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Weight Gain Comparison between Heifers Fed Colostrum or Whole Milk until Weaning

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ABSTRACT

***Background*:** The milk-feeding phase, wherein whole milk is the natural food, is critical to calf development, health, and vitality. However, feeding milk to calves is costly in the rearing system because the milk supplied to calves is not sold. In farms in which the average production is high, excess colostrum and transitional milk are produced that are used to feed calves until weaning. The objective of this study was to evaluate the performance of heifers exclusively fed colostrum (including transitional milk) or raw whole milk.

***Materials, Methods & Results*:** Immediately after their birth, 83 ear-tagged healthy Holstein Friesian heifers adequately receiving the initial colostrum were separated into two experimental groups. Group 1 (n = 34) was fed only fresh whole milk and group 2 (n = 49) was fed only colostrum diluted in water at a 2:1 ratio. Colostrum was removed from cows until the fifth day after birth and was stored in sanitized disposable plastic bottles, stored in a freezer at -20°C and before administration, the colostrum was thawed. Liquid diets were administered using a bottle twice a day during the first month, namely 2 L in the morning and 2 L in the afternoon. During the second month, the heifers were fed 4 L once a day in the morning. The heifers had access to an enclosure with fodder, in addition to concentrate specifically for heifers, which was placed in an individual trough daily. The leftovers were weighed at the end of the afternoon. The heifers were abruptly weaned when they reached a daily intake of 1 kg of concentrate. The heifers were individually weighed at birth and at 30, 60, 90, 120, 150, and 180 days. The average weights were 40.4, 54.1, 74.5, 95.1, 108.2, and 126.1 kg in group 1 and 45.4, 58.4, 78.2, 95.9, 110.8, and 125.1 kg in group 2. The use of diluted colostrum was satisfactory as it resulted in similar weight gains.

***Discussion*:** Feeding milk to calves is one of the most cost-increasing factors to a dairy farm because the total milk volume fed to animals at this stage is not sold and results in a large loss in income for the farmer. Calf management during the milk-feeding phase is of the utmost importance, especially in the first days after birth, to ensure the development of the systemic immune response of animals. The performance of these animals in the first months affects their subsequent development. Whole milk is commonly used to feed calves for 8 to 12 consecutive weeks. However, whole milk can be replaced by a good substitute, such as colostrum and transitional milk. The aim of this study was to show that these substitutes are effective alternatives for calf development and cost reduction. The weight gain of animals fed diluted colostrum was similar to that of animals fed only whole milk, which corroborates the results of previous studies on the development of calves treated with colostrum-based liquid diet, fermented or not, with and without additives. Those studies reported favorable growth rates in comparison with the traditional production system as a result of higher dietary protein levels in colostrum-based diets. The availability of roughages and concentrates should be initiated during the milk-feeding phase, as it is fundamental for rumen development, helps in early weaning and reduces expenses during this period. Replacing whole milk with colostrum and transitional milk for feeding calves, stimulating roughage, and concentrating intake can result in significant savings in the rearing system.

Keywords: heifer development, colostrum, early weaning, nutrition, feeding.

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INTRODUCTION

In dairy farms, calf rearing is one of the most complex and expensive activities. In the first few hours of life, calves must acquire passive immunity by early ingestion of good colostrum for immunoglobulin absorption through intestinal cells [9,30].

Colostrum, a secretion of the mammary gland released by the mother in the first few hours after birth, contains solids, proteins, immunoglobulins, fats, minerals, and vitamins. Its commercial value is null, but its intake by the calf in adequate quantity and quality affects postnatal development. After colostrum ejection, transitional milk is produced, and the composition gradually changes until the milk turns into its marketable version [15].

In farms in which the average production of cows is high, colostrum and transitional milk are usually obtained in quantities higher than those demanded by calves and are ultimately discarded because they are not sold. These materials have nutritional characteristics better than those of commercial milk. [11]. A rational and viable alternative is to use colostrum and transitional milk until the calves [1,2,21,24] reach the minimum concentrate intake for weaning [21].

The objective of this study was to evaluate the performance of heifers exclusively fed colostrum and transitional milk in comparison with that of heifers fed only raw whole milk.

MATERIALS AND METHODS

The experiment was approved by the Animal Ethics Committee of the Fluminense Federal University (Comissão de Ética no Uso de Animais/ Universidade Federal Fluminense - CEUA/UFF - number 2320110419) and was performed in a semi-intensive dairy farm, located in the municipality of Valença, Rio de Janeiro (RJ).

In total, 83 ear-tagged healthy Holstein Friesian heifers, born by normal delivery, were used. All newborn heifers were fed colostrum from their mothers in three feedings between 1 and 24 h after birth. Newborns were then separated from their mothers. The navel of the heifers was treated with 5% iodine once a day from birth to the fifth day after birth.

On the second day after birth, the heifers were separated into two experimental groups. Group 1 (n = 34) was only fed fresh whole milk derived from the farm after each milk feeding. Conversely, group 2 (n = 49) was fed only colostrum diluted in water at a 2:1 ratio. Both groups were fed using a bottle.

Colostrum was removed from cows until the fifth day after birth and was immediately stored in sanitized disposable plastic bottles, which were dated and stored in a freezer at -20 °C. Before administration, the colostrum was thawed in a water bath at 50 °C.

During the first month, the liquid diet was administered twice a day, viz., 2 L in the morning and 2 L in the afternoon. In the second month, 4 L was administered in a single feeding in the morning. In addition, 1 kg of concentrate was provided in an individual trough. The leftovers were weighed at the end of the afternoon. The heifers also had access to an enclosure with fodder consisting of *Panicum maximum*. The heifers were abruptly weaned when they reached a daily intake of 1 kg of concentrate.

The heifers were weighed at birth and at 30, 60, 90, 120, 150, and 180 days after birth, and the weight was estimated using a weight tape every 30 days.

RESULTS

The mean estimated heifer weights, in groups 1 (milk) and 2 (colostrum), are represented in Figure 1.

The diets resulted in similar weight gains. The heifers exclusively fed colostrum had similar weight gains and had higher weight gains in the first five weighing (until 150 days after birth).

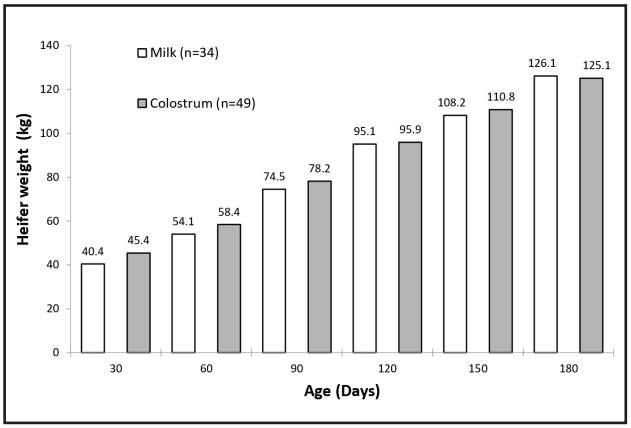

Figure 1. Weight gain (kg) of heifers fed diluted colostrum or whole milk.

DISCUSSION

Feeding milk to calves is one of the most cost-increasing factors in a dairy farm and accounts for approximately 90% of calf rearing costs from birth to

weaning [14,27]. In animals weaned at approximately 60 days after birth, as in this experiment, approximately 240 L of milk per heifer is consumed. This value represents a loss in income for the farmer because the milk is not sold, thereby diverting resources and reducing the profitability of dairy farms [7].

Adequately managing calves during the milk-feeding phase, particularly the colostrum feeding phase, is of the utmost importance because their health in the first months affects their subsequent development [29].

Colostrum is a dense, yellowish, and creamy discharge produced at the first milking after delivery. The following secretions, from the second to the ninth milking (fifth day of lactation), are termed transitional milk because their composition gradually resembles that of whole milk [31], as previously described in the literature [15] and outlined in Table 1.

Table 1. Milk and colostrum composition.

Component	Number of milk feedings					
	1	2	3	4	5	11
	Colostrum		Transitional milk		Whole milk	
Total solids %	23.9	17.9	14.1	13.9	13.6	12.5
Fat %	6.7	5.4	3.9	3.7	3.5	3.2
Protein* %	14.0	8.4	5.1	4.2	4.1	3.2
Antibodies %	6.0	4.2	2.4	0.2	0.1	0.09
Lactose %	2.7	3.9	4.4	4.6	4.7	4.9
Minerals %	1.11	0.95	0.87	0.82	0.81	0.74
Vitamin A ug/dl	295.0	-	113.0	-	74.0	34.0

*Includes percentage of antibodies indicated in the next row (Wattiaux M.A., 2015) [31].

Bovine colostrum contains 0.4 to 1.5 million cells/mL, predominantly leukocytes that are ingested in large numbers during the first feedings [15]. Bovine colostrum cells are important for mammary gland defense [20] and the systemic immune response of newborn calves [5,30]. In addition to its immunological properties, bovine colostrum has excellent nutritional qualities [6] because it contains, on average, 14% protein, 6.7% fat, 2.7% lactose, and vitamins and minerals [25].

After the initial colostrum intake, a heifer is fed whole milk or a good substitute for 8 to 12 consecutive weeks, in amounts ranging from 8 to 10% of its live weight [26]. In turn, to limit the amount of milk ingested by calves daily, they consume solid foods early on [31].

Supplementing calf feeding with roughages and concentrates plays a key role in ruminal development. Therefore, these supplements must be provided during the milk-feeding phase because they contribute to early weaning and reduce expenses during this period [18,22].

Early weaning is based on a specific age or concentrate intake, and is encouraged to reduce costs during this period [4].

In this experiment, roughage and concentrate were provided from the beginning of the second month to maintain the volume of milk as in the first days, which helped increase concentrate intake. Once a heifer reached a daily intake of 1 kg of concentrate, it was abruptly weaned. This occurred at approximately 60 days after birth.

Diluted colostrum, which is used as a substitute in milk-feeding calves, maintains nutritional characteristics similar to those of milk, such as good availability, easy storage, and zero commercial value. Thus, diluted colostrum is used in milk-feeding programs, as described by some authors [13,19]. In farms in which production is high, the production of colostrum and transitional milk is higher than the calf demand. Therefore, they can be used as rational and viable alternatives [1,2,21,24] as long as they are stored adequately.

Various authors suggest different colostrum storage methods: refrigeration, in milk coolers and separate milk cans [6]; freezing, which requires additional handling, proper equipment, and careful thawing [28]; fermentation, by adding preservatives, such as formic, acetic and propionic acids, and formaldehyde [12]; fermentation without adding preservatives, anaerobically, forming "colostrum silage" [23].

In this study, excess colostrum and transitional milk were stored in disposable plastic bottles and were frozen. Animals fed diluted colostrum gained weight similarly to animals exclusively fed milk. Therefore, using excess colostrum is an effective option for calf development and cost reduction.

A comparative study [16] on the development of calves treated with a milk- or fermented colostrum-based diet concluded that calves showed a constant and similar growth rate, suggesting that fermented colostrum promotes weight gain of the same magnitude as do traditional production systems.

The efficacy of providing fermented colostrum without additives was compared with effects of feeding whole milk to calves. In this case, more weight was gained with fermented colostrum, most likely associated with the higher dietary protein level of colostrum-based diets [19].

Conversely, a study showed that weights of calves exclusively fed milk were higher than those fed colostrum silage diluted in water. The authors attributed this difference to the dilution itself, a 1:1 ratio, which reduced its nutritional composition in comparison with that of whole milk [3].

Colostrum and transitional milk, which are often discarded, have different means of preservation and are effective in the calf milk-feeding phase, increasing profits for farmers who have more liters of milk available for sale.

The Brazil average value paid to farmers, according to the net price in April 2019, is R$ 1.59 per L of milk [8]. The results of this study suggest that replacing whole milk with diluted colostrum saves approximately 240 L of milk per weaned heifer, which translates into savings of R$ 381.60 per heifer.

CONCLUSION

Replacing whole milk with excess colostrum and transitional milk for calf feeding is important. Exclusively using these substitutes for feeding until weaning is an effective alternative for farmers because it promotes similar weight gains. Colostrum and transitional milk which are often discarded because they cannot be sold, have high potential value considering their availability, richness in essential nutrients, and easy storage and preservation. Adopting this low-cost liquid diet, especially during early weaning, may reduce the cost of a weaned heifer, maximizing profits for farmers who will have more liters of milk available for sale.

Ethical approval. The experiment was approved by the Animal Ethics Committee of the Fluminense Federal University (Comissão de Ética no Uso de Animais/ Universidade Federal Fluminense – CEUA/UFF) (number 2320110419) and was performed in a semi-intensive dairy farm, located in the municipality of Valença, Rio de Janeiro (RJ).

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Declaration of interest. The authors declare that there are no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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