Early Lactation Milk Yield and Interrelationships Between Milk Constituents of Free Grazing Prepartum Supplemented Bunaji Cows

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Abstract: A study was conducted to investigate effect of prepartum supplementary feeding of free grazing Bunaji cows on the early lactation milk yield (MY) and interrelationships between the resulting milk constituents. Twenty cows, balanced for their weight and parity, were allocated to a completely randomized design, with five animals per treatment. The treatments were: A, range grazing (RG); B, RG + 100% corn bran (CB); C, RG + 60% CB + 40% palm kernel cake (PKC), and D, RG + 60% CB + 40% dried brewer’s grains (DBG). Whereas milk yield was significantly (P < 0.05) higher in supplemented cows than in the control, milk constituents were similar among the treatments. Milk fat (MF) was negatively insignificantly (P > 0.05) correlated to total solid (TS) and crude protein (CP) (r = -0.885; -0.6989). Contrarily, insignificant (P > 0.05) but positive correlations existed between TS and CP (r = 0.8607), TS and lactose (r = 0.8554), CP and solids-not-fat (SNF) (r = 0.7677), lactose and CP (r = 0.6210) and MY and CP (= 0.560). There was a negative and highly significant (P < 0.01) correlation between MF and SNF (r = -0.9893) and MF and lactose (r = 0.9944). The relationships between TS and SNF and MF and gross energy were positive and highly significant (P < 0.01, r = 0.9459). However, MY and MF were significantly negatively related (P < 0.05, -0.9840). Prepartum supplementary feeding improved the milk yield of the grazing cows in the early lactation while both positive and negative relationships existed between milk constituents of the cows suggesting that the regression equations can be used to predict one milk constituent from the other.

Key words: Cow, Free Grazing, Milk Constituents and Yield, Prepartum Supplementation, Relationship

INTRODUCTION

The Nigeria dairy industry still remains rural and traditional with the Fulani pastoralists controlling about 95% of the national herd[1]. Cattle and to a lesser extent sheep and goats production are generally associated with the pastoral Fulani who engage predominantly in traditional/extensive systems of management with little or no input. Under this system, the productivity of these animals is very poor and below their genetic potentials principally due to poor nutrition occasioned by poor quality and scarcity of natural forages, especially during the dry season, which limits the full expression of the milking potentials of the indigenous cattle. During this period, low quality hay and crop residues constitute important sources of nutrients for cattle which are the major source of domestic milk supply. These feed resources are highly lignified, less digestible and very low in crude protein. Thus the nutritional requirements of grazing lactating cows for milk synthesis and let-down are not adequately met. There is paucity of information on the early milk yield and interrelationships between milk constituents of grazing cows under traditional management systems in the tropics. This study was therefore designed to investigate the effect of supplementary feeding of gestating traditionally managed Bunaji cows on early milk yield and the interrelationships between the resulting milk constituents.

MATERIALS AND METHODS

Study Area: The study was conducted on-farm among the agropastoralists settled in the Southwestern Nigeria. It lies roughly between longitude 3° 4’ West, 6° 4 East of Greenwich and latitude 6° 10’ and 9° 10’ North of the equator. Annual rainfall is between 1,500 and 2,000mm and follows a bimodal distribution. The temperature ranges from 22 - 33°C while the wet season lasts for 8.0 - 8.5 months starting from mid-March to mid-November.

Cattle Management Practices of the Agropastoralists in the Study Area: Milk production in the study area is based largely on indigenous Bunaji cattle breed kept by Fulani herdsmen who grow food crops in addition to their primary cattle herding activities. Cattle are herded to the fields in the morning after milking to graze natural forages and crop residues. They are returned in the evening and corralled during the night in the open field, near the homestead. Unweaned calves are tied by ropes to separate them from their dams. Cows are...
partially milked once a day in the morning, the remainder of the milk being suckled by the calves.

Experimental Animals, Design and Management: Twenty gestating dual purpose dairy Bunaji cows in their 2nd and 4th lactation, with average weight of 294.50 ± 3.75 kg, were used for the experiment. The cows were selected when they were in the last trimester of their pregnancy which was determined by interviewing the herd owners. The cows were balanced for weight and parity (lactation number) and separated into 4 groups of 5 cows each. The groups were randomly assigned to 4 treatments: range grazing (RG), A; RG + 100% MB, B; RG + 60% MB + 40% PKC, C and RG + 60% MB + 40% DBG, D in a complete randomized design.

Supplements were offered during the last trimester of pregnancy individually early in the morning for 90 days before grazing at 20% of the daily dry matter intake calculated at 3% body weight. After feeding, animals were grazed on natural range. Common salt was offered to individual animals throughout the experimental period. Feed refusal was very small and virtually negligible as all the cows finished their feed before going out for grazing.

Milking Procedure: Milking of the cows began one week after calving to allow calves access to colostrum, but milk production records began two weeks after calving. Hand milking was done in the morning between 0.700 to 0.800 hours local time while calves were used to initiate milk let-down. Partial milking was done in order to reserve milk for sucking calves. MY record was taken on weekly basis for 90 days. Milk samples for constituent analysis were collected into bottles containing a pinch of potassium dichromate (K$_2$CrO$_7$) powder to maintain homogeneity and prevent clotting. The samples were kept chilled later and analysed for milk components.

### Table 1: Composition of the supplemental diets (%)

<table>
<thead>
<tr>
<th>Composition</th>
<th>Treatments</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>A (Range grazing)</td>
</tr>
<tr>
<td>Dry matter</td>
<td>91.90</td>
</tr>
<tr>
<td>Crude protein</td>
<td>12.98</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>8.78</td>
</tr>
<tr>
<td>Ash</td>
<td>3.50</td>
</tr>
<tr>
<td>Ether extract</td>
<td>2.78</td>
</tr>
<tr>
<td>Nitrogen free extract</td>
<td>6.45</td>
</tr>
<tr>
<td>Acid detergent fibre</td>
<td>28.20</td>
</tr>
<tr>
<td>Neutral detergent fibre</td>
<td>50.77</td>
</tr>
<tr>
<td>Gross energy MJ/kg DM</td>
<td>17.15</td>
</tr>
</tbody>
</table>

### Chemical Analysis: The proximate constituents of the experimental diets and milk samples were determined according to AOAC$^{(2)}$ methods. Gross energy contents of feeds were determined using Gallen-Kamp ballistic bomb calorimeter (Modal CB- 370). The neutral detergent fibre and acid detergent fibre components were determined by methods of Van Soest et al.$^{(3)}$.

### Statistical Analysis: Irrespective of the treatments, all data obtained for each milk constituent of each animal were pooled together and the relationships between milk constituents were determined using correlation and regression analyses$^{(4)}$.

### RESULTS AND DISCUSSION

The composition of the experimental diets is shown in Table 1 while the milk yield and composition are presented in Table 2. Linear correlations between various milk components were determined and the results are presented in Table 3.

Milk yield (MY) was superior (P < 0.05) in the supplemented cows compared to their non-supplemented counterparts obviously due to the improved plane of nutrition of the supplemented cows, which resulted in extra feed, nutrients and energy intake. Parallel observations were indicated by Olafadehan and Adewumi$^{(5)}$. The average milk yield of about 73 kg for all the animals irrespective of the treatments was fairly similar to the value of 67 kg reported elsewhere by Ahamefule et al.$^{(6)}$ for the same breed of animal within corresponding lactation phase. Milk yields of supplemented cows on treatments B, C and D were 28.3, 55.0 and 58.4%, respectively, higher than that of the non-supplemented cows on treatment A. The non-significant influence of diets on the milk composition of the experimental cows concurs with the findings of Bwire and Wikortson$^{(7)}$. 

The insignificant negative relationship between TS and MF in the present study is somewhat different from the observations of Belewu[8] and Ahaemafule et al.[9] who reported small but positive relationship between these two components. The result appears plausible since SNF and MF, which are negatively correlated in the present study, are the two major components of TS. When expressed as the percent of the TS, MF constituted 36.14, 34.58, 34.39 and 33.67% of the TS of the milk content of treatments A – D, respectively. Other workers have reported that 29.1 - 35.1% of TS was MF[9,10,11].
Contrary to the relationship between TS and MF, TS was positively but insignificantly (P > 0.05) correlated with CP and lactose. The positive but insignificant correlations between TS and MF and TS and lactose, and significant relationship between TS and SNF contents of milk, respectively, imply that the observed increase in the TS of milk was due to the corresponding increase in SNF. CP and lactose contents of the milk which is also a confirmation that milk constituents are components of TS and anything that affects the milk constituents will invariably affects the TS in the milk. The findings corroborate previous reports\cite{6,12}. However coefficient of determination showed that SNF had a more pronounced effect on TS than CP and lactose, respectively. Similarly, the significant positive correlation between TS and SNF, and the insignificant positive relationships between TS and CP and TS and lactose confirm previous findings by Tona \cite{11} and Belewu\cite{6}, and Ahamefule et al.\cite{10} respectively. However, Tona\cite{11} reported that TS was significantly positively correlated to CP. Milk proteins constituted on the average 27.6% of the TS contents of the Bunaji cows; this value is within the range of 25.8 - 30.5% reported as milk protein percentage of TS\cite{11,13}. The highly significantly negatively correlated relationship between MF and lactose contradicts the positive and significant correlation reported by Belewu\cite{6}, but corroborates the negative correlation indicated by Tona\cite{11}. The highly significant (P<0.01) and negative correlation between MF and SNF depicts an inverse relationship between these two major components of milk. This is of nutritional interest as emphasis is laid on consumption of animal products with less fat content. Hence, the minimum standards for market milks are fixed for fat and SNF contents to ensure quality milk supply to the consumers and to prevent adulteration of milk\cite{11,13}. Svennersten-Sjaunja et al.\cite{11} analysed various milking records of cows on different farms in Sweden and found that the consumer’s demand was milk with moderate or low fat content. It thus appears that one of the ways of reducing MF content is to attempt to manipulate the diets of the animals such that it favours more production of SNF at the expense of the fat. The result agrees with the findings of Belewu\cite{6} who observed a small but negative relationship between MF and SNF but disagrees with the report of Tona\cite{11} who indicated significantly positive relationship between these two milk components. The variation in the result could be ascribed to the fact that fat is the most variable component of milk. The insignificant negative correlation between MF and CP contradicted the positive but non-significant and significant relationships reported by Belewu\cite{6} and Tona \cite{11} respectively.

The insignificant positive correlation between the CP and lactose content of milk disagrees with the reports of Cressman et al.\cite{14} and Barney et al.\cite{17}. Variation in results may be due to differences in the milk composition of temperate breeds of cattle and tropical breeds. For example, the milk CP values in the current study were higher than 2.65 - 3.16% reported for cross breed and exotic breeds of lactating cows, respectively\cite{11,13,14} and the milk of temperate breeds also has a lower caloric value of 66 kcal/100g\cite{22} compared with 75 – 77 kcal/100g in this report. Adeneye\cite{23} earlier reported higher fat, protein and lactose contents for the milk of tropical breed compared to their temperate counterparts. The positive correlations between SNF and CP and SNF and lactose are consistent with the earlier findings\cite{6,8,10,22}. Tona\cite{11}, however, noted positive and significant correlation (r = 0.66) between SNF and lactose. The result of relationship between SNF and lactose was not unexpected since CP and lactose are the major components of SNF\cite{23}. The significant and negative correlation between MF and MY showed that as the MY increases, MF decreases. This appears plausible since feeding of supplementary concentrate diets is usually accompanied by alteration of the volatile fatty acids with production of more propionate, which is glucogenic and supplies the energy for milk synthesis at the expense of acetate and butyric, which are lipogenic and used for milk fat synthesis. This connotes that nutritional intervention or manipulation that aimed at increasing MY is beneficial as it will be accompanied by butterfat reduction. Parallel observations were made by Beauchemin and Rhodes\cite{23} and Ahamefule et al.\cite{10} who reported inverse relationship between MY and butterfat. The significantly and positively correlated relationship between MF and GE agrees with the reports of Belewu\cite{10} and Adeneye\cite{23} who stated that milk caloric value is controlled largely by MF content since fat is a rich energy source. There was a small but positive relationship between MY and CP which implies that any feeding regime which improves MY will equally improve the milk CP content; this appears beneficial considering the nutritional roles of protein.

**Conclusion:** It is concluded that prepartum supplementation of grazing cows improved their milk production and that both positive and negative relationships existed between milk constituents of Bunaji cows which implies that it is possible to use the regression equations to predict one constituent from the other.

**REFERENCES**