HOARD'S DAIRYMAN

Pondering protein in calf starter

by Al Kertz

IN AN article in the April 10, 2025, issue of *Hoard's Dairyman*, I lamented the demise of calf starter even though liquid feeding protocol has rightfully ascended. The evolution goes back to the 1970s, when the early weaning program was still in vogue.

Starter history

Contrary to what some may believe, I did not invent that program — although I did describe it. Early weaning had been established at Cornell University before I was born to spare milk feeding and maximize milk sales. In the 1970s, a typical milk replacer had 22% crude protein (CP) and 10% to 12% fat, which was later modified to 20% CP and 20% fat — the misnamed proverbial "industry standard" 20/20 milk replacer.

In the early 2000s, studies at Cornell and other universities established the "accelerated" or higher CP milk replacer, fed at a higher level.

In the meantime, calf starters — which were typically texturized and had 16% CP as-fed — went through changes. Texturized starters can be challenging to handle depending on how much molasses is added and their physical characteristics. Pelleted starters are usually cheaper to formulate and manufacture, and they contained greater than 16% CP. Thus, began a marketing campaign for higher CP starters at 18%, 20%, 22%, and greater. There really were no good data or studies to support these higher CP starters, but they became endemic. One rationale used to support higher percent CP starters was that calves did not eat enough starter, so they needed a higher percent CP. No, then the problem was a poor starter and/or program; and intake and energy were limiting, not CP.

Digging deeper

One issue with high CP texturized and pelleted starters is poor pellet quality leading to fines. Calves do not like fines, and they can lower their starter intake. A texturized starter with a poor quality pellet can result in fines and poor intake. I had the consultant lower the starter CP from 22% to 20% as-fed, allowing the formulation to use more wheat middlings into the pellet, eliminating the fines, and boosting starter intake. It also reduced formulation costs.

This led to a July 2025 Invited Review paper in the *Journal of Dairy Science* authored by Morteza Ghaffari of the University of Bonn, Germany; Jim Drackley at the University of Illinois; and myself.

Protein paradox

Table 1 shows the National Academies of Sciences, Engineering, and Medicine's (NASEM) 2021 requirements for CP and metabolizable energy (ME) for a range of average daily gains (ADG) for a 110-pound calf fed only milk replacer. Note that as ADG moved up, the percent CP rose as dry matter intake (DMI) also lifted. To double birth weight (BW) (90 pounds) at 2 months of age would typically require about 1.5 pounds ADG. Interpolating percent CP of DMI between 1.32 and 1.98 pound ADG yields about 24% CP of DMI from milk replacer fed alone. If that was provided by a calf starter, that would be about 20.6% as-fed.

Yet, there are starters being fed with greater CP than that. Granted, starter digestibility is less than milk replacer digestibility. That is the value of the NASEM 2021 Young Calf Model, which allows input of body weight with intakes of milk replacer, starter, and ambient temperatures in any given situation to predict ADG. The NASEM 2021 Young Calf Model predicts about 0.2 pounds less ADG with the same inputs as the NRC 2001 due to better calf body composition data subsequent to publication of the 2001 Model.

We must also take into account the inverse relationship between the amount of milk or milk replacer consumed and starter intake. When 0.25 pounds more milk or milk replacer is fed daily, that reduces starter intake by 0.15 pounds. That may not seem like much, but if 0.25 pounds more milk replacer was fed for 60 days until weaning, that would add up to 9 pounds less starter consumed over those two months.

The review paper delves into various studies — including ADG, calf starter intakes, and physical forms since performance does vary due to these factors. Lastly, protein requirements for dairy heifers was calculated from NASEM 2021 and are useful for simple reference.

Table 1. Energy (ME) and crude protein (CP) requirements for calves with different dry matter intakes (DMI) and average daily gains (ADG)

ADG lb./day	DMI, lb./day	ME, Mcal/day	CP, lb./day	CP, % of DMI
0.37	1.23	2.58	0.22	18.3
0.88	1.56	3.29	0.34	21.8
1.32	1.76	4.05	0.46	23.7
1.98	2.31	4.85	0.58	24.9
2.20	2.71	5.66	0.69	25.6

Table 2. Protein requirements for Holstein heifers with mature body weight (BW) of 1,541 lbs. based on Dairy NASEM 2021 equations

Body weight (BW) lb.	247	493	792	925	1,232
BW as % of mature BW	16	32	48	60	80
Estimated DMI, lb./day	7.3	13.2	17.6	20.5	24.0
CP, % of diet DM, ADG 1.54 to 2.16 lb./day	18.4 to 21.1	14.3 to 16.0	12.6 to 14.0	11.8 to 13.0	12.5 to 13.5

Putting into practice

Crude protein requirements drop with increased body weight, but they grow in the later stages of pregnancy. As the CP percent drops below 14%, digestibility of the diet may decline depending on forage and fiber levels. However, these data are based on the predicted DMI. If actual DMI changes, requirements and dietary concentrations may change.

In closing, optimizing protein intake in the diet requires a balance between protein and energy to support lean tissue growth while minimizing nitrogen excretion and excessive fat deposition. Gaps exist in our understanding of protein dynamics at critical developmental stages, particularly in the period from post-weaning to first calving.

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