Feedstuffs Reprint

Milk replacer level will inversely affect dairy calf starter intake

Bottom Line

with
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I FIRST became aware of the interaction between milk replacer feeding level and calf starter level in preparing a 1979 review (Kertz et al., 1979) on early-weaning programs.

Calf starter intake accounted for 65% of the variation in bodyweight gain at four-week weaning based on six trials that included 18 treatments and 277 calves. However, things have changed considerably since around 2000 with the advent of accelerated or intensive milk replacer feeding programs.

More recently, Gelsinger et al. (2016) summarized data from nine trials with 21 treatments and found an inverse relationship (r = -0.82) between starter dry matter intake (DMI) versus liquid feed DMI. The starter DMI ranged from about 1.80 to 0.44 lb., while liquid DMI ranged from about 0.88 to 2.6 lb. This all affects the weaning transition (two weeks before to two weeks after full weaning).

A specific study (Hill et al., 2016) was done to look further into this interaction in milk replacer feeding programs on starter intake and calf performance.

Forty-six male Holstein calves with an initial bodyweight of 98 lb. at two to three days of age were purchased from one dairy farm and transported 3.5 hours to the Provimi calf research facility in Ohio.

The study used three treatments: (1) moderate (MOD) — calves were fed 1.45 lb. of milk replacer split into twice-daily feedings for 39 days and then 0.725 lb. for three days, followed by full weaning; (2) high moderate (HIMOD) — calves were fed 1.94 lb. of milk replacer split into twice-daily feedings for the first five days, then 2.42 lb. for 23 days, 1.45 lb. for 18 days and 0.725 lb. for three days until full weaning, and (3) high (HI) — calves were fed 1.94 lb. of milk replacer split into twice-daily feedings for five days, then 2.42 lb. for 37 days and 1.23 lb. for six days, followed by full weaning.

The milk replacer was a whey protein-based product with 28% crude protein and 20% fat on an as-fed basis; it was reconstituted before feeding at 14% solids.

The calves were housed with individual pens bedded with long wheat straw in a naturally ventilated, side-curtained barn with no added heat. In a second phase, these calves were then grouped by prior milk replacer treatments in pens of three to four calves for the next 56 days in an inside/outside housing arrangement with straw and no added heat.

The same textured starter (19.4% crude protein, 14.6% neutral detergent fiber and 6.4% acid detergent fiber) fed in the first phase was also fed in this phase, along with 5% chopped grass hay (9.2% crude protein, 64.2% neutral detergent fiber and 38.1% acid detergent fiber). Water was provided free choice in both phases.

The second phase followed the first phase and ran from February to April.

Discussion

Starter intake during the first 56 days was inverse to milk replacer intake, as expected (Table). This resulted in similar metabolizable energy (ME) intakes and average daily gain (ADG) among the treatments. This ADG did double birth weight by the end of two months of age — a generally agreed-upon target for calf growth.

Another factor is that this milk replacer had 20% fat. In the classic study by Kuehn et al. (1994), calves fed 20.9% crude protein milk replacers with 21.6% versus 15.6% fat ate less starter, had lower total ME intake and had lower ADG prior to weaning at the end of six weeks. There was also a carryover effect after weaning for lower starter intake.

Subsequently, Diaz et al. (2001) fed Holstein bull calves a constant energy and protein level from milk replacers that differed in having 15%, 21% or 32% fat. Intakes were adjusted weekly, resulting in a similar daily empty bodyweight gain of 1.37 lb. with no starter being fed. A final target bodyweight of 187 lb. was selected because this is an upper limit at which most commercial dairies feed milk replacer before weaning — just as achieved in the Hill et al. study.

Body composition on a moisture-free basis (because there is an inverse relationship between body fat and water; Reid et al., 1955) was greater ($P < 0.006$) for 32% versus 21% fat and for 21% versus 15% fat. Since ADGs were the same across treatments, percent body fat progressively increased with percent fat in the milk replacer, while percent crude protein and percent ash in empty bodyweight proportionately decreased. Thus, 15% fat became the optimum level in ac-

Summary of results from Hill et al. (2016)

	MOD	HIMOD	HI	SEM
Phase 1, 56 days				
Milk replacer intake, lb./day	1.01	1.67	1.92	—
Starter intake, lb./day	2.14	1.39	1.21	0.09
ME intake, Mcal/day	5.33	5.58	5.86	0.38
ADG, lb./day	1.54	1.59	1.70	0.07
Bodyweight, lb.	187.4	185.4	190.9	5.1
Feed efficiency, gain/DMI	0.49	0.52	0.54	—
Phase 2, 57-112 days				
DMI, lb./day	7.13	6.96	7.49	0.20
ME intake, Mcal/day	10.2	10.9	10.7	0.67
ADG, lb./day	2.44	2.40	2.31	0.02
Bodyweight, lb.	324.4	319.2	321.5	3.66
Feed efficiency, gain/DMI	0.34	0.34	0.31	0.02
Body condition score change	0.3	0.3	0.3	0.05
Digestibilities, %				
Week 11				
Dry matter	72.6	74.0	70.6	1.37
Crude protein	72.2	78.6	72.9	2.18
Starch	95.8	95.0	94.3	2.03
Neutral detergent fiber	33.7	33.5	25.1	2.37
Week 16				
Dry matter	83.0	82.4	81.6	0.58
Crude protein	84.7	83.6	83.9	0.81
Starch	94.4	95.6	92.2	1.69
Neutral detergent fiber	66.7	65.4	65.1	2.68

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celerated milk replacer programs with 28% crude protein. This means percent fat in milk replacer is more than just a marketing angle.

During the second 56-day phase, there were no differences in DMI, ME intake, ADG or feed efficiency, although feed efficiency was about 35% poorer than those during the first 56 days. This was due primarily to two factors. First, bodyweights were greater, which increases maintenance requirements and reduces overall efficiency of energy utilization for growth. Second, no milk replacer was fed that exceeded 90% digestibility, while some hay consumed had less than 50% digestibility.

This reinforces the need to feed calves well during the first two months, when nutrient utilization and conversion to growth are the most efficient they will ever be in the life of a dairy animal.

Note the high ADG of greater than 1 kg (2.2 lb.) during the second 56-day phase of this study. That is a red flag because it illustrates greater fattening.

In 2007, I emailed Mike Van Amburgh at Cornell University about this issue of excess growth rate in Holstein heifers. Matt Meyer, his graduate student at the time, had completed his doctoral thesis with heifers fed at two rates of gain. Van Amburgh's email response was that "any energy intake that allows for growth in excess of 1 kg per day will end up as fat; that appears to be the upper limit for optimizing protein deposition. ... It is not encouraged and is usually done to overcome a bad or average calf growth program."

Granted, the calves in the 2016 study by Hill et al. were bull calves, and fattening is desirable if they will eventually go to a meat market. However, excessive fattening is not desirable in dairy heifers.

The researchers might not have expected to see differences in digestibilities at 11 weeks of age, since all three treatments were fed the same starter and grass hay after 56 days — and there were none, except for greater crude protein digestibility for HIMOD versus MOD and greater dry matter digestibility for MOD versus HI. Similarly, there were only a few differences in digestibility at 16 weeks among the three treatments. However, the greater digestibilities occurred across nutrient categories for 16 versus 11 weeks.

This indicates some further maturation in digestive tissue and function from 11 to 16 weeks. If that occurs at this age, I think it is even more likely that offering limited starter intake for less than two to three weeks before or after weaning is more likely to be a limiting factor for the development of younger calves' rumen function.

Thus, this further signals the importance of the weaning transition program from two weeks before to two weeks after weaning.

The Bottom Line

When selecting and managing a calf feeding program, the amount fed and protein/fat level of the milk replacer inversely affects consumption of the starter. This, in turn, will affect how well calves do during the weaning transition program — the two weeks before and two weeks after weaning.

Care must also be taken to not unduly fatten young calves and heifers, which can occur at gains of more than 2.2 lb. (1 kg) per day over an extended period of weeks or months.

References

Diaz, M.C., M.E. Van Amburgh, J.M. Smith, J.M. Kelsey and E.L. Hutten. 2001. Composition of growth of Holstein calves fed milk replacer from birth to 105-kilogram bodyweight. J. Dairy Sci. 84:830-842.

Gelsinger, S.L., A.J. Heinrichs and C.M. Jones. 2016. A meta-analysis of the effects of preweaned calf nutrition and growth on first-lactation performance. J. Dairy Sci. 99:6206-6214.

Hill, T.M., J.D. Quigley, H.G. Bateman II, F.X. Suarez-Mena, T.S. Dennis and R.L. Schlotterbeck. 2016. Effect of milk replacer program on calf performance and digestion of nutrients in dairy calves to 4 months of age. J. Dairy Sci. 99:8103-8110.

Kertz, A.F., L.R. Prewitt and J.P. Everett Jr. 1979. An early weaning calf program: Summarization and review. J. Dairy Sci. 62:1835-1843.

Kuehn, C.S., D.E. Otterby, J.G. Linn, W.G. Olson, H. Chester-Jones, G.D. Marx and J.A. Barmore. 1994. The effect of dietary energy concentration on calf performance. J. Dairy Sci. 77:2621-2629.

Reid, J.T., G.H. Wellington and H.O. Dunn. 1955. Some relationships among the major chemical components of the bovine body and their application to nutritional investigations. J. Dairy Sci. 38:1344-1359. ■