Vol.4, No.1, 18-22 (2014)
http://dx.doi.org/10.4236/ojas.2014.41003

Effects of protein and mineral supplementation on the performance of lactating dairy cows gobra and crossbreed guzerat during the dry season in senegal

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Received 21 October 2013; revised 25 November 2013; accepted 8 December 2013

ABSTRACT

The purpose of this study carried out in the township of Dahra was to access the effect of dry season protein and mineral supplementation of Gobra and Crossbreed Guzerat cows on milk production. The experimental design is a completely randomized block. The treatments were: supplement of molasse-urea blocks with supplement of hay; supplement of molasse-urea blocks without any hay; no supplement of molasse-urea blocks and supplement of hay; no supplement of molasse-urea block without any hay. For each breed, the treatments were replicated three times on a lot of cows with the similar zootechnic parameters. A total of twelve lactating cows per breed were then used. The supplement of block + hay has significantly ($p < 5\%$) allowed obtaining the largest average daily quantity of milk: 1.9 ± 0.7L/day/cow and 2.4 ± 0.8 L/day/cow respectively in Gobra and Crossbreed Gobra*Guzerat. The increases in production compared to the control treatment (without supplement) are 52.63% and 100% respectively in the breed Gobra and Gobra*Guzerat. The supplement of hay comes in the second place and contributes to an additional production of 66.66% in both breeds of cow. Then, the supplement of block follows and it allows increasing the production of 44.44% and 50% respectively in Gobra and Crossbreed. In both races, the supplement of block + hay has allowed obtaining the highest profits of $1.6/L/day/cow for Gobra and $ 2.8/L/day/cow for the Crossbreed, that equals to an increase by $ 0.3 and $ 0.9 compared to the control treatment. The supplement of hay and the block supplement have respectively given a profit of 0.4 and $ 0.3/L/day/cow in Gobra and 0.6 and $ 0.4/L/day/cow in the Crossbreed. The adoption of supplementation molasse-urea block + hay by producers appears an alternative to boost milk production in dry season.

KEYWORDS

Milk Yield; Supplements; Gobra; Guzerat; Dry Season

1. INTRODUCTION

In Senegal, the sub-sector of livestock is a significant component of the economy with a contribution of 7.5% of national GDP and 35% of the Agricultural Gross Domestic Product. Potentially, all agro-ecological zones of the country have real advantages for animal production. Thus the Sylvo-Pastoral Zone contributes nearly 40% of the national milk production from the pastoral system [1]. Once considered as a domestic product of consumption, milk today has a considerably economic value to policy-makers to face the growing demand of the population. However, all the hopes placed on the development of the dairy sector are destroyed by the difficulties to maintain during the dry season the production levels obtained in winter and to sustain the collection and processing of

milk [2]. In the dairy radius around the city of Dahra (in the center of Senegal), this problematic situation is closely related to the production system that is primarily based on the value of natural pastures varying in time and space. At the beginning of the dry season, the fodder stock, basic of live stock feed is already permanently exhausted. A phase of qualitative and quantitative decline will begin and will continue more or less rapidly until the next rainy season [3]. This fodder deficit in dry season combined with the depreciation of the food quality and the high cost of feed leads to a nutritional deficiency especially in lactating cows. During this period, they show severe protein and mineral deficiencies that affect the levels of milk production. Studies in Senegal have already highlighted these deficiencies including calcium and phosphorus deficiencies that are the most common [4,5]. In this context, making available to milk producers technology for protein and mineral supplement is needed to correct nutritional deficiencies observed in cows and to improve milk production levels during dry season. It is in this dynamic that technologies such as multi-nutritional blocks complementation (molasse-urea) and hay harvested at the end of the rainy season were offered to producers of milk in the dairy radius of Dahra. The blocks of molasse-urea can provide animals with energy, nitrogen, and potentially all the necessary mineral support for the proper functioning of the digestive tract of ruminants [6]. The objective of this work is to study during the dry season, the effects of supplementation by the molasse-urea block and hay on the performance of dairy cows around the city of Dahra in Senegal.

2. MATERIAL AND METHODS

2.1. Study Area

The studies were conducted in the department of Linguère specifically in the township of Dahra and its periphery (villages of Pampy and Thingholy located in the rural community of Thiamène Pass at 5 km from the township of Dahra).

The geographical coordinates are 15˚21'3" North and 15˚36'13" East and the relief is mostly flat. This pastoral area is part of the Sylvo-Pastoral Zone in Senegal. The climate is Sahelian characterized by a long dry season of 9 months and a rainy season occurring between July and September [7]. The rainfall varies from one year to the next with an average of 419.59 mm during the last twelve years (rainfall data from the weather station of the "Centre de Recherches Zootechniques de Dahra''). The harmattan is dominant, but the monsoon, hot and humid wind is activated during the rainy season. The temperature remains high throughout most of the year. The lowest occur between December and February and the highest between April, May and June; the average is estimated at about 30˚C. The vegetation includes herbaceous and woody stratum. The herbaceous layer consists of annual species dominated by grasses among which *Cenchrus bifrorus*, *Zornia glochidiata*, *Schoenefel diagracilus*. The woody stratum is composed of trees and shrubs dominated by *Balanites aegyptiaca*, *Boscia senegalensis*, *Acacia senegal*, *Acacia seyal*, *Acacia radiana*, *Pterocarps lucens*, *Combretum glutinosum*, *Combretum aculeatum* [7]. Extensive farming is the dominant system in the study area. This mode of traditional extensive farming coexists increasingly with a semi-intensive system that is based on the complementation of animals with concentrated foods mainly in dairy production [8,9]. The supplementation is usually done in the evening at the return of pastures [10]. This dynamic of milk production was prompted by the presence of mini-dairies that gave opportunities for producers of fresh milk to market in any season. The main breeds are the local Gobra and Crossbreed Guzerat deriving from the crossing between Gobra and Guzerat. The Guzerat breed is imported from Brazil and introduced into the pastoral zone through animal research. It also has a good potential beefing. It produces higher milk production (1 - 5 liters per cow per day depending on the season and the growing conditions). As for local Gobra, it is characterized by good provision for meat production, but the cows are deemed poor milk producers [11]. The quantities produced vary between 0.5 and 1liter per cow per day in the dry season and between 1 - 2 liters per cow per day in the rainy season.

2.2. Experimental Animals and Design

The animal material consisted of lactating cows Gobra and Crossbreed (Gobra*Guzerat) selected in the township of Dahra and the rural community of Thiamène. These cows are in their third calving and a mean weight estimated at 350 kg. Calving took place between August and October 2012. The farmers' practice in terms of animal behavior is to water them at drilling in the morning or at the nearest fountain before leading to natural pastures till evening. Watering is done once a day. The calves are kept at home or left wandering in the vicinity of homes. They suck twice daily (morning and evening) and are left to the supervision of women. The supplementation of 2 kg of cake for each cow is done in the evening after grazing. Milking is done once a day in the two villages while inside the township of Dahra, cows are milked in the morning and evening. The experimental design is a completely randomized block. The treatments were: supplement of molasse-urea blocks with supplement of hay; supplement of molasse-urea blocks without any hay; no supplement of molasse-urea blocks and supplement of hay; no supplement of molasse-urea block without any hay. For each breed, the treatments were replicated three times on a lot of four cows with the

similar zootechnic parameters. A total of twelve lactating cows per breed were then used. The molasse-urea blocks of 3 kg consisted of several ingredients including molasse, urea, wheat bran, the bichelate phosphate and sodium chloride (Table 1). It is served ad libitum to the animals. Hay is composed of annual grasses mowed and maintained at the "Centre de Recherche Zootechnique de Dahra'' and is given at a dose of 3 kg/day/cow. Its values in MAD and UF totaled over 190 g and 0.5 UF respectively for a phosphate ratio of about 1.5 [6]. The hay is harvested in September-October and stored in good conditions. Its energy content is 0.45 UF while the MAD value is estimated at 28.6 g [12].

2.3. Data Collection and Statistical Analysis

Hand milking was done one time at the morning. Calves were allowed to suck for about one minute in order to stimulate milk down. They were then tied in front of their dams when cows were hand milked. Partial milking was done in order to reserve milk for sucking calves.

As for economic evaluation, simple calculations were performed to determine the relative economics of supplementation with block, block + hay and hay only. The costs of the feeds consumed by each cow per day were computed for each cow. While the feed was costed at the prevailing market prices, milk was priced using the producers' prices in order to quantify the net benefits from the feeding intervention.

3. RESULTS

3.1. Milk Production in Lactating Cows

The variation of the average daily milk yield of cows depending on treatments has the same trend in both breeds (Figure 1). The supplement of block + hay has significantly ($p < 5\%$) allow obtaining the largest average daily quantity of milk of 1.9 ± 0.7 L/day/cow and 2.4 ± 0.8 L/day/cow respectively in Gobra and Crossbreed Gobra*Guzerat. The increase in production compared to the control treatment (without supplement) is therefore 52.63% and 100% respectively in the breed Gobra and Gobra*Guzerat. The supplement of hay comes in second place and contributes to an additional production of 66.66% in both breeds of cow. Then the supplement of block follows and allows increasing the production of 44.44% and 50% respectively in Gobra and Crossbreed (Table 2).

The Figure 2 shows the trends of daily milk production per cow for the two races on the 9 weeks of the experiment. It was noted that throughout the period and in all breeds, the hay + supplement block gave the best results, followed respectively the supplement of hay, block supplement, and finally the control treatment.

Table 1. Composition per 100 kg of molasse-urea block.

Composition	Quantity (kg)
Wheat bran	15
Molasse	35
Bichelate phosphate	15
Calcium Oxyde	10
Cement	14
Urea	6
Sodium	5
Total	100

Table 2. Effect of feed supplements on milk production.

Treatments	Gobra	Crossbreed Gobra*Guzerat
Block supplement	1.3 ± 0.6a	1.8 ± 0.5a
Hay supplement	1.5 ± 0.6b	2.0 ± 0.3b
Block supplement + Hay supplement	1.9 ± 0.7c	2.4 ± 0.8c
Without supplement	0.9 ± 0.5d	1.2 ± 0.5d

Means that do not share a letter are significantly different at 5%.

3.2. Profitability of the Feed Supplements

There is a significant difference between treatments for the benefit they achieve compared to the control treatment (Table 1). In both races, the supplement of block + hay has allowed obtaining the highest profits of \$1.6/L/day/cow for Gobra and \$2.8/L/day/cow for the Crossbreed, that equals to an increase of \$0.3 and \$0.9 compared to the control treatment. The supplement of hay and the block supplement have respectively given a profit of 0.4 and \$0.3/L/day/cow in Gobra and 0.6 and \$0.4/L/day/cow in the Crossbreed.

4. DISCUSSION

The variation of the average daily milk yield of cows depending on treatment has the same trend in both breeds. This trend can be explained partly by the fact that the races Gobra and Guzerat have similar characteristics. They are well suited to the harsh conditions of hardy livestock breeding in the Sahel. They are also breeds that have strong abilities in meat production. However, they have a very low milk potential. On the other hand, it can be explained by the fact that the two breeds live in similar conditions with the same ecological constraints and the same sanitary and food treatment. The supplement of block and hay allows having the largest average daily quantity of milk that is 1.9 ± 0.7 L/day/cow and 2.4 ± 0.8 L/day/cow in Gobra and in Crossbreed Gobra* Guzerat respectively. This result shows the importance of food supplementation on improving milk production in pasto-

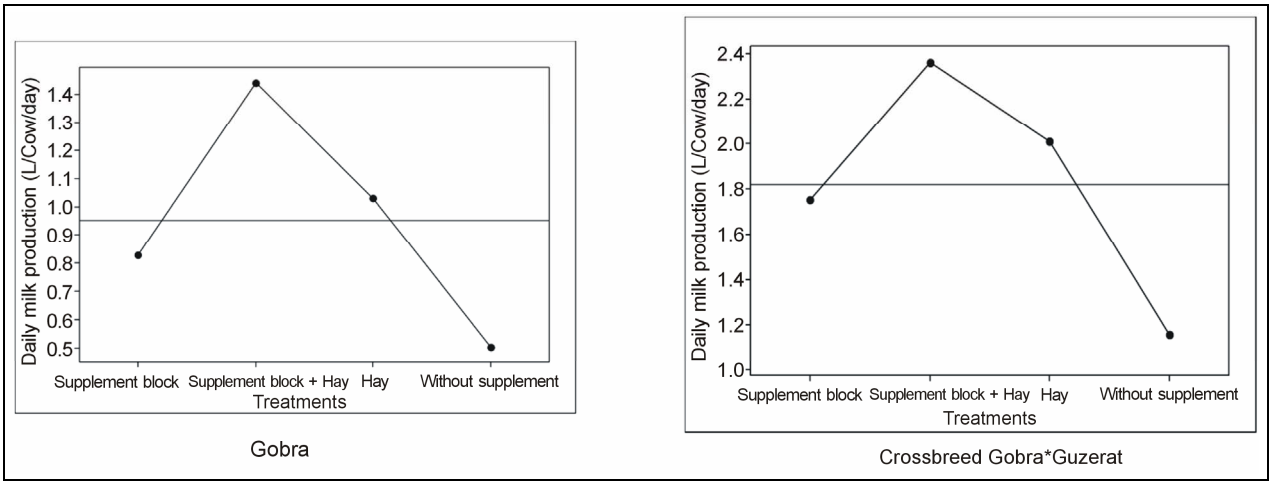

Figure 1. Variation of the daily milk production of cow as affected by supplements.

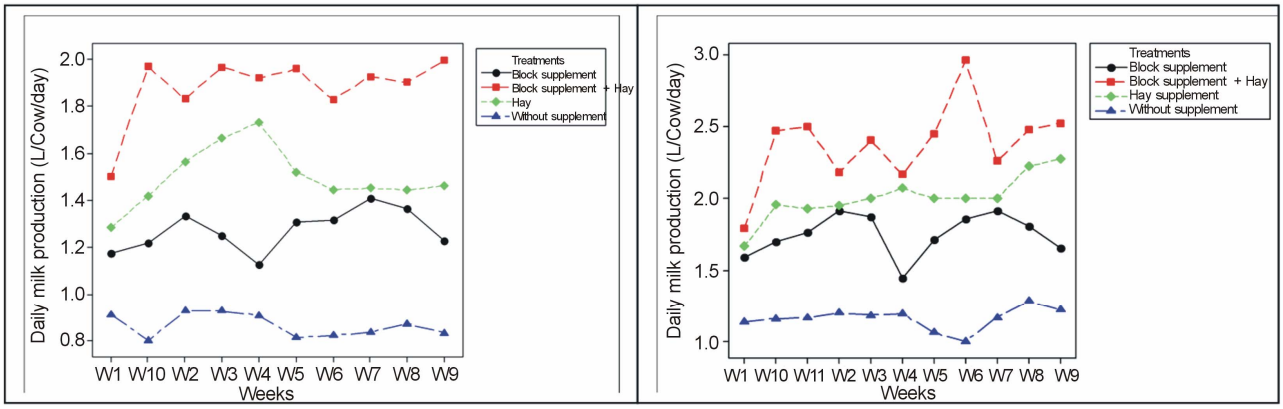

Figure 2. Evolution of daily milk production.

ral systems. In fact, due to the decline in the nutritional value of fodder and low productivity generated in the dry season, supplementation is necessary to improve the levels of milk production [13,14]. The positive response of cows to supplementation with molasse-urea blocks and hay was explained in part by the deficiency of forage resources in minerals, proteins and other nutrients. The study of the composition of these forage showed that their levels, although very low in protein in fresh, fell sharply in nitrogen and other mineral materials. According to Calvet [12] this decline in nutritional components is much more pronounced for minerals such as calcium and phosphorus. These mineral deficiencies have been described in several studies conducted in Senegal in the pastoral zone [4,5]. According to Cissé [4], in addition to the deficiencies of phosphorus and calcium, Senegalese forages have weak content in sodium, copper and zinc.

The molasse-urea block as a mixture of nutrients (molasse, urea and minerals (phosphate and calcium oxide)) constitutes a supplement of protein, minerals and energy. Combined with a good quality of hay (hay harvested in late winter and kept in good conditions), it can therefore correct the nutritional deficit that causes production declines in dry season. This leads to say that food intake to fill the nutritional deficit during the dry season can maintain production levels during the rainy season. The average daily quantity of milk in Gobra of 1.9 ± 0.7 L/day/cow is twice the usual dry season production. This result is consistent with the findings of food research in Senegal indicating that the intake of a dietary supplement after grazing improves significantly milk production [15]. Indeed, Diao [16] in the Senegal River delta has shown that dietary supplementation has positive effects on animal performance and milk production. It allows cows to produce twice as much milk [17]. Some works carried out in the south of Kolda region in Sénégal have shown that supplementation of cattle in stables had a significant impact on milk production in the dairy radius [2-18]. The result obtained by Diop [19] in the sylvopastoral zone confirms the use of food supplementation during the dry season in sub-urban areas that allows producers to maintain production levels of cows. The results showed that the response to food intake is different depending on the breed. Crossbreed showed an increase in the production

of 100% against 52.63% for Gobra. Thus, Crossbreed valorizes better the supplement than Gobra. The intake of hay is the supplement that comes in the second place and allows an additional increase of 66.66% in both breeds of cow. This result shows that good quality of hay, stored in good conditions, combined to farmers practice enables an increase in milk production during the dry season by 66%. It also shows the importance of supplementing dairy cows with good hay. In the sylvopastoral zone, the producers used to harvest forage when it has no nutritional value. Thus this result raises the question of the establishment of fodder banks on time. The result also shows that the provision of hay of good quality allows a greater increase of milk production than the block only. The effect of the block is expressed much better when paired with a hay of good quality. The economic assessment shows that supplementation can bring added value to milk production with a significant difference between treatments. This result confirms those of Ba Diao [16] in the region of the Senegal River and Dièye [2] in the cotton zone of Kolda. The combined supplementation of hay and block gives the best profit margin. The increase in earnings of $ 0.3 per liter for Gobra and $ 0.9 for Crossbreed shows that it is more appropriate to complement Crossbreed for their genetic potential responds better to food intake. However, the benefit obtained with Gobra is not negligible. In the dairy radius of Dahra, the diffusion of dietary supplementation techniques may be considered as a lever to technical problems. The adoption of supplementation molasse-urea block and hay by producers would be a good way to make milk playing a key role in the development of local economies.

ACKNOWLEDGEMENTS

We address our gratitude to “Fond National de Recherches Agricoles & Agro-Alimentaires” (FNRAA) which allowed the financial support to complete successfully this study.

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