Feedstuffs

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How does protein and starch levels interact in calf starters?

Whether recognized or not, there is an interrelation between protein and starch levels in calf starters.

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I have noticed that as the mantra to feed greater protein (CP) levels in calf starters has taken place, this creates restrictions in formulation of those textured starters. As more protein meal is needed in the formula with greater CP level, that allows less space for the textured particles, which either leads to their reduction or to greater feed cost. That in turn may reduce starch from less corn or other coarse grains. Thus, there is an interrelation between protein and starch levels in calf starters, whether recognized or not. This led to the groups at Provimi Nurture Research Center and Penn State to address this topic with calves at Penn State (Christi et al., 2021).

The experiment used 16 male Holstein calves which had been weaned. They had been fed 3 liters of pasteurized whole milk twice daily until 5 weeks of age, and then only once a day 3 liters for a week until full weaning at end of 6 weeks. All calves were rumen fistulated before 5 weeks of age. All calves were fed a commercial starter with 35% starch and 20% CP until they began the study at 8 through 16 weeks of age. Four calves were randomly allocated to each of four treatments: low starch/low CP (18/16%), low starch/high CP (18/22%), high starch/low CP (38/16%), and high starch/high CP (38/22%). These calf grower formulations were mixed with 5% coarsely-ground grass hay (8.6% CP DM) and fed as a total mixed ration (TMR) free choice. Water was also available free choice. Calves were housed in individual pens with about 7 x 5 feet floor space. Pens were bedded with wood shavings, cleaned daily. At 11 and 15 weeks of age, calves were moved to collection stalls for total digestibility measurements.

Table 1 illustrates how formulations were made to create the various calf growers used in the trial. The texture was only 30% using 15% each of whole oats and shelled corn which would be below the minimum 45% which I would recommend (Ghaffari and Kertz 2021) for calf starters. However, in this study, these formulations were used as calf growers since calves were already weaned and the growers were mixed with 5% coarse-ground grass hay and fed as a TMR. And if the texture was even greater, it would have been even more difficult to achieve the starch/CP levels desired.

Table 1. Composition of high starch/high protein (**HS-HP**), low starch/high protein (**LS-HP**), high starch/low protein (**HS-LP**), and low starch/low protein **(LS-LP)** textured calf growers.

	HS-HP	LS-HP	HS-LP	LS-LP
Texture Ingredients, %				
Oats, whole	15	15	15	15
Corn, shelled whole	15	15	15	15
Molasses	2.5	2.5	2.5	2.5
Pellet ingredients, %				
Soybean meal	27.3	24.7	13.4	10.8
Corn, ground	23.8	0	24.2	0
Wheat middlings	10	10	10	10
Soybean hulls	2.85	29.5	16.2	43.3
Nutrients. %				
CP	23.2	21.6	16.8	15.2
NDF	14.6	33.2	24.5	40.6
Starch	39.0	18.4	37.2	17.0

2. Calf performance during weeks 8 to 16 on high starch/high protein (**HS-HP**), low starch/high protein (**LS-HP**), high starch/low protein (**LS-HP**), and low starch/low protein **(LS-LP)** textured calf growers.

	HS-HP	LS-HP	HS-LP	LS-LP

Initial body weight, lb	149.3	150.6	156.3	163.4
Daily gain, lb	2.47	2.58	2.47	2.44
Dry matter intake, lb/day	7.16	8.04	7.64	8.81
Gain:Feed	0.35	0.32	0.32	0.28
Digestibilities 11 weeks, %				
Dry matter	79.5	77.6	72.5	70.6
NDF	50.5	69.3	48.9	62.1
ADF	46.5	68.6	44.1	61.1
Starch	96.7	94.2	96.8	92.7
Nutrients. %				
CP	23.2	21.6	16.8	15.2
NDF	14.6	33.2	24.5	40.6
Starch	39.0	18.4	37.2	17.0

Some key points are:

- Dietary treatments did not affect daily gain, dry matter intake, and body measurements (data not shown) although feed efficiency (Gain;Feed) did improve for higher starch and higher CP treatments.

- Digestibilities are only shown for 11 week measurements since they were greater than at 15 weeks. High protein improved dry matter, NDF, and ADF digestibilities; while high starch lowered NDF and ADF but not dry matter digestibilities. Starch digestibility was improved only with high starch but not with high protein (P = 0.13). There were no significant interactions between starch and protein treatments.
- Rumen pH values were more different at 11 vs 15 weeks (graphed in manuscript). In both periods, lower pH values were with high starch treatments.

What does all this mean? First, remember that these were post-weaned calves—not preweaned calves. With preweaned calves and a more textured starter along with no hay being fed, results may have been different, or similar. With these postweaned calves, 5% coarse-ground grass hay was fed mixed with a lower textured grower. Thus, the high starch treatments lowered NDF and ADF digestibilities, but not for dry matter and starch. Along with lower rumen pH, this indicates some marginal ruminal acidosis, especially at 11 versus 15 weeks of age. High protein impact on increasing dry matter, NDF, and ADF digestibilities may have been due at least partially to ruminal deamination of protein/amino acids which utilizes more hydrogen ions converting amino groups to ammonium. This is most evident in urea conversion to ammonium in the rumen (Kertz 2010).

The Bottom Line

Postweaned calves are in a sensitive conversion to utilize forage. This study indicates that both dietary protein and starch levels affect dry matter, NDF, ADF, and starch digestibilities. Mitigating factors are how much texture is in the grower, and the amount and source of forage fed with the grower. This and other studies indicate 5% chopped or coarse-ground grass hay along with some texture in the grower (or I advocate simply feeding the well-textured starter for this 3rd month at least) may be the best feeding scenario.

References

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