0.05ha which evidently (Kallah, 1982) ensured adequate dry matter fill. Also early-dry season (October-December), which happens to coincide with the period of this study, is reported (Linn, 1995; Schroeder and Park, 1997) as the period of optimum nutritional profile of tropical pasture for maximum yield in dairy animals. Schroeder and Park (1997) had observed that about 25 kg dry matter intake is required by proven high producing dairy cattle breeds for maintenance and milk production daily. In the tropics however, the minimum daily dry matter intake for lactating ruminants for maintenance and milk production can be met by ensuring that animals had access to dry matter fill equivalent to 5% of their respective bodyweights (Devendra and Mcleroy, 1982) which averagely would amount to 18, 12 and 10 kg, respectively, for the White Fulani, N'dama and Muturu cows, in Nigeria.

Table 2: Early lactation milk yield and composition of Muturu, N'dama and White Fulani

Breed	Milk Yield (kg)	TS (%)	BF (%)	SNF (%)	CP (%)	Lactose (%)	Ash (%)
Muturu	24.14[c]	11.56[b]	2.88	8.63[b]	3.90	4.32	0.7400[b]
N'dama	36.52[b]	12.87[a]	2.87	10.01[a]	3.94	4.39	0.8000[a]
White Fulani	66.85[a]	11.46[b]	2.88	8.87[b]	4.06	4.14	0.7100[b]
SEM	0.04	0.25	0.01	0.35	0.01	0.04	0.0008

[abc]: Means on the same column with different superscripts differ significantly ($p<0.05$), TS = Total Solids, BF = Butterfat, SNF = Solids-Not-Fat, CP = Crude Protein, SEM = Standard Error of the Mean

Table 2 shows the milk yield and composition of the 3 cattle breeds in early lactation. Early lactation or first 100 days of milk production is a period of peak milk yield and high dry matter intake. Usually, there is excessive nutritional demand on dams within this period for milk production and this most times result in negative nutrient balance. Good management therefore, demands that cows should be well nourished in early lactation to avoid loss of condition which may subsequently affect yields in the mid and late lactation stages.

However, milk yield differed significantly ($p<0.05$) among the breeds and was highest for White Fulani and least for Muturu cows. The yield obtained for White Fulani in early lactation (66.8 kg) is comparably lower than the value of 85.5 kg recorded by Olafadehan *et al.* (2007) elsewhere for same breed within corresponding lactation period. Other values reported for the breed were mostly for the entire other than delineated lactation phases. Nevertheless, the slight variation in yield reported for the breed above may be due to differences in parity, season and environment of study and perhaps, management of the animals. Animals used in the present study were in their first lactation. Studies (Ibeawuchi and Dagut, 1990; Agyemang *et al.*, 1991) have shown that milk production is influenced by parity and that animals in their first parity produced less milk than those in 2nd or 3rd parities. Also the environment and season could have exerted some influence on the lactating animals. This study was carried out in the early-dry season (October-December). Studies have shown that lactating animals produced more milk in rainy than in the dry season (Singye, 1981; Agyemang *et al.*, 1991).

More importantly though is the issue of management. Even though the animals used in both studies were managed semi-intensively, the white Fulani cows used by Olafadehan *et al.* (2007) were on higher plane and level of supplementation, comparatively. All things being equal, a high level correlation exist between milk production and quantity/quality of feed intake (Ibeawuchi and Dagut, 1990). Inadequate nutrition is a limiting factor to milk production in lactating animals (Agyemang *et al.*, 1991).

Muturu cows are not normally milked; consequently data on their milk production are not documented, making it difficult to compare the present result with any existing records. However, lactation yields of 127-421 kg have been reported (Olaloku, 1976; Fricke, 1990) for the breed in lactation lengths of 120-216 days on range which in any case, is not in consonance with the period of this study.

Published works on milk off take of N'dama cows under short period of lactation are not common in Nigeria either, but studies elsewhere (ILCA, 1991; Starkey, 1984) reported adjusted milk production of 60-80 kg year^{-1} based on field observation and farmers interview. Even though this annual yield was not delineated into stages of lactation, actual early lactation yield may however not differ from the result obtained for the breed in the present study. A similar study by Agyemang *et al*. (1991) indeed reported milk off take of 404 kg in 420 days for N'dama; suggesting an average production of 0.96 kg day^{-1} or approximately between 96-100 kg milk in 100 days. This estimate is comparably higher than the result obtained for N'dama in this study (36.52 kg) and even higher than the yield (85.5 kg) reported by Olafadehan *et al*. (2007) in early lactation for White Fulani. The observations by Agyemang *et al*. (1991) further indicated that short lactation lengths usually associated with indigenous tropical cattle breeds may not be a production constraint for the N'dama; suggesting also that N'dama could be developed into a dual purpose (beef and dairy) breed. The present result however does not justify the foregoing observation made by Agyemang *et al*. (1991) for N'dama; rather it nonetheless demonstrated that the White Fulani produced almost twice as much milk as N'dama in early lactation (Table 2) which agrees with the findings of Ohaeri (2007). All the same, the variations in milk yield recorded for N'dama in this study relative to reports of investigations elsewhere (ILCA, 1991; Starkey, 1984; Agyemang *et al.,* 1991) may be attributed to differences in management, environment and period of study.

The total solids, solids-not-fat and ash (%) values also differed significantly ($p<0.05$) among the breeds. Muturu and White Fulani had similar ($p>0.05$) levels of TS, SNF and ash in milk which were inferior ($p<0.05$) to N'dama. Total solids and yield were negatively correlated in the milk of the 3 cattle breeds in this study. This observation was earlier reported by Jenness (1980) and more recently collaborated by Ahamefule and Ibeawuchi (2005) and Ndubueze *et al.* (2006). The White Fulani produced more milk than either the N'dama or Muturu, therefore, less TS was expected in her milk, relatively. Taken from the foregoing, more TS was expected in the milk of Muturu than N'dama in this study. This however, was not the case. It is thought that the contrary picture presented here may be attributed to the inherent or genetic make up of the Muturu (which makes her a poor milker). Reports indicate that Muturu cows seldom produce enough milk to suckle their calves (Adebambo, 2001). This inherent poor milking ability of the Muturu may indeed be responsible for the observed abnormally. However, the TS value obtained for White Fulani (11.56%) compared well with the value of 10.83% reported by Ndubueze *et al.* (2006). Data on milk composition of Muturu cow, as observed earlier, is not common, nevertheless, the TS observed for N'dama fell within the range of what has been reported (Ohaeri, 2007) for the breed.

The butterfat contents of milk of the breeds were similar ($p<0.05$), but the present values (Table 2) were quite low compared to the values of 5.1 and 5.7% earlier reported by Agyemang *et al.* (1991) and Ndubueze *et al.* (2006) for N'dama and White Fulani breeds, respectively. The crude protein and lactose concentrations of milk also followed similar pattern as in butterfat. Their concentrations were not influenced by breed ($p>0.05$), however, the average milk protein value recorded for N'dama (3.94%) compared fairly well with the value of 3.20% reported for the same breed (Agyemang *et al.*, 1991) while the present value for White Fulani (4.06%) is slightly lower than 3.58% recorded by Ndubueze *et al.* (2006).

The linear regression and correlation coefficients between yield and compositions in the milk of the 3 cattle breeds are given in Table 3. Milk yield was also negatively correlated to BF as in TS, in the milk of all the cattle breeds. Reports of Ibeawuchi (1985), Ndubueze (2004) and Ukah (2007) also corroborate this finding. Ahamefule and Ibeawuchi (2005) also made similar observation when they fed pigeon pea-cassava peel based diets to lactating West African Dwarf goats. In the 3 cattle breeds also, significant positive correlations existed between CP and SNF and CP and BF but the relationship between Lactose and TS was non-significant. This is in consonance with the observations of Ahamefule *et al.* (2007). Positive correlations also existed between Lactose and SNF; BF and TS and CP and TS in the milk of the 3 animal groups, levels of significance were however inconsistent with breeds.

Similar observations were made in the relationships between milk constituents in the Sahelian, Red Sokoto and West African Dwarf goats (Ibeawuchi *et al*., 2003; Ahamefule and Ibeawuchi, 2005; Akpa *et al*., 2002). Meanwhile, the positive relationships established between TS and most milk constituents in this study, is a confirmation that milk constituents are components of TS and that anything that affects milk constituents will invariably affect the TS in milk. Ibeawuchi and Dagut (1990) had earlier also expressed similar view.

Table 3: Inear regression equation and correlation coefficient (r) between milk yield and various constituents of milk

Parameters X	Parameters Y	Breed	Regression equation	Standard error	Correlation coefficient (r)	Significance
Milk yield		Muturu	Y = 10.82-1.19x	0.94	-0.13	NS
	Total solids	N'dama	Y = 12.64- 0.25x	0.74	-0.10	NS
		White Fulani	Y = 9.44-1.18x	0.65	-0.74	*
Milk yield		Muturu	Y = 3.40-0.83x	0.19	-0.48	NS
	Butterfat	N'dama	Y = 3.54-0.70x	0.09	-0.89	**
		White Fulani	Y = 3.44-0.33x	0.09	-0.90	**
Lactose		Muturu	Y = 5.12+0.09x	0.34	0.32	NS
	Solids-not-fat	N'dama	Y = 5.43+0.10x	0.13	0.54	*
		White Fulani	Y = 5.16+0.11x	0.62	0.23	NS
Crude protein		Muturu	Y = 2.78+0. 12x	0.22	0.58	*
	Solids-not-fat	N'dama	Y = 1.80+0. 21x	0.18	0.69	*
		White Fulani	Y = 3.28+0.08x	0.11	0.69	*
Crude protein		Muturu	Y = 6.52+0.90x	0.19	0.73	*
	Butterfat	N'dama	Y = 5.84+0.66x	0.20	0.57	*
		White Fulani	Y = 5.49+0.49x	0.12	0.66	*
Butterfat		Muturu	Y = 3.42+0.04x	0.21	0.24	NS
	Total solids	N'dama	Y = 3.21+0.02x	0.21	0.09	NS
		White Fulani	Y = 4.83+0.17x	0.14	0.74	*
Crude protein		Muturu	Y = 2.62+0.11x	0.24	0.45	NS
	Total solids	N'dama	Y = 1.49+0.19x	0.20	0.56	*
		White Fulani	Y = 3.14+0.08x	0.14	0.47	NS
Lactose		Muturu	Y = 5.00+0.05x	0.35	0.19	NS
	Total solids	N'dama	Y = 5.51+0.08x	0.14	0.41	NS
		White Fulani	Y = 6.39+0.19x	0.60	0.30	NS

CONCLUSION

In conclusion, the White Fulani produced the greatest quantity of milk in this study; confirming her status as the principal milk producer in Nigeria. The production of this breed should be encouraged in Nigeria. The lactation performance could be presently improved with good management and subsequently with well articulated breeding programme. The milk yield of N'dama and Muturu were quite low. Evidence from this study does not support the development of N'dama into a dairy breed as being canvassed; rather enhanced performance can also be achieved under good management. Muturu is disadvantaged in milk production; its small nature also does not position it well as a beef animal either. Good handling and nutrition may improve on the present result; however such improvement will only be limited by her inherent potentials for milk production and therefore will not guarantee returns on investment. Alternatively, it may used in its present state as a good source of beef, big enough for a family size.

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