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# Growth and Intake of Calves Fed Milk Replacer by Nipple Bottle or Computer Feeding System[1]

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## Abstract

*Forty Holstein calves were assigned at birth to a randomized complete block experiment to evaluate method of milk replacer feeding on growth, intake, and behavior of calves. Commercial medicated milk replacer was fed at 460 g/d in 4 L of water divided into 2 feedings per day from nipple bottles or in 8 feedings per day from a computerized milk feeding system. Calves were placed into one of two group pens containing 2 to 12 calves per pen at approximately 7 d of age for a 52-d trial. A separate outdoor exercise area was connected to each pen. Commercial calf starter (19.5% CP on a DM basis) was offered to each group of calves for ad libitum consumption. Intake of milk replacer was lower (13 g/d) when calves were fed by the computer feeder. Reduced intake of milk replacer in the computer feeder was caused by calves occasionally losing their neck chains and by computer malfunctions during the experiment. Body weight gain was increased by 120 g/d (698 vs 578) when calves were fed by the computer. Calves fed from the computer feeder had fewer incidences of inter-animal contact (n = 1) than calves fed from nipple bottles (n = 40) in the 1st h after each feeding. The computerized milk feeding system appears to be an effective and practical method feeding milk replacer to replacement calves.*

(Key Words: Milk Replacer, Calves, Computer Feeder, Feed Intake.)

## Introduction

Successful management of young calves prior to weaning requires supplying calves with adequate transfer of passive immunity and reducing the animal's exposure to pathogens in the environment. A key component of most recommended housing systems for preweaned herd replacements is isolation from other animals, particularly other calves that might harbor pathogens to which the animals may be exposed. Calf hutches are a popular method of housing calves that incorporate the concept of isolation to reduce the incidence of disease (5).

Calves have been housed in groups to reduce labor costs and for animal well-being concerns (13). Contact between calves is greater when calves are housed in groups, but Bøe (1) and Bøe and Havrevoll (2) reported little effect of housing on the prevalence of interanimal sucking. Negative behavior (interanimal sucking) may be influenced more by the method of feeding; calves housed in groups and fed in one or two meals daily may be more likely to engage in interanimal contact than those fed more frequently (10, 13). Calves housed in groups have been fed milk replacer (MR) for ad libitum consumption or the amount of MR consumed has been controlled by acidification (9, 11, 12). Microprocessor-controlled milk feeding systems have been used with veal calves in Europe with success (1, 2, 3, 7, 8, 10), although limited experience in the U.S. has been less positive (14). Microprocessors controlling most computerized MR feeding systems can be programmed to control various management options, including DM concentration of reconstituted MR, number of meals per day, reduction of amount of MR fed to promote early weaning, and others. The objective of this study was to measure the growth, intake, and behavior of herd replacement calves fed MR twice daily from nipple bottles or eight times daily via a computer feeding system.

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## Materials and Methods

Forty Holstein bull (n = 20) and heifer calves born at the Middle Tennessee Experiment Station (Spring Hill, TN) were blocked by sex and assigned randomly at birth to a randomized complete block experiment. Calves were fed colostrum (4 L/d) for 3 d, then were placed in individual metal stalls bedded with sawdust for an additional 4 to 5 d. Thereafter, calves were placed into one of two group pens (34 m² per pen) containing 2 to 12 calves per pen. Pens were bedded with sawdust. A separate outdoor drylot exercise area (74 m² per area) was connected to each pen. Calves were fed 460 g of MR in 4 L of water equally divided into two feedings per day from nipple bottles (MRB) at a 10- to 12-h interval or equally divided into eight feedings per day from a computerized milk feeding station (MRC; Automatic Nursing with Identification, Intersoft-Agri, Tullahoma, TN; Figure 1). The microprocessor allowed each calf one meal of 500 mL of reconstituted MR (115 g of MR/L) at 3-h intervals. Upon entering the feeding station, the computer identified each calf by its magnetic neck chain. If feeding was allowed, MR was mixed with warm tap water [approximately 120 °F (489 °C)] in a mixing chamber. After mechanical mixing, the reconstituted MR was transferred to a feeding bowl and then was gravity-fed to a nipple in the feeding station. Any MR not consumed during a 3-h period was credited to the next 3-h period. The computer cleaned mixing bowls and nipples six times daily by rinsing with hot tap water. No cleaning solution was used during cleaning cycles.

Plywood side walls were added to the entrance of the feeding station to reduce competition among calves at the feeding station. Side walls were approximately 1.5 m long × 1 m high and effectively eliminated competition.

Commercial calf starter (Tennessee Farmers Cooperative, LaVergne, TN) was fed to each group of calves once daily in a feed bunk in each pen and was available for ad libitum consumption. Amount fed and refused was weighed daily. Commercial MR (Tennessee Farmers Cooperative) was fed to both groups of calves. The MR was medicated with oxytetracycline (125 g/ton) and neomycin (250 g/ton) and contained protein from milk and modified soy flour. Water was available at all times. Calves were observed at each feeding for incidence of scours using the scale of 1 = normal fecal consistency to 4 = severe scours (6).

Calves were weighed at the start of the study (mean age = 7.6 d) and once weekly to approximately 56 d of age. A video recorder with two cameras per pen was used to record the number of contacts by animals during the study. The camera recorded behavior once weekly beginning at approximately 0900 h and continuing for 24 h. However, initial observation indicated that most (≤90%) cross-nursing occurred within 1 h of MR feeding; therefore, data were reported for 1 h postfeeding only at each feeding. A contact was defined as one animal not previously in contact with another making oral contact with another calf. Samples of MR and calf starter were collected monthly, composited, and analyzed for DM, CP, Ca, and P.

Intake of MR, BW, BW gain, and days scouring were pooled for the study and analyzed as a randomized complete block design by ANOVA. Calves were blocked by date of birth and sex of calf. Preliminary analysis

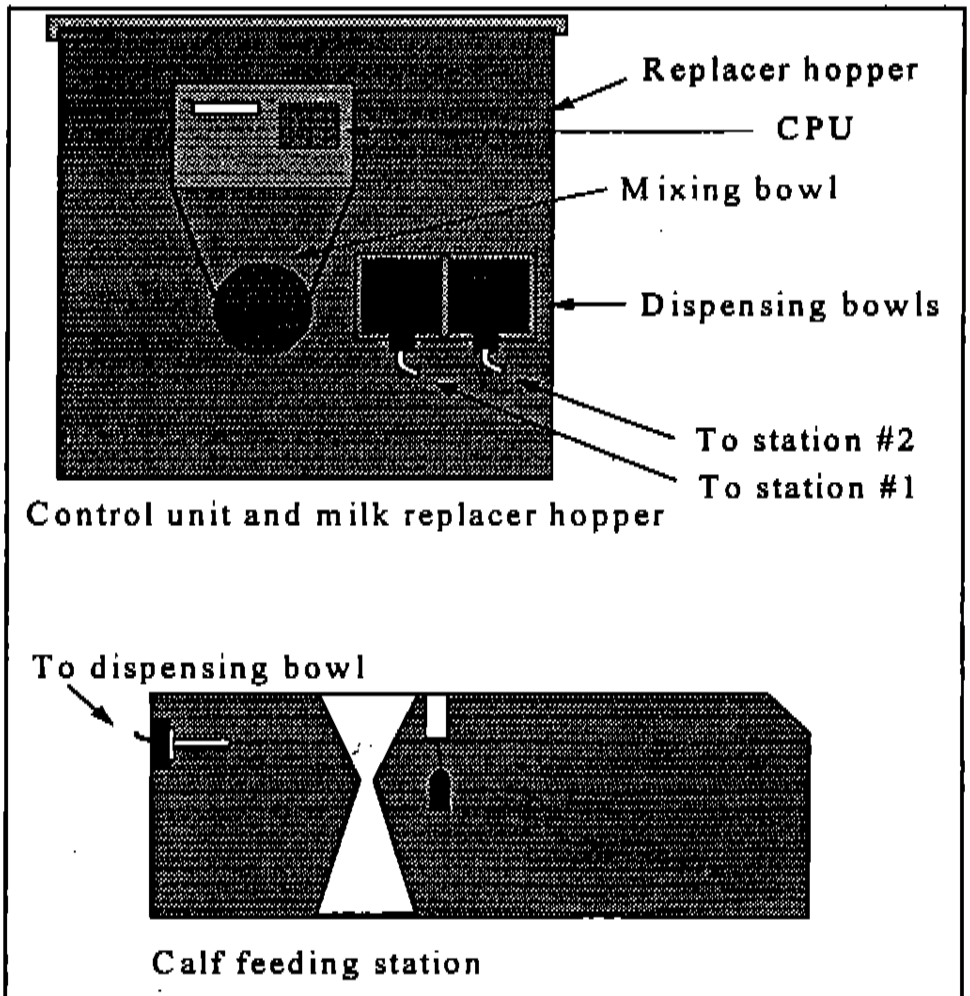


*Figure 1. Schematic diagram of computerized milk feeding system.*

indicated that BW at 7 d was not significant as a covariable in any analysis; therefore, no covariable was used. Significance was $P<0.05$ unless otherwise noted.

## Results and Discussion

Calves were generally healthy throughout the trial. Two calves died (one per treatment) due to scours and one died (MRC) due to complications following a broken leg. Mean days scouring was 2.6 d (Table 1); scours were generally not severe and were unrelated to treatment. Calves that were observed with scours were removed from the group pen and placed in an individual pen. Electrolytes were fed for 2 to 3 d and antibiotic therapy was initiated according to manufacturer's directions or until the animal's condition improved. Thereafter, the calf was returned to the group pen.

Intake of MR was measured for each calf. Calves on treatment MRB were given a 2-L nipple bottle at each feeding. Calves on treatment MRB were observed to minimize competition among animals and physically separating calves when competition occurred. Calves on treatment MRC were trained upon entering the group pen. Training was uneventful; all calves learned to use the computer within 1 d, and most learned to use the computer within a few minutes.

Intake of MR was lower ($P<0.01$) for calves on treatment MRC, although the difference between treatments was only 13 g/d (Table 1). Reduced intake of MR when calves were fed by the computer feeder was due to lost neck chains and a few computer malfunctions during the experiment. Milk replacer used in the study was 91.5% DM and 22.8% CP (DM basis). Label guarantees for fat and crude fiber were 20 and 0.5% on an air-dry basis, respectively.

Body weight and BW gain at the end of the study were greater for calves on MRC (Table 1). The increase in BW gain was 120 g/d, an increase of 21% over calves on treatment MRB. The increase in BW with similar amounts of MR feeding was unexpected. We found no other results in the literature suggesting such a marked increase in BW gain with computerized feeding vs feeding from nipple bottles. The amount of MR fed by the computer was determined by calibrating the weight of MR powder provided per minute the screw feeder was engaged. This amount was used to calculate the length of time the screw feeder should be engaged to deliver the proper amount of MR powder. In addition, the MR fed to calves on treatment MRB was weighed and calibrated to the cup provided by the manufacturer. Although the amount of MR offered was calibrated weekly during the study, changes in MR formulation (or size of the cup provided in each MR bag) may have increased the amount of MR mixed by the computer or decreased the amount of MR mixed into nipple bottles. Further studies are needed to confirm that body weight was increased when calves were fed similar amounts of MR by the computerized feeder.

Intake of calf starter was not evaluated statistically, as animals were group-fed starter throughout the trial. Mean starter intakes during the study were 1067 and 1128 g/d for calves on treatments MRC and MRB, respectively. Calf starter was 88.5% DM and 19.5% CP on a DM basis.

Closed circuit cameras were set up to monitor each pen of calves for 1 h after each feeding. Calves were not monitored over a 24-h period. Cameras were used 1 d/wk throughout the study. Calves were identified by painting numbers on each animal's flank; however, it was not possible to identify each animal on treatment MRB immediately after feeding, as animals typically congregated in small groups for up to 60 min after feeding. Therefore, number of contacts could not be evaluated statistically; inferences regarding the number of inter-animal contacts must be made with caution. There was an average of one interanimal

**TABLE 1. Change in BW and intake of calves housed in groups and fed milk replacer two times per day from bottles or eight times per day from a computer feeder.**

| Item | Treatment | | | | | Percentage |
|---|---|---|---|---|---|---|
| | Computer | SE | Bottle | SE | P | change |
| n | 18 | ... | 19 | ... | ... | ... |
| Age at start, d | 7.8 | 0.6 | 7.4 | 0.5 | NS | ... |
| Age at end, d | 60.2 | 0.7 | 60.0 | 0.6 | NS | ... |
| Days on trial | 52.3 | 0.8 | 52.5 | 0.8 | NS | ... |
| BW at start, kg | 39.8 | 0.9 | 40.9 | 0.9 | NS | ... |
| BW at end, kg | 76.2 | 1.9 | 71.1 | 1.9 | 0.07 | +7 |
| BW gain, g/d | 698 | 35 | 578 | 35 | 0.02 | +21 |
| DMI, g/d | | | | | | |
| Milk replacer | 435 | 4 | 448 | 4 | 0.01 | −3 |
| Calf starter[a] | 1067 | ... | 1128 | ... | ... | −5 |
| Inter-animal contacts[b] | 1 | ... | 40 | ... | ... | ... |
| Scours, d | 2.5 | 0.4 | 2.8 | 0.4 | NS | ... |

[a]Not analyzed statistically as calves were fed in groups.

[b]Number of oral contacts made by calves in the first hr after removing nipple bottles from the group fed by nipple bottle. Data were not analyzed statistically.

contact per calf in the group of calves fed by computer in the first hr after calves were fed. Calves fed by computer had MR available throughout the day; therefore, feeding calves on treatment MRB was not associated with intake of MR by calves on treatment MRC. However, at each feeding, MR was added to the computer hopper if necessary and pens were washed. Mean number of interanimal contacts for calves on treatment MRB was 40 per calf in the 1st h after feeding. Most contacts occurred in the first 10 min after bottles were removed. Video recordings clearly showed that calves fed by bottle attempted to continue nursing; most calves milled about in the feeding area and continued to nurse on other calves or on pen fixtures. This behavior declined with time after feeding until about 60 min after feeding. Video recordings also indicated little competition among calves on treatment MRC. We observed few instances of calves forcing other calves out of the feeding station while drinking. However, the number of calves per group and social dominance of calves may influence the frequency of this behavior.

Most studies that have evaluated group housing systems have fed calves MR for ad libitum consumption. Generally, ad libitum consumption leads to increased MR intake, increased BW gain and feed costs, and decreased intake of calf starter. When a computerized system is used, however, calves may be housed in groups and limit-fed MR with little competition among animals. Labor required to maintain the computer feeding system was minimal. Management of the computer feeder included daily evaluation of the condition of the computer and feeding station, adding powdered MR to the feed hopper once daily, downloading and printing the daily computer report, and ensuring that all calves maintained working neck chains. These management tasks were completed in a few minutes per day. Conversely, feeding calves MR by nipple bottle was more labor intensive and required 30 to 45 min per feeding to mix MR, feed calves, and thoroughly clean the bottles after feeding.

Feeding MR to calves more frequently than twice daily generally has not resulted in improved BW gain or efficiency of energy utilization (15, 16). However, Williams et al. (15) reported improved efficiency of fat digestibility in young calves (20 d of age) fed MR six times daily compared to calves fed once daily. Williams et al. (15) fed MR containing significant amounts of skim milk powder that coagulated in the abomasum and supplied energy nearly continuously from the gut in calves fed once daily. However, it is not clear if a continuous supply of energy would be provided to calves fed once or twice daily when nonclotting MR was fed. The MR used in this study contained no skim milk or casein, so coagulation in the abomasum did not occur. Feeding frequency may be more important when calves are fed for ad libitum consumption than when limit-fed (2).

Maatje and Verhoeff (7) reported reduced rate of BW gain in veal calves housed in groups and fed via computerized milk feeding system compared to those housed in individual crates and fed from buckets. Differences in BW gain were attributed to lower MR intake during the 161-d feeding period. Further, morbidity and mortality were greater when calves were housed in groups compared to individual housing. Maatje et al. (8) and Tomkins (14) also reported increased morbidity and mortality when veal calves were housed in groups and fed by computerized feeder. In the current study, rate of morbidity and mortality were low and were unaffected by method of MR feeding. Our calves were fed adequate amounts of high quality colostrum, isolated from mature animals, and proper hygiene was maintained throughout the study. Calves with diarrhea were separated from the group to minimize the spread of pathogens to other calves. Under these conditions, group housing with computerized feeding supported intake and rates of BW gain similar or superior to calves housed in groups and fed conventionally.

Hammell et al. (4) concluded that calves have a requirement for sucking independent of milk intake. This need may not have been met when calves were fed on treatment MRB in the current study, as interanimal sucking in the 1st h after feeding was greater in this group. Calves fed by the computer feeder spent little time sucking, and apparently, continuous availability of the nipple satisfied this need. However, all group calves have the opportunity to engage in interanimal contact, so use of a computerized MR feeding system will not prevent all interanimal contact.

# Conclusions

Calves fed on treatment MRC and housed in groups had greater BW gain than calves on treatment MRB. Calves housed in groups had few occurrences of scours and excellent BW gain. Calves on treatment MRB engaged in more non-nutritional sucking than calves fed on treatment MRC. The computerized MR feeding system appears to be an acceptable alternative to individual feeding when animals are housed in groups.

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