Corn processing in starter and starch digestion and performance

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Making and feeding a well-texturized calf starter (Ghaffari and Kertz 2021) is still a practical issue which impacts feed costs and calf performance (Kertz 2019, Kertz 2025b). The most comprehensive study in this area was done at Penn State (Lesmeister and Heinrichs 2004). Corn was included at 33.3%, whole oats at 15.5%, and the same premix pellet at 46.1% along with 5% molasses in the well-texturized calf starter. The corn was either whole, dry rolled, roasted rolled, or steam flaked. Research herd calves were fed a 20% CP and 20% far milk replacer with free choice water and calf starter. Calves were abruptly weaned at about a month of age in an early weaning program in vogue at that time. There were essentially no differences in performance and other measures among the corn sources. If anything, the steam-flaked corn had some minor limitations. This can be due to steam-flaked corn crumbling somewhat and creating some fines which calves do not eat as well. Another possible factor is that steam -flaked corn is more highly fermentable which can lead to a lower rumen pH and result in less rumination to reduce particle size. So, I generally recommend using rolled or whole corn—as long as it is not too flinty or hard (Du et al., 2021); and let the calf do the processing!

With that as a preamble, let's review a study done on an Iranian commercial dairy farm (Malekkhahi et al., 2025). Thirty-six Holstein female calves (88 ± 4 lb body weight) were selected and separated from their dams at birth, weighed, and housed in individual pens (2.7 m × 1.2 m × 1.8 m; length × width × height). Calves were randomly allotted to one of 3 treatments: (1) calf starter (CS) containing 58% ground corn (GC), (2) CS containing 58% micronized corn (MC), and (3) CS containing 58% super-conditioned corn (CC). The processing details of corn are described in more detail in the research paper. While all CS used the same 58% corn (**Table 1**), it was surprising to me why heated whole soybeans and beet pulp were added unless it was for some cost reduction reason.

"Starters were uniformly mixed with 5% chopped alfalfa hay and offered daily as a TMR from day 3 to 77 after birth. Starters were formulated to achieve 20% CP and 40% starch, on a DM basis. The amount of feed offered was adjusted daily to target 10% refusals."

Table 1. Ingredients and nutrient composition of calf starters with GC (ground corn), micronized corn (MC), and super-conditioned corn (CC).

Ingredients	Ground corn	Micronized corn	Super-conditioned corn
Alfalfa hay chopped	5.0	5.0	5.0
Dry ground corn	58.0	----	----
Micronized corn	---=	58.0	----
Super-conditioned corn	----	----	58.0
Soybean meal 48% CP	25.5	25.5	25.5
Canola meal	5.7	5.7	5.7

Beet pulp	1.6	1.6	1.6
Wheat bran	1.3	1.3	1.3
Heated whole soybeans	2.0	2.0	2.0
Vitamin and minerals	1.6	1.6	1.6
Salt	0.3	0.3	0.3
Nutrients, % of DM			
ME, Mcal/kg	3.10	3.08	3.10
DM. % as fedd	91.7	92.3	92.0
DM	94.1	94.3	92.3
NDF	15.0	15.2	15.0
ADF	6.30	6.27	6.24
CP	20.3	20.6	20.5
Ether extract	3.81	3.71	3.93
Starch	40.2	40.4	40.3

"Calves were fed 5 L of colostrum during the first 12 hours of life (2.5 L at 1 hour after birth and 2.5 L at 12 hours after the first feeding) followed by transition milk (4 L/day) thereafter. Calves (3 days old) enrolled in the study were fed 4 L/day of whole milk (3.40 ± 0.11% fat, 3.10 ± 0.07% crude protein, 4.88 ± 0.05% lactose, and 11.3 ± 0.15% total solids) in buckets twice daily at 0900 and 1800 hours from day 3 to wk 7, followed by morning feeding (2 L/day) from week 8 to 9 of age."

"Behavioral data (standing, lying, eating, and ruminating) were monitored by direct observations of all the calves over the total time (min) devoted to each monitored behavior for 3 days in the preweaning (day 61 to 63 of the trial) and postweaning (day 75 to 77 of the trial) periods. Calves were observed for 4 hours immediately after the morning feeding; therefore, the total time for each calf behavior was equal to 12 hours before and 12 hours after weaning. Behavioral activities of the calves were recorded by 3 trained observers, and every effort was made not to disturb the calves in any way. The observers recorded the frequency of standing (no chewing activity), lying (no chewing activity), eating, and ruminating (either lying or standing; Terré et al., 2013). Blood samples were collected from the jugular vein on the last day of week 11."

Digestibility was measured by acid insoluble ash with fecal grab samples.

Table 2. Calf performance fed calf starters with GC (ground corn), micronized corn (MC), and super-conditioned corn (CC).

Item	**Ground corn**	**Micronized corn**	**Super-conditioned corn**
Dry matter intake, lb/day			
Preweaning 1 to 9 weeks	2.21	2.08	2.27
Postweaning 9 to 11 weeks	4.87	4.81	4.67
Overall 1 to 11 weeks	3.10	3.06	2.97
Daily gain lb/day			
Preweaning 1 to 9 weeks	1.03	1.06	1.17
Postweaning 9 to 11 weeks	1.96	2.00	2.27

Overall 1 to 11 weeks	1.30	1.32	1.48
Dry matter digestibility, %	74.2	74.6	76.3
Starch digestibility, %	89.4	92.1	95.3

Calf performance:

- With these starters being in meal form with 5% chopped alfalfa hay, intake was low with no differences among treatments.
- Daily gains were also quite low before weaning. Too low to double birth weight at the end of 2 months, much less by 9 weeks of age. There was a slight significant difference *(P* < 0.02) for CC vs MC and GC.
- Likewise, dry matter (*P* < 0.03) and starch (*P* < 0.04) digestibilities were greater for CC versus MC and GC.
- Withers (P > 0.04) and hip heights *(P* <0.05) were also greater for CC versus MC and GC,

Table 3. Calf feeding behavior fed calf starters with GC (ground corn), micronized corn (MC), and super-conditioned corn (CC).

Minutes daily	**Ground corn**	**Micronized corn**	**Super-conditioned corn**
Standing	224	242	218
Lying	320	328	335
Eating	79	73	67
Ruminating	77	73	65

- Standing and lying times did not differ among treatments.
- But times eating (*P* < 0.07) and ruminating (*P* < 0.05) were lowest on CC versus MC and GC.

So, while calves on the CC starter had some benefits in daily gain, dry matter digestibility, and starch digestibility, lower times eating and ruminating indicate calves on this CC starter may have been marginally ruminally acidotic. Time ruminating was only 9% for CC, 10% for MC, and 12% for GC. That compares to 21% for a well-texturized starter and 9% for an all pelleted starter (Porter et al., 2007). Also, calves on this CC treatment had greater glucose (*P* < 0.03), beta hydroxy butyrate (*P* < 0.11), and insulin (*P* < 0.02) blood levels than the other 2 calf starter treatments.

Comments:

- First, I commend the authors for taking postweaned measurements. These measurements are too often not made or recorded to determine whether there were any carryover effects (Kertz 2025b),
- I acknowledge that this study was most likely constrained by the commercial dairy's operation. If I had my druthers, I would recommend a new calf starter for this dairy. Why grind the corn, micronize, or super condition it? That all takes time, labor, equipment, and costs more. Let the calves process it as whole or rolled unless the corn is hard or flinty (Du et al., 2021). Likewise, chopping alfalfa hay takes time, labor,

equipment, and costs more. And when chopping alfalfa hay, the leaves often shatter and are lost somewhat—and they contain most of the protein and calcium. As I recall in one study, the alfalfa hay had only about 12-13% CP when analyzed after chopping.

The Bottom Line

Feeding a meal calf starter with 58% corn and 5% chopped alfalfa hay resulted in poor calf performance prior to weaning. Using ground untreated corn or two different heat-processed corn in this study made little difference. Grinding or processing corn and including chopped alfalfa hay requires time, labor, equipment, and more costs versus feeding a well-texturized calf starter which provides better intake, daily gain, and rumen development.

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