Scientific Paper

Productive response of calves fed RELAC milk replacer at different growth stages

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Abstract

Objective: To evaluate the effect of including RELAC milk replacer at different growth stages on dry matter intake, crude protein, crude fiber and average daily gain in crossbred dairy calves.

Materials and Methods: Forty-five crossbred dairy calves (Holstein × Zebu) aged 15 days and with an average live weight of 28,0 kg (± 2 kg) were randomly assigned to three treatments with 15 animals each. Treatment I (control) consisted of feeding Raltec Milk-17-1 until 90 days of age (weaning). Treatment II included Raltec Milk-17-1 until 60 days, followed by RELAC plus a whole diet until weaning. In treatment III, the animals received Raltec Milk-17-1 until 30 days of age and then switched to RELAC with a whole diet until 90 days of age. Both milk replacers were administered at a dose of 4 kg animal^{-1} day^{-1}, divided into two feedings, with Raltec reconstituted at 100 g L^{-1} of water and RELAC at 120 g L^{-1}. Live weight was determined every 15 days and ADG was obtained for each stage.

Results: The results showed differences ($p < 0,05$) in daily dry matter, crude protein and crude fiber intake between the different experimental stages. However, no differences ($p > 0,05$) were observed in average daily gain (ADG) among treatments, although calves in treatment III had lower ADG between 30 and 60 days compared with groups I and II.

Conclusions: The use of RELAC since 30 days of age did not negatively affect the productive performance of calves compared with conventional milk replacer (Raltec Milk-17-1), suggesting its viability as an alternative in calf feeding in dairy production systems.

Keywords: consumption, crude fibre, dry matter, weight gain

Introduction

In addition to the effects that the world is already experiencing with climate change, population growth, poverty levels, resource scarcity due to soil degradation and depletion, pollution, and armed conflicts, among others, the effects of SARS -CoV-2 have added to the devastating situation, bringing with them a collapse in exports (Ramonet, 2020). Likewise, the conflicts between Russia and Ukraine have brought certain imbalances and negative consequences for the global economy (USDA, 2022).

According to FAO reports (2019), hunger affects more than 42,5 million people in Latin America and the Caribbean. Therefore, the development of animal production in the tropics is essential as one of the fundamental ways to mitigate the negative impact of food shortages.

Whole milk prices are on an upward trend. Currently, they exceed US$ 4 500 per ton. This behavior has been influenced by the more than fourfold increase in consumption of this product in countries such as India and China, coupled with global population growth and the slow increase in milk production worldwide.

In Cuba, various imported milk substitutes have been used with satisfactory results, such as reduced production costs during the lactation stage of animals using this technology and satisfactory weight gains, with gains that can reach 600 and 700 g per day at certain stages (Plaza and Ybalmea, 2008).

The RELAC milk replacer is a balanced feedstuff that replaces the whole milk that calves consume since 31 days of age. It is produced in solid form by mixing the ingredients, is palatable and appealing to young calves, and is formulated from ingredients that are mostly produced in the American tropics. It is known that the raw materials require a finely pulverized grinding level (talc) with

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particles less than 0,16 mm in diameter to simulate whole milk once the product is reconstituted and allow the calf to almost perfectly close the reticular canal and digest the milk replacer in the abomasum (Plaza *et al*., 2009).

It is clear that calf rearing in Cuba should move towards artificial rearing with milk replacers, given the need for whole milk for human consumption (Plaza *et al*., 2009). Therefore, the objective of this study was to evaluate the effect of including the RELAC milk replacer at different growth stages on the dry matter intake, crude protein, crude fiber, and average daily gain in crossbred dairy calves.

Materials and Methods

Experimental area. The work was carried out in rearing facility number 246 of the Loma de Candelaria Base Business Unit (UEB, for its initials in Spanish) belonging to the Camilo Cienfuegos Genetic Animal Husbandry Company located in the Consolación del Sur municipality, in the southwest of the Pinar del Río province. This UEB is located near the Loma de Candelaria town, at 22º 45′ North latitude and 83º 15′ West longitude, at an altitude of 348 m above sea level. It is bordered to the north by the Sierra del Rosario, to the south by the National Highway and animal husbandry areas of the La Barbarita UEB, to the west by the animal husbandry areas of the Corralito UEB and to the east by the Juventud dam, in the Paso Real de San Diego town (SIGPecuaria, 2011).

Experimental units. Forty-five Holstein x Zebu crossbred dairy calves of both sexes were used, with an average age of 15 days and average weight of ±28 kg. They were randomly distributed into three treatments (n=15) in a randomized block design.

Treatments

- Treatment I: (control) fed with Raltec Milk-17-1 technology until weaning at 90 days of age
- Treatment II: fed with Raltec Milk-17-1 technology until 60 days of age and RELAC milk replacer from 61 to 90 days, weaning age, and a whole diet.
- Treatment III: fed with Raltec Milk-17-1 technology until 30 days of age and RELAC milk replacer from 31 to 90 days, weaning age, and a whole diet.

Experimental procedure. Both milk replacers were supplied at a rate of 4 L per animal/day in two daily feedings (8:30 a.m.; 3:30 p.m.). RALTEC MR was reconstituted at a rate of 100 g L^{-1} of water and RELAC MR at a rate of 120 g L^{-1} of water. RALTEC Star T-1 from Xovel was offered as solid feedstuff in treatment one; while in treatments two and three, the whole diet was offered *ad libitum* (two feedings per day) until consumption reached 2,5 kg per animal per day, with water *ad libitum*. The animals were placed in individual slatted floor cribs (Rotecna technology, modified with aluminum) with the corresponding containers for access to milk replacer, concentrate feed, and water, since their entry into the rearing facility until the end of the trial (90 days). They were homogenized by weight and age and according to the experimental design.

Sampling and measurements. Milk replacer intake was measured daily in the morning and afternoon, 30 minutes after feeding, as the difference between what was offered and what was rejected. Likewise, concentrate feed intake was evaluated in the morning based on the rejection of the diet offered the previous day by weighing it with a pan scale before the new offering. Live weight was determined every 15 days on a digital scale (DIGI DS-160) and the ADG was obtained for each stage.

For the chemical analysis of the feedstuffs under study, the dry matter (DM) content (method 930.04), crude protein (CP) (method 955.04), and crude fiber (CF) (method 920.39) were determined, as described by the AOAC (2019).

Statistical analysis. The theoretical assumptions of the variance analysis were verified for all variables using the Shapiro and Wilk (1965) test for normality of errors and *Levene* (1960) test for homogeneity of variance. Analysis of variance was performed according to a simple classification model. The Fisher-Yates test (1958) ($p < 0,05$) was used for comparison, and where necessary, the mean values were compared using Duncan's test (1955). All data were processed using the INFOSTAT statistical package (Di Rienzo *et al*., 2016).

Results and Discussion

Table 1 shows the differences found ($p < 0,05$) in the daily intake of all analyzed nutrients: DM, CP, and CF per animal (kg day^{-1}) according to the experimental stages.

DM intake in the 30-60 day period was lower in treatment III for animals that started consuming RELAC at 30 days, although there were differences ($p < 0,05$) among the three treatments, with higher intake in the control treatment. Meanwhile, from 60 to 90 days, an increase in intake was observed in the animals in treatment III compared with treatment I (control), although there were differences ($p < 0,05$)

Table 1. Total nutrient intake, DM (kg animal day^{-1}), CP (kg animal day^{-1}), CF (kg animal day^{-1}), at different experimental stages.

Indicator	Treatment				
	I	II	III	± SE	P - value
DM 30-60	1,42 [a]	1,01 [b]	0,99 [c]	± 0,0032	p = 0,0001
DM 60-90	1,60 [a]	1,54 [b]	1,64 [c]	± 0,0006	p < 0,0001
DM 30-90	1,26 [a]	1,28 [b]	1,32 [c]	± 0,0016	p < 0,0001
CP 30-60	0,17 [a]	0,19 [b]	0,20 [c]	± 0,0007	p = 0,0001
CP 60-90	0,28 [b]	0,27[a]	0,31 [c]	± 0,0005	p < 0,0001
CP 30-90	0,22 [a]	0,24 [b]	0,25 [c]	± 0,0003	p < 0,0001
CF 30-60	0,02 [a]	0,03 [b]	0,04 [c]	± 0,0002	p = 0,0001
CF 60-90	0,06 [a]	0,08 [b]	0,09 [c]	± 0,0003	p < 0,0001
CF 30-90	0,04 [a]	0,05 [b]	0,06 [c]	± 0,0001	p < 0,0001

Treatment I. Control: fed with Raltec Milk-17-1 technology until weaning at 90 days of age.
Treatment II: fed with Raltec Milk-17-1 technology until 60 days of age and RELAC milk replacer from 61 to 90 days, weaning age, and a whole diet.
Treatment III: fed with Raltec Milk-17-1 technology until 30 days of age and RELAC milk replacer from 31 to 90 days, weaning age, and a whole diet.

among treatments. However, in the complete stage (30-90 days), dry matter intake was similar.

The crude protein consumed by the animals in the 30-60 period showed differences ($p < 0,05$) for the three treatments. Similarly, it was observed that the animals in Treatment III had a higher intake of this nutrient, an effect that was similarly manifested in the 60-90 day and 30-90 day stages.

On the other hand, crude fiber intake by the animals in the 30-60 day period showed differences ($p < 0,05$) for the three treatments. In general, the performance was similar in the animals in Treatment III, and was also evident in the 60-90 day and 30-90 day stages.

Table 2 shows the average daily gains, which did not show differences ($p < 0,05$) among treatments in the 60-90 and 30-90 day stages. However, there were differences ($p < 0,05$) in the animals in treatment III in the 30-60 day period, which had lower ADG than treatments I and II.

The quality of the milk replacer, concentrate feed, and forage can offer specific conditions that affect the results (Nemocón, 2020). This aspect could influence the results, as some raw materials did not meet the required quality standards.

An important aspect relates to the total amount of milk replacer supplied to the calves, which was 0,32 kg of dry matter per day, compared with that indicated by Chapman *et al*. (2016), which generally affects nutrient intake by the animals. This fact is also associated with the low dry matter intake of solid feedstuffs in the 30- to 90-day stage, which

Table 2. Average daily gain (ADG, g animal^{-1} day^{-1}) of calves fed milk replacers.

Indicator	Treatment				
	I	II	III	± SE	P - value
30 to 60	0,32[b]	0,26[b]	0,18[a]	± 0,02	0,0006
60 to 90	0,41	0,31	0,52	± 0,04	0,0765
30 to 90	0,33	0,28	0,25	± 0,02	0,0532
Differences in g 30-90	-	80	50		

Treatment I. Control: fed with Raltec Milk-17-1 technology until weaning at 90 days of age.
Treatment II: fed with Raltec Milk-17-1 technology until 60 days of age and RELAC milk replacer from 61 to 90 days, weaning age, and a whole diet.
Treatment III: fed with Raltec Milk-17-1 technology until 30 days of age and RELAC milk replacer from 31 to 90 days, weaning age, and a whole diet

was below that reported by Ybalmea *et al*. (2004) and Pared *et al*. (2020), who related it to the nutritional quality of the complete diet used in the research.

Dry matter intake in calves in the RELAC treatments was low compared with the studies by Plaza *et al*. (1984) and Ybalmea (2015). The values found in this study for Treatment II (1,01 kg·day^{-1} at 30-60 days and 1,54 kg day^{-1} at 60-90 days) and Treatment III (0,99 kg day^{-1} at 30-60 days and 1,64 kg day^{-1} at 60-90 days) were lower than those reported by these authors (1,22 and 2,37 kg day^{-1} for the same periods, respectively). This difference could be ascribed not only to the intake and quality of liquid feedstuffs, but also to the characteristics of the whole diet used in the different studies.

Heinrichs *et al*. (2003) determined that a daily weight gain of 0,34 kg animal^{-1} day^{-1} in Holstein calves in the first six months of age is adequate, which is related to the results achieved in this study, although with crossbred animals.

The current global trend in dairy calf rearing is to focus on growth performance using whole milk or milk replacers of high nutritional quality for calves (Amado *et al*., 2019). Differences in the nutrient composition of the feed offered to calves cause variations in body weight at weaning (Moallem *et al*., 2010), aspects that are related to the results achieved in this study.

Conclusions

The use of RELAC since 30 days of age did not negatively affect the productive performance of calves compared with conventional milk replacer (Raltec Milk-17-1), suggesting its viability as an alternative in calf feeding in dairy production systems.

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Conflict of interests

The authors declare that there is no conflict of interests among them.

Authors' contribution

- Mélanis Dominguez-Lima. Conception and design of the research; data analysis and interpretation and writing of the paper.
- Bertha Bienvenida Chongo-García. Conception and design of the research and data analysis and interpretation.
- Alejandro Mejías Caba. Data analysis and interpretation.
- Rafael Rodríguez Hernández. Data analysis and interpretation.

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