Adding forage to calf starters scrutinized

Bottom Line

with
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I HAVE increasingly noted issues with calf starters being fed around the U.S. and in other countries, including calf starters that are all-pelleted, meal, meal with cottonseed hulls and fed with hay or some combination of these (Hill et al., 2008; *Feedstuffs*, Jan. 12, 2009).

Thus, a *Journal of Dairy Science* title (Khan et al., 2011) that purported a benefit for performance and rumen development when calves were fed hay caught my attention. This study was done at the University of British Columbia by a group that has done several innovative calf studies.

A total of 10 female and five male Holstein calves from the university's research herd were allotted to each of two treatments. Prior to that, calves were fed colostrum within six hours after birth and were moved to individual pens (approximately 4.0 ft. x 6.5 ft.) bedded with sawdust.

Only calves with a total serum protein level greater than 5.3 g/dL and weighing more than 80 lb. on day 1 were used in the study. Water was always made available in plastic buckets.

Pasteurized waste and saleable milk (3.3% ± 0.25% protein, 3.72% ± 0.24% fat, 4.2% ± 0.06% lactose and somatic cell count of 857 ± 373 x 1,000/mL) were fed in two-liter plastic nipple bottles according to a somewhat involved step-up and step-down program. All calves were fed eight liters per day from day 3 to day 35, four liters per day from day 36 to day 53 and two liters per day from day 54 to day 56.

A texturized calf starter was fed *ad libitum* for at least 10% refusals and contained, on an as-fed basis, 57.5% concentrate pellet, 14% flatted barley, 13% flatted oats, 10% steamed corn and 3.5% molasses. Its proximate analysis was 89.5% dry matter and, on a dry matter basis, was 20.7% crude protein, 18.6% neutral detergent fiber, 11.0% acid detergent fiber, 7.7% ash, 1.23% calcium and 0.68% phosphorus with calculated total digestible nutrients of 72.55% (National Research Council, 2001).

At day 3, calves were assigned to a calf starter with no forage control treatment (ST) or a calf starter with forage treatment (STH) provided *ad libitum*. The forage was a chopped orchardgrass hay (mean particle size of 1.2 cm ± 0.4 cm using the Penn State Particle Separator box). The hay's proximate analysis was 87.4% dry matter and, on a dry matter basis, 17.7% crude protein, 62.4% neutral detergent fiber, 34.8% acid detergent fiber, 9.1% ash, 0.37% calcium and 0.29% phosphorus with calculated total digestible nutrients of 57.5% (National Research Council, 2001).

All milk, calf starter and hay were sampled and analyzed weekly. Blood samples were taken on days 7, 21, 35, 49 and 63 and analyzed for glucose and ketones.

On day 70, all bull calves were sacrificed, their digestive tracts were measured and weighed and rumen tissue samples were measured for papillae and wall thickness. Rumen pH was also measured from squeezed rumen contents.

Calves consumed all of the milk that was fed throughout the trial. During the first 35 days, little calf starter or hay was consumed. However, when milk was reduced from eight liters to four liters for days 36-53, intake progressively increased through week 10.

There was no difference in calf starter intake between the ST and STH treatments during the first five weeks ($P = 0.80$) or in total intake ($P = 0.20$) of calf starter versus calf starter plus hay for that same period. Initial bodyweights were 98 lb. and were similar at the end of week 5 ($P = 0.42$) for both treatments.

During weeks 6-10, calf starter intake was similar ($P = 0.10$) for both treatments, but total intake was greater ($P < 0.006$) when hay intake was added to calf starter intake for the STH treatment. Bodyweights were similar ($P = 0.08$) at the end of week 10. From graphs in the article, I estimated that hay intake was 20-25% of calf starter intake during weeks 6-10 for the STH treatment. There also were no treatment differences in height and frame size measurements.

Data for the five male calves sacrificed per treatment showed no differences in bodyweight with or without digesta, but rumen/reticulum with or without digesta was heavier ($P < 0.02$ or 0.03) for the STH calves fed hay along with calf starter (Table).

This is not surprising given results from a study by Stobo et al. (1966) that found increasing gut fill and rumen/reticulum weights with increasing forage levels in calf diets.

There also were no differences in rumen wall thickness or papillae measurements by treatment in this trial, yet the researchers concluded that "provision of chopped hay to calves fed high volumes of milk can promote solid feed dry matter intake and

Rumen measurements and data from male calves sacrificed after week 10

Parameter	ST	STH	Std. error of means	P-value
Bodyweight with rumen ingesta, lb.	231	230	13.1	0.82
Bodyweight without rumen ingesta, lb.	217	206	10.9	0.34
Rumen/reticulum with digesta, lb.	17.6	28.0	3.4	0.02
Rumen/reticulum without digesta, lb.	3.5	4.2	0.24	0.03
Rumen				
Wall thickness, cm	0.82	0.85	0.05	0.87
Papillae concentration, number/sq. cm	93.5	103.8	10.6	0.36
Papillae length, cm	1.14	1.26	0.16	0.87
Papillae width, cm	0.48	0.52	0.04	0.35
pH	5.06	5.49	0.10	0.002

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rumen development without affecting bodyweight gain."

One study they cited to support that claim was Coverdale et al. (2004) in which dietary treatments were either coarse texturized calf starter, ground calf starter or coarse texturized calf starter with either 7.5% or 15.0% chopped grass hay.

In one trial, intake was held constant across these treatments, and calves fed the hay treatments had greater bodyweight gain and feed efficiency than calves fed the coarse texturized calf starter. In a second trial, bodyweight gain, feed efficiency and age at weaning did not differ, while calf starter and total dry matter intake tended to be greater with diets containing hay.

In the Kahn et al. trial, calf starter was offered *ad libitum,* and calves were weaned according to intake. However, there were no measurements of height or frame size, nor were there any measures of gut fill, which can limit and confound interpretations of bodyweight gain and feed efficiency.

The most telling datum of the Khan et al. trial was rumen pH. Calves fed what was described as a texturized calf starter had marginal rumen acidosis, as indicated by the lower ($P < 0.002$) rumen pH with the ST treatment. This resulted because the calf starter contained processed barley, oats and corn.

Barley, if not processed, will largely go through calves undigested, but when processed, it greatly increases the surface area of a very fermentable starch source and reduces any physical effect on rumination.

Oats and corn do not need to be processed for calf starters (*Feedstuffs*, May 9, 2005; Leismeister and Heinrichs, 2004). In fact, it is better if they are not processed because calves will fully chew and ruminate them — leaving hardly any in feces — for up to at least two to three months of age. Processing increases the likelihood of more fines being generated, particularly from handling of the calf starter. Thus, the "texturized" aspect of these grain sources was diminished.

Also, these three grains sum to 37% of the formula — about the minimum I would recommend in a good texturized calf starter. (Some calf starters are denoted as commercial calf starters that are denoted as texturized but may have as little as 10-15% coarse grains.)

This is why some hay in the calf starter in this trial may have reduced marginal rumen acidosis and elevated pH. Some nutritionists feel that the starch level in calf starter needs to be neither too high nor too low. However, the optimal level is difficult to pull out of calf trials that are not confounded by other factors.

In Porter et al. (2007), higher-fiber versus lower-fiber calf starter inclusion did have some benefits, but coarse texturized versus all pelleted was the greater factor in different calf performance.

Finally, another factor is that the pellet quality of the pelleted portion of a texturized calf starter may be poor. Calves do not like to eat fines. One reason pellet quality may be poorer is because of the inclination to feed of high-crude protein calf starters.

Using realistic intakes for calf starter and milk/milk replacer in the young calf model of the National Research Council's 2001 dairy recommendations will not likely generate a calf starter with more than 18% crude protein on a dry matter basis. If calf starter intake is not good, then having more crude protein in the starter will not address the limiting factor — not enough energy due to intake being too low.

As texturized calf starters are formulated for high levels of crude protein, there is less room for ingredients that make for a better-quality pellet. This leads to a high-crude protein calf starter — which the calves do not need — but a poorer-quality pellet, which will lead to even lower intake.

The Bottom Line

Inclusion of hay in a "texturized" calf starter appears to have some marginal benefits. However, closer scrutiny during a university study found that calves were marginally acidotic due to all grains having been processed and included at a lower level of the total calf starter formulation. Texturized calf starters are not all equal.

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