Milk Replacer versus Whole Milk: Effects on Calf Performance

Introduction

The use of pasteurized waste (i.e., nonsalable) milk as a liquid feed for calves has increased in recent years (NAHMS 2002; NAHMS 2007) due to greater availability of on-farm pasteurizers. Properly pasteurized waste milk can be a high-quality source of nutrients for young calves, and is oftentimes thought of as supporting superior calf health and performance compared with conventional milk replacer programs. This view is accurate when considered in the context of nutrient concentration; pasteurized waste milk often contains much greater concentrations of protein and fat (Jorgensen et al., 2006) and will likely result in greater crude protein and fat intake compared with a conventional milk replacer program. The primary areas of concern with pasteurized waste milk are bacterial contamination, variation in nutrient intake, and the low concentrations of vitamins and minerals compared with milk replacer.

Godden et al. (2005) reported that feeding pasteurized waste milk (1 gallon/calf per day) increased average daily gain (ADG) and decreased morbidity and mortality compared with calves fed a 20-20 milk replacer (1.0 lb powder/calf per day). Dry matter (DM), protein, and fat concentrations in pasteurized waste milk were not reported, but distinct differences in nutrient intake between groups would be expected considering that the pasteurized waste milk contained various amounts of transition milk (Godden et al., 2005). The differences in calf performance are not surprising under the conditions of the study.

Recent research has compared raw (Hill et al., 2008) and pasteurized (Hill et al., 2007) salable whole milk (not waste milk) with conventional milk replacers and reported the effect of liquid feed source on calf performance. These studies are novel because daily dry matter intake (DMI) was equalized between the whole milk and milk replacer treatments, thus the primary difference among treatments was the protein and fat concentration in the whole milk. This article summarizes these studies with emphasis on the calf performance data.

Study 1: Raw Milk versus Conventional Milk Replacer (Hill et al., 2008)

The trial used Holstein bull calves purchased from multiple dairy farms. Calves were fed their liquid feed source twice daily from d 0 to 39, and once daily from d 40 to 42. All calves were offered ad libitum access to a 20.4% CP (DM basis) pelleted calf starter and fresh water from d 0 to 56. The trial was conducted from February to April where the average temperature was 37.4°F (range of 3.2° to 68°F).

Three treatments (16 calves per treatment) differing in source of liquid feed were used in this study: 1) 1.0 lb/day (as-fed) of a 20-20 milk replacer powder in 1 gallon of total solution (**MR**), 2) 50% of DM from MR, 50% of DM from raw salable milk (**MR+milk**), and 3) all DM from raw salable milk (**Milk**). The DM content of raw salable milk was monitored regularly throughout the trial to maintain equivalent DMI among treatments, which meant that the total volume of liquid feed offered to the calves differed among treatment due to fluctuations in raw milk DM. The MR used in this study contained supplemental L-Lysine and DL-Methionine, and the fat source was a combination of animal and vegetable fat.

Raw salable milk averaged 13.6% DM (range of 10.5-15.0%), 25.3% CP (range of 24.5-25.9%), and 27.6% fat (range of 25.9-28.5%). Nutrient intake and calf performance measurements are presented in **Table 1**.

Calves fed 100% MR consumed less protein, fat, and metabolizable energy (ME) from their liquid feed than did calves fed MR+milk and 100% milk. However, total protein and ME intake was similar among groups due to greater starter intake by calves fed 100% milk replacer, whereas total fat intake remained higher for calves fed 50% or 100% raw salable milk. According to these data, calf body weight on d 42 of the trial was 132, 126, and 125 lbs for MR, MR+milk, and Milk treatments, respectively.

Table 1. Nutrient intakes, ADG, starter DMI, and feed efficiency for calves fed equal amounts of dry matter from MR, half MR and half raw milk, or raw milk from d 0 to 42.

	Treatment			
Item	**MR**	**MR + Milk**	**Milk**	***P*-value[1]**
Nutrient intake from liquid				
DM, lbs/d	0.95	0.96	0.96	0.56
CP, lbs/d	0.21	0.23	0.25	**0.05**
Fat, lbs/d	0.21	0.24	0.27	**0.03**
ME, Mcal/d	2.07	2.17	2.28	**0.05**
Nutrient intake from liquid and starter				
DM, lbs/d	1.87	1.78	1.80	0.18
CP, lbs/d	0.40	0.40	0.42	0.19
Fat, lbs/d	0.25	0.27	0.30	**0.04**
ME, Mcal/d	3.43	3.38	3.50	0.77
Calf performance				
ADG, lbs/d	0.96	0.84	0.83	**0.03**
Starter DMI, lbs/d	0.92	0.82	0.83	**0.05**
Gain:Feed	0.51	0.47	0.46	**0.04**

[1]*P*-value for contrast MR vs. MR+milk and Milk. Contrast for MR+milk vs. Milk was not significant (*P* > 0.10) for any measurement.

Study 2: Pasteurized Milk versus Two Conventional Milk Replacers (Hill et al., 2007)

This trial used Holstein bull calves purchased from multiple dairies. Liquid feeds were fed from d 0 to 42. All calves were offered ad libitum access to an 18% CP (as-fed basis) pelleted calf starter from d 3 to 56 and had access to fresh water at all times. This trial was conducted from September through November.

Treatments were arranged as a 3 × 2 factorial with 3 sources of liquid feed DM fed at 2 rates of DMI (6 treatments, 8 calves/treatment). The 3 liquid feed sources were: 1) 22-20 all-milk protein MR with no supplemental amino acids and lard as the sole fat source (**CON22**), 2) 20-20 all-milk protein MR with supplemental amino acids (L-Lysine and DL-Methionine) and specific fatty acids (provided by sodium butyrate, coconut oil, canola oil, and lard) (**MOD20**), and 3) pasteurized whole milk (**MILK**). The low feeding rate of each liquid feeding source was intended to match the DM provided by 1.0 lb of milk replacer powder (as-fed basis), whereas the high feeding rate was intended to match the DM provided by 1 gallon of pasteurized whole milk.

The nutrient composition (as-fed basis) of pasteurized milk was 14% DM, 3.2% CP, and 3.6% fat, which is equal to 22.9% CP and 25.7% fat on a DM basis. Nutrient intake and calf performance measurements for the main effect of liquid feed source are presented in **Table 2**.

Calves that were fed the MOD20 milk replacer had the greatest ADG compared with calves fed CON22 or MILK. Calf body weight on d 42 was 123, 132, and 125 lbs for the CON22, MOD20, and MILK treatments, respectively. In this study, starter intake did not differ despite differences in total fat intake.

Table 2. Nutrient intakes, ADG, starter DMI, and feed efficiency for calves fed equal amounts of dry matter from a 22-20 MR (22-20 NRC), a 20-20 MR balanced for AA and fatty acid specifications (20-20 AA-Fat), or pasteurized whole milk (PWM) from d 0 to 42.

	Treatment		
Item	**CON22**	**MOD20**	**MILK**
Nutrient intake from liquid			
DM, lbs/d	1.06	1.05	1.06
CP, lbs/d	0.24[a]	0.23[b]	0.25[a]
Fat, lbs/d	0.22[b]	0.22[b]	0.27[a]
Calf performance			
ADG, lbs/d	0.97[c]	1.17[a]	1.06[b]
Starter DMI, lbs/d	0.73	0.88	0.92
Gain:Feed	0.53[b]	0.60[a]	0.53[b]

[a,b,c]Means within a row with unlike supercripts differ (*P* = 0.05).

Discussion

The research summarized here demonstrated that a well-formulated milk replacer can support equivalent or greater calf performance despite differences in dietary CP and fat concentrations compared with whole milk. The increased performance of calves fed certain milk replacers appears to be due to supplementing specific amino acids and/or altering the fatty acid profile of the milk replacer (Hill et al., 2007, 2008).

Regardless of the mechanism responsible, these papers further support the notion that all milk replacers are not created equal despite what is listed on the tag, and that properly-formulated conventional milk replacers can support equal or improved calf performance than whole milk when equalized for total DMI.

References

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