Performance and health of dairy calves fed limited amounts of acidified milk replacer

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Abstract

To compare growth performance of Brown Swiss calves fed acidified milk replacer (AMR) at 8% of birth weight, 20 newborn calves were reared under a new calf-feeding programme. Body weights, total weight gains and gains in body measurements, feed intake and feed efficiency values determined at different stages of growth of AMR-fed calves were comparable to those of calves fed sweet milk replacer (SMR). Faecal consistency scores and percent days with diarrhoea of calves offered AMR from four to 35 days of age were respectively 0.4 and 19.1% lower than those fed SMR. Most of the behavioural parameters studied were not unfavourably influenced by acidification of the replacer. In conclusion, growth, feed intake and feed efficiency characteristics of Brown Swiss calves fed AMR or SMR were not different from each other. However, incidence of diarrhoea of the young calves was decreased and health status of the calves was improved with the feeding of acidified milk.

Keywords: Acidified milk substitute, calf feeding, weight gain, Brown Swiss, behaviour
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Introduction

A new dairy calf feeding programme that saves labour, promotes improved growth performance, is simple, convenient and economical was developed based upon results of studies conducted by Yanar *et al.* (1994), Yanar *et al.* (1999), Yanar *et al.* (2000). In this programme, the milk replacer is offered to calves once a day at 8% of their birth weight per day by using a water-milk bucket. The amount of replacer is kept constant until weaning at five weeks of age. In spite of many advantages of this calf-feeding programme, incidence of diarrhoea among the calves was higher than expected, especially during the first weeks of their lives. Several researchers (Jaster *et al.*, 1990; Thickett *et al.*, 1990; Toll-Vera & Vera, 1996) reported that the feeding of acidified milk replacer (AMR) reduced diarrhoea problems and improved the health status of young calves. To utilise the advantages of AMR, an innovative calf-feeding programme including AMR or sweet milk replacer (SMR) for Brown Swiss calves was developed and compared in this study. Objectives of the research were to compare growth, feed intake and feed efficiency traits, incidence of diarrhoea as well as behavioural characteristics of Brown Swiss calves raised under the new calf-feeding scheme.

Materials and Methods

Twenty Brown Swiss calves (10 male and 10 female) born at the Research Farm of Atatürk University, Erzurum, Turkey were used in this study. To receive colostrum the calves were allowed to suckle their dams for the first three days of their lives. They were then allocated randomly to one of two liquid feeding groups, AMR and SMR. The SMR (a commercial milk replacer: Ecomilk, Aliment D'allaitement) was manufactured by Safyo Sas Co., France. Throughout the trial the calves were kept in individual pens containing hay and starter feeders and a milk-water bucket.

The milk replacer was diluted with warm water (about 50 °C) to contain about 12% dry matter (DM). It was cooled to 36-37 °C before being fed to the calves. Half the milk replacer was acidified by adding formic acid and pH of the AMR fell to about 4.8. The pH was continuously monitored. The replacer was offered once a day to calves at a level of 8% birth weight per day, using the water-milk bucket. The amount of replacer was kept constant until weaning at five weeks of age (Yanar *et al*., 1994). Two kinds of calf starters were used in the study. Starter I was fed from four days of age to four months of age, and Starter II to calves older than four months. The calves received two kg of these starters daily for the duration of the liquid feeding period, and were offered dry hay *ad libitum* during the whole trial (six months), as recommended by

Ugur & Yanar (1998). Quantities of starters and dry hay remaining in the feeders were weighed back daily and amounts consumed were calculated and recorded. The DM (AOAC, 1990; method 934.01), crude protein as kjeldahl nitrogen (AOAC, 1995; method 990.03), ether extract (AOAC, 1990; method 920.39), ash (AOAC, 1990; method 9420.5) and crude fibre (Tyznik, 1992) levels in the diets were determined.

Table 1 Chemical composition of the milk replacer, starters and dry hay

Nutrients	Milk replacer [a]	Starter I	Starter II	Dry hay
Dry matter (DM) (g/kg)	970.0	900.1	894.0	902.1
Crude protein (g/kg DM)	207.2	190.1	180.4	57.2
Ether extract (g/kg DM)	145.1	34.3	33.3	25.2
Ash (g/kg DM)	106.4	81.1	86.0	104.1
Crude fibre (g/kg DM)	11.0	100.4	118.1	302.4

[a] In dry powder form

Body weights were determined at birth, at weaning (five weeks of age) and at four and six months of age. Body measurements, *viz*. body length, height at withers, chest depth and heart girth were obtained at birth, weaning and six months of age. During the liquid feeding period, faecal consistency score for each calf was recorded daily. Faecal consistency scores were: 1 = normal (soft-solid consistency, no fluid), 2 = soft (semi-solid, mostly solid), 3 = runny (semi-solid, mostly fluid), 4 = watery (all fluid), as described by Larson *et al*. (1977).

Behavioural data were obtained from video records taken of each individual calf at five minute intervals after receiving the milk replacers. The data were collected from days 4 to 35. The behavioural parameters were; 1) frequency of the daily milk replacer intake from bucket, 2) time spent watching around, 3) time spent licking the walls of the pen, 4) number of days needed to learn how to drink the milk replacer from the open pail without assistance, 5) total time spent taking in the milk replacer.

The data were analysed statistically using a 2x2 completely randomised factorial experimental design. When growth and feed parameters were analysed, birth weight was included in the statistical model as a covariate. Results of preliminary statistical analyses revealed that the influence of interactions on the traits studied was not significant. Therefore, a reduced statistical model was used, and only main effects of the treatment groups were analysed statistically, using the SPSS statistics package programme (SPSS, 2002). Correlation coefficients were calculated using the SPSS package programme.

Results and Discussion

Body weights for calves determined at birth, weaning, four and six months of ages were similar between treatments (Table 2). Similar results were reported by Daenicke (1983) who stated that weekly weights of calves consuming AMR during the entire growth period were comparable to those of calves fed SMR. Influence of sex of calves on the weights at various stages of growth was not statistically significant, as also noted by Yanar *et al.* (1997).

Differences in total weight gains of Brown Swiss calves fed AMR or SMR were not different ($P > 0.05$) (Table 2). Although average total weight gain of the calves that consumed AMR was 1.22 kg lower ($P > 0.05$) than those fed SMR during the pre-weaning period, they caught up during the post-weaning phase. The overall total weight gains were identical at 95.8 and 96.0 kg for the AMR- and SMR-fed calves, respectively. Similar results were reported by Skrivanova *et al*. (1990) and Frelich *et al.* (1992) who indicated that there were no significant differences between the AMR and SMR groups in terms of body weight gains. Sex of the calves also did not differ ($P > 0.05$) regarding the weight gains, as stated by Yanar *et al.* (1999).

Gains in body measurements in the pre-weaning and post-weaning phases are presented in Table 2. Calves fed AMR had similar gains in body measurements to those consuming SMR. The finding suggests that skeletal growth of calves reared on AMR and SMR was comparable, in accordance with the results reported by Erickson *et al.* (1989).

Table 2 Least squares means (± s.e.) for body weights, weight gains and changes in body measurements of Brown Swiss calves receiving an acidified or a sweet milk replacer

	Milk replacer*		Sex**	
	Acidified n = 10	Sweet n = 10	Male n = 10	Female n = 10
Body weight (kg) at:				
Birth	34.8 ± 1.6	35.7 ± 1.6	37.1 ± 1.6	33.4 ± 1.6
Weaning	41.7 ± 0.8	42.9 ± 0.8	42.2 ± 0.9	42.4 ± 0.9
4 mo of age	85.5 ± 4.1	87.3 ± 4.1	86.4 ± 4.2	86.4 ± 4.2
6 mo of age	131.0 ± 5.9	131.2 ± 5.9	131.8 ± 6.1	130.5 ± 6.1
Total weight gains (kg):				
Pre-weaning phase	6.44 ± 0.9	7.66 ± 0.9	6.92 ± 0.9	7.18 ± 0.9
Post-weaning phase	89.35 ± 5.4	88.34 ± 5.4	89.60 ± 5.6	88.11 ± 5.6
Overall gains from birth to 6 mo of age	95.79 ± 6.0	96.00 ± 6.0	96.51 ± 6.2	95.29 ± 6.2
Changes in body measurements (cm):				
Pre-weaning phase:				
Body length	5.1 ± 1.10	5.4 ± 1.10	4.2 ± 1.1	6.3 ± 1.15
Height at withers	2.5 ± 0.87	3.2 ± 0.87	2.7 ± 0.9	2.9 ± 0.90
Heart girth	3.8 ± 1.05	3.8 ± 1.05	3.4 ± 1.1	4.3 ± 1.09
Chest depth	2.3 ± 0.59	1.6 ± 0.59	1.9 ± 0.61	1.9 ± 0.61
Post-weaning phase:				
Body length	26.6 ± 1.6	24.8 ± 1.6	27.5 ± 1.6	23.9 ± 1.6
Height at withers	21.4 ± 1.7	19.3 ± 1.7	21.5 ± 1.7	19.2 ± 1.7
Heart girth	37.5 ± 1.9	41.3 ± 1.9	39.0 ± 1.9	39.8 ± 1.9
Chest depth	12.1 ± 0.8	13.3 ± 0.8	13.0 ± 0.8	12.3 ± 0.8

* Between milk replacers differences within rows were not statistically significant ($P > 0.05$)
** Between sexes differences within rows were not statistically significant ($P > 0.05$)

Feed efficiency and feed intake values both in pre-weaning and post-weaning phases were similar for both treatments (Table 3). The findings regarding comparable feed efficiency and feed intake values were in agreement with results of Nocek & Braund (1986), Woodford *et al.* (1987) and Jaster *et al.* (1990).

Calves fed AMR had lower ($P < 0.01$) faecal consistency scores than calves that consumed SMR (Table 4). Percent calf days with diarrhoea were also higher ($P < 0.01$) for calves offered SMR compared with those fed AMR. The results might be due to a lowering of the pH in the lower digestive tract of young calves. The higher acidity of the alimentary canal may promote lactobacilli growth and inhibit *Escherichia coli* proliferation (Muller, 1986; Jaster *et al*., 1990; Vajda & Majic, 1993). Therefore, the occurrence of diarrhoea among young calves decreased dramatically. These results are in agreement with findings of Fallon & Harte (1989) and Toll-Vera & Vera (1996).

Average frequency of the daily milk replacer intake and total time spent for replacer intake per day for AMR-fed calves were numerically higher than those fed SMR. However, differences were not significant (Table 4). The frequencies of the AMR and SMR intakes ($r = -0.67$ and $r = -0.59$, respectively) per day were associated ($P < 0.01$) with days in pre-weaning period. Erickson *et al.* (1989) reported that as the milk replacer was acidified and tasted sour, calves did not consume excessive quantities at one time. As a result, they drank frequently and in small portions of AMR. After they got used to this form of feeding, the number of intakes decreased (Stolpman, 1983). Total time required to consume all the AMR and SMR ($r = -0.63$ and $r = -0.13$) were correlated ($P < 0.01$) with days of pre-weaning phase. The result was in accordance with findings of Richards *et al*. (1988) who indicated that as calves became older, they spent less time drinking replacer.

Table 3 Least squares means (± s.e.) for feed efficiency and total feed intake of the calves receiving an acidified or a sweet milk replacer

	Milk replacer*		Sex**	
	Acidified n = 10	Sweet n = 10	Male n = 10	Female n = 10
Feed efficiency (kg/kg):				
Pre-weaning period	3.38 ± 0.49	2.60 ± 0.49	2.99 ± 0.32	2.93 ± 0.33
Post-weaning period	4.49 ± 0.25	4.90 ± 0.27	4.61 ± 0.27	4.78 ± 0.25
Overall from birth to 6 mo of age	4.42 ± 0.23	4.71 ± 0.23	4.49 ± 0.23	4.64 ± 0.23
Total feed intake (kg dry matter intake, DMI):				
Pre-weaning phase:				
DMI from replacer	10.0 ± 50.13	10.29 ± 0.13	10.33 ± 0.14	10.00 ± 0.14
DMI from dry hay	2.36 ± 0.23	2.35 ± 0.23	2.33 ± 0.24	2.38 ± 0.24
DMI from starter	9.40 ± 0.72	7.36 ± 0.72	8.07 ± 0.75	8.69 ± 0.75
Total DMI of all feeds	21.81 ± 0.71	20.00 ± 0.71	20.73 ± 0.73	21.07 ± 0.73
Post-weaning phase:				
DMI of starter	343.2 ± 14.9	368.5 ± 14.9	351.3 ± 15.4	360.4 ± 15.4
DMI of dry hay	58.4 ± 4.0	64.4 ± 4.0	61.8 ± 4.2	61.0 ± 4.2
Total DMI of all feeds	401.6 ± 17.7	432.9 ± 17.7	413.1 ± 18.3	421.4 ± 18.3

* Between milk replacers differences within rows were not statistically significant (P > 0.05)
** Between sexes differences within rows were not statistically significant (P > 0.05)

Table 4 Least squares means (± s.e.) for percent calf days with scours (%), average faecal consistency scores and behavioural traits of the calves receiving an acidified or a sweet milk replacer

	Milk replacer			Sex***	
	Acidified n = 10	Sweet n = 10	S	Male n = 10	Female n = 10
Percent calf days with scours [a]:					
4 to 17 d	2.8 ± 3.6	22.8 ± 3.6	**	1.0 ± 3.6	15.7 ± 3.6
18 to 35 d	0.5 ± 4.3	18.8 ± 4.3	**	13.3 ± 4.3	6.1 ± 4.3
4 to 35 d	1.5 ± 3.3	20.6 ± 3.3	**	11.8 ± 3.3	10.3 ± 3.3
Average faecal consistency scores [b]:					
4 to 17 d	1.3 ± 0.1	1.8 ± 0.1	**	1.5 ± 0.1	1.6 ± 0.1
18 to 35 d	1.3 ± 0.1	1.7 ± 0.1	**	1.6 ± 0.1	1.4 ± 0.1
4 to 35 d	1.3 ± 0.1	1.7 ± 0.1	**	1.5 ± 0.1	1.5 ± 0.1
Behavioural traits:					
Frequency of daily milk replacer intake from open pail	5.5 ± 0.8	3.5 ± 0.8		4.8 ± 0.8	4.2 ± 0.8
Total time spent for the milk replacer intake (min.)	6.2 ± 0.7	4.5 ± 0.7		5.6 ± 0.7	5.1 ± 0.7
Number of days needed to teach the calf how to drink milk replacer from open pail without help	28.1 ± 1.3	30.4 ± 1.3		28.3 ± 1.3	30.2 ± 1.3
Time spend for licking the walls of the pen (min.)	1.2 ± 0.1	1.6 ± 0.1	*	1.3 ± 0.1	1.5 ± 0.1
Time spend for watching around (min.)	2.5 ± 0.2	2.2 ± 0.2		2.2 ± 0.2	2.5 ± 0.2

S – significant at * P < 0.05, ** P < 0.01; *** Between sexes differences were not significant (P > 0.05)
[a] Percentage calf days with faecal consistency score equals ≥ 3
[b] 1 - normal (soft-solid consistency, no fluid), 2 - soft (semi-solid, mostly solid)

Furthermore, acidification of the replacer did not result in an adverse effect on the number of days for the calves to learn consuming the milk replacer from an open pail without assistance.

Conclusion

Results of the study suggested that growth, feed intake and feed efficiency characteristics of Brown Swiss calves reared under the new calf feeding program with acidified milk replacer were similar to calves receiving a sweet milk replacer. However, occurrence of scours of the young calves was noticeably lower and health status of the calves was improved.

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