Pelleted versus texturized calf starter digestibility and ruminal effects

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I recently realized that I had overlooked some key research about pelleted versus texturized calf starters (CS). As many may realize, I (and calves) prefer well-texturized CS because they offer many benefits to young calves. That was covered in a number of prior *Feedstuffs* columns and addressed in Chapter 4 over about 25 pages in my book (Kertz 2019). So, I will not rehash that now.

This research was done at the University of Wisconsin (Gelsinger et al., 2019. 2020) with 10 ruminally cannulated Holstein bull calves. Calves received 4 quarts of colostrum within 3 hours of birth. Birth weight averaged 85.2 ± 2.9 lb. Calves were included in the study when serum total protein was > 5.5 g/dL. After some additional colostrum feeding over 48 hours, calves were fed twice daily 2 quarts (0.5 lb of DM) of milk replacer (22% CP, 20% fat) via nipple bottle at 0700 and 1900 hours for 6 weeks followed by a single feeding of 2 quarts at 0700 hour for 7 days. Calves were completely weaned at 8 weeks of age. Starters were randomly assigned when calves were about 1 week of age (6.6 ± 3.4 days), and each calf remained on their respective CS for the duration of the study. Calf starters (**Table 1**) were designed to cause (pelleted-PEL) or blunt (texturized-TEX) rumen acidosis.

Beginning at 1 week of age, fresh CS (0.5 lb) was offered daily at 0800 hours and weigh-backs recorded at the end of each 24-hour period. Calves were housed in individual calf hutches (4.8 m^2/calf) from birth through 8 weeks of age. Then calves were housed in divided super-hutches (5.0 m^2/calf). Rubber mats were placed beneath the entire area of individual hutches and super-hutches to prevent bedding consumption and to facilitate fecal collection. Rumen cannula were fitted to each calf at approximately 3 weeks of age. Larger cannulas replaced these smaller ones between 7 and 9 weeks of age to accommodate the growth of the fistulas. Details about *in situ* and digestibility measurements are in the initial paper. *In situ* involves grinding samples of the CS, placing a sample in a sealed dacron bag of a certain pore size, and then placing them fixed in the calf's rumen for removal at given times to measure disappearance or calculated digestion.

Table 1 Calf starter composition.

Item %	Pelleted	Texturized
Ground corn grain	49.4	---
Whole corn grain	---	37.1
Extruded corn grain	5.0	---
Soybean meal	22.1	---
Protein concentrate mix	---	33.2
Ground oats	6.2	---
Whole oats	---	10.1

Cottonseed hull pellets	---	12.3
Whear middlings	5.2	---
Canola meal	3.3	---
Starch	1.0	---
Molasses	---	3.0
Crude protein (CP)	21.7	19.5
NDF	15.1	25.3
ADF	5.4	13.5
Starch	42.7	35.3
Sugar	5.6	6.2
Ash	9.0	5.9

Comments about starters:

- **Texturized** had 47.2 % texture from 37.1% whole corn and 10.1% whole oats which alone met the minimum of 45% recommendation (Ghaffari and Kertz 2021). Addition of 12.3% pelleted cottonseed hulls was not likely needed; and, basically, contributed little nutrients.
- Greater CP in pelleted CS may have helped "buffer" this starter versus lower CP in the texturized CS which had adequate CP. Deamination of amino groups from CP and amino acids in the acid rumen environment results in each amino moiety taking up 2 hydrogen ions to form ammonium. This reduction in hydrogen ions in the rumen either keeps it from becoming more acidic or elevates the pH (Kertz 2010).
- Greater NDF and ADF in texturized CS was due mostly to cottonseed hills.
- These hulls also contributed to lower starch in texturized CS versus greater corn and added starch in pelleted CS.

Figure 1a. DM , NDF, starch, and nitrogen intakes by ages 5 to 15 weeks and pelleted (Pel) vs texturized (Tex) calf starters.

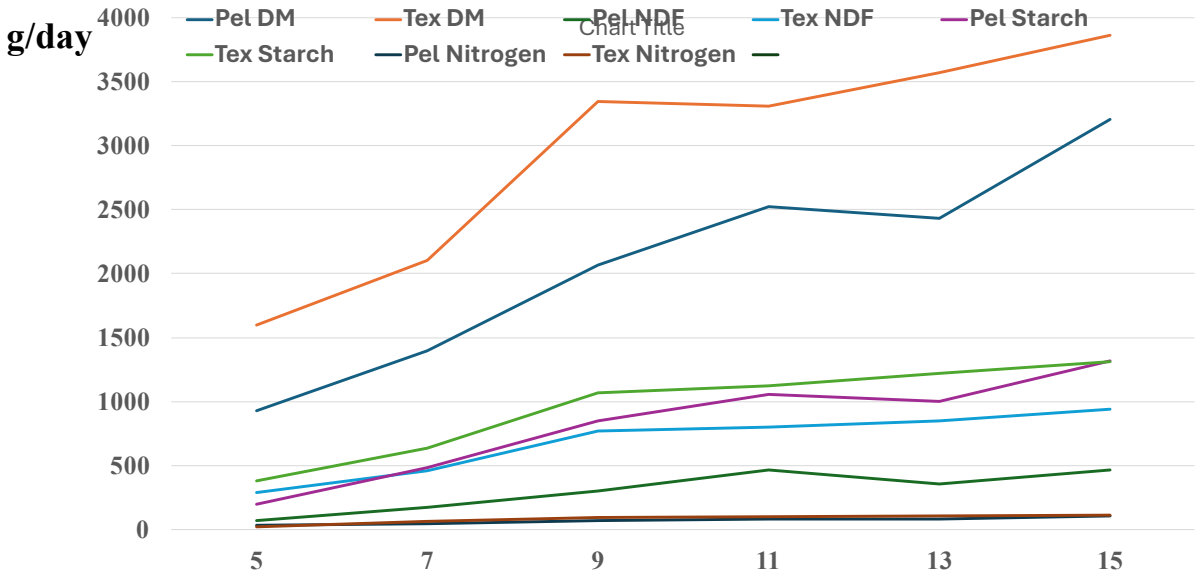


Figure 1a shows that the texturized versus pelleted CS had:

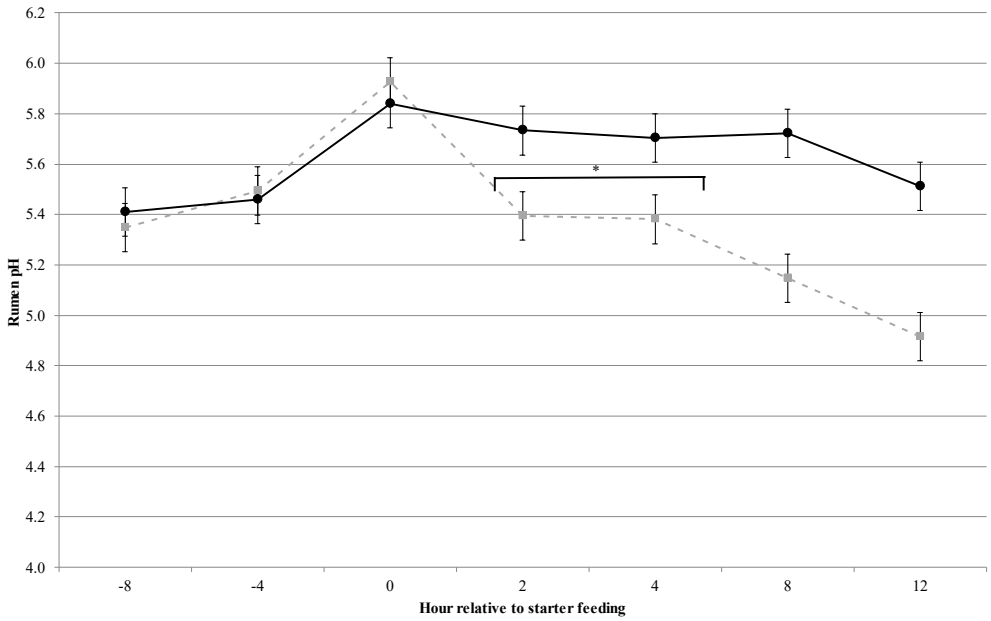
- consistently greater dry matter (DM) intakes across the weeks of the study
- correspondingly greater NDF intake because of the pelleted cottonseed hulls
- greater starch intakes
- greater nitrogen intakes, except for week 5, even though the pelleted CS had greater % CP because calves consumed more of the texturized CS

Interestingly, the pelleted CS had greater (P < 0.01) DM, NDF (P < 0.07), starch and nitrogen digestibilities across time periods than the texturized CS. Now why would that be? I think it is primarily, if not solely, due to the 12.3% pelleted cottonseed hulls which have a low digestibility and nutrient content.

Not shown is that *in situ* digestibilities were similar to the other digestibilities noted just above. However, I think *in situ* values are limited because they do not allow eructation and rumination differences as seen by Porter et al., 2007 in evaluating pelleted versus texturized CS.

These same bull calves were also used in a companion study of rumina acidosis (Gelsinger et al., 2020). **Figure 1** shows pH values that are in the mid- 5 range except for the pelleted CS which decreased even further post feeding while the texturized CS fed calves pH increased from pre-feeding to the upper 5's before declining. Now these pH values may seem too acidic--and they are compared to that for cows. But rumina pH values are in the mid or low 5 range for preweaned calves (Kertz, 2019 p. 76). I think, and other such a Jeff Firkins of The Ohio State University (personal correspondence), agree that this seems to be due to lack of resident protozoa at that stage of life. Protozoa engulf starch which temporarily takes starch out of circulation in the rumen and moderates its fermentation rate in the rumen. Protozoa also have a high deaminase activity which we have already mentioned "buffers" the rumen. As protozoa become more established around 2 months of age, calves reached a more normal rumen pH.

Figure 1. Rumen pH over time after feeding.



Better ruminal pH seen in **Figure 1** resulted in greater CS intake (began feeding at week 1) for texturized CS beginning in week 2; and widening after weaning at 8 weeks (**Figure 2)**. Not surprisingly, calf body weight gain followed a similar pattern **(Figure 3)** with body weight difference widening out until the end of the study at 17 weeks. From **Figure 3**, I estimated that final body weight was about 72 lb more for texturized versus pelleted CS, which meant calves on the texturized CS averaged about 0.6 lb more daily gain over the 17 week period. Average daily gain for the texturized CS fed calves was about 2.3 lb while it was about 1.6 lb for the pelleted CS.

Figure 2. Calf starter (CS) intakes over weeks of age with solid line texturized and dashed line pelleted CS.

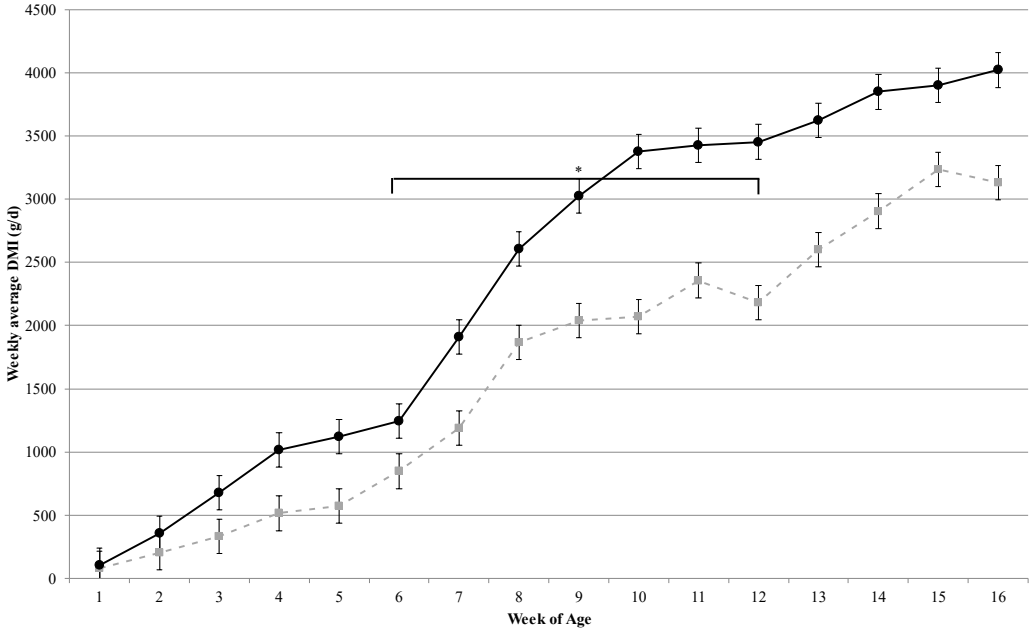
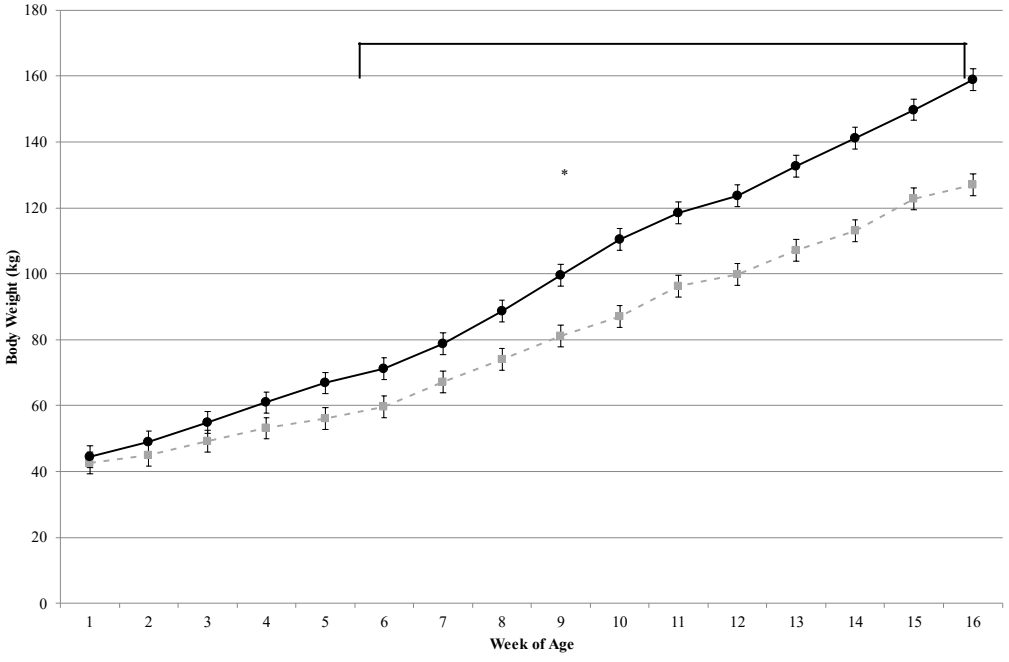


Figure 3. Calf body weights by age and treatments with solid line texturized and dashed line pelleted CS.



Comments:

- This study was a bit confounded because 12.1% pelleted cottonseed hulls were used in the texturized CS when it would have been better if the 7.1% whole corn grain and 10.1% whole oats were increased instead.
- Starch was 42.7% in the pelleted CS versus 35.3% in the texturized CS. Starch levels can be greater in the texturized CS because the greater whole grain particle size leads to earlier and more extensive rumination which facilitates more favorable rumen pH and digestibilities (Porter et al., 2007). The starch level in this pelleted CS was too high without feeding some roughage—which entails purchasing, chopping, storing, and feeding another feedstuff and more labor to do these functions. But a lower starch level in a pelleted CS may not provide better ruminal fermentation for a more favorable rumen papillae development and functional rumen development.
- Only 10 calves, 5 per treatment, were used in this study which limits some robustness in final data (Kertz and Chester-Jones 2004). However, extensive physiological and other data collected limits the number of calves which can be accommodated.
- These data, and others in the papers which I did not discuss, support the many benefits of a well-texturized vs a pelleted CS.

Thanks to Matt Akins and Sonia Arnold for providing data (Figure 1a) and Figures 1-3.

The Bottom Line

` This detailed and comprehensive study illustrated the benefits of a texturized versus a pelleted CS in intake, daily gain, rumen development and function. The science and art of producing well-texturized CS needs rejuvenation and practice (Kertz 2025).

References

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