Early Starter Intake by Nursery Calves: The Impact on Growth, Health, and Gastrointestinal Development

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Early starter intake is widely recognized as beneficial as it prepares the calf for weaning when all nutrients will be provided by dry feed. Benefits beyond additional nutrients in early life may also include medication incorporated into calf starter grains, and health effects such as less gastrointestinal upsets. Earlier life dry feed sources are most commonly grain, because of their fermentation to butyrate and propionate; the primary volatile fatty acids responsible for stimulating gastrointestinal development. However, post weaning, dry hay is often added to provide acetic acid to mediate acidic conditions in the rumen as grain consumption increases. However, response to acidosis is dependent on what point (or how much) starter are calves eating when this condition is created and what will be the outcome?

A recent study at the University of Minnesota evaluated the effect of starter grain consumption and gastrointestinal maturation. Eighteen bull calves were fed a nonmedicated, all milk protein, 22:20 milk replacer, at 1.5% of birth body weight, reconstituted to 12.5% solids. Calves were fed milk replacer twice daily until d 42 of life, once daily from d 43 to 49, and no milk was offered d 50 to 56, at which point calves were harvested. Calves had access to water and starter grain (19.9% crude protein, 38.0% starch) throughout the trial. Body weights (BW) and measurements were taken weekly, and fecal scores were taken thrice weekly. Harvested calf measurements included empty and full weights of stomach compartments, small intestine (SMI), and cecum, a rumen fluid sample, and tissue samples for further evaluation from the reticulo-rumen (RR) and SMI. Data were analyzed using PROC MIXED of SAS. Significance was declared at $P \leq 0.05$ and trends/tendencies at $0.05 < P \leq 0.10$.

Benchmarks of starter grain consumption were set at how long it took calves to consume 250 g/d, 500g/d, 1000g/d, and 2000g/d, and averaged 19, 24, 31, and 44 days, respectively. Fewer days to achieve all four benchmarks resulted in greater d 56 starter intake, BW gain, and greater SMI length. Fewer days to 500, 1000, and 2000 g/d resulted in greater RR tissue weight. Fewer days to 500 g/d tended to increase omasum tissue weight. Earlier starter grain intake therefore is beneficial to the development of the gastrointestinal system and results in a larger calf.

Interestingly, as total starter consumed by d 56 increased, SMI weight increased, but not length, revealing an increase in tissue mass or inflammation. Histology scores given for the duodenum on a 0 to 3 scale for mucosal appearance (0 = no thickening, 1 = mildly thickened, 2 = moderately thickened, 3 = markedly thickened) and villi appearance (0 = no inflammation, 1 = mildly inflammation, 2 = moderately inflammation, 3 = markedly inflammation) revealed that mucosal thickening and duodenal inflammation (presence of leukocytes and plasma cells) was mild to moderate in all calves. Thus, the increase in SMI weight may have been due to the inflammation observed. Furthermore, as starter grain consumption and inflammation increased, the presence of goblet cells located in the duodenum decreased. This may be due to the increase in inflammation causing sloughing of the epithelial lining of the GI tract. Because the

function of goblet cells is mucin production, fewer cells present may compound the inflammation.

Appearance of ruminal papillae was noted with the naked eye and microscopically and assigned a 0 to 3 score (0 = tall and slender, 1 = mildly blunted, 2 = moderately blunted, 3 = markedly blunted). Papillae scores were reaching mildly to markedly blunted, and 15 of the 18 calves were noted for papillae fusion. Papillae may fuse with rapid growth, and ultimately decrease the surface area available for nutrient absorption. These results indicate acidotic conditions in the calf. However, ruminal pH samples averaged 5.9. Cows are not considered to be acidotic until pH reaches 5.8, but with the high amount of inflammation and fusion occurring, calves may require a different benchmark for acidosis than cows.

At time of harvest, calves were consuming ~3.6 kg/d of high starch starter grain. Clearly, the gastrointestinal morphology was less than desirable, but at what consumption point should a fiber source be offered to mitigate these conditions? A benchmark of weaning calves when they consume 1.5-2 lbs of starter for 3 days is accepted, is this when hay should be introduced?

The quest for fast growing calves is often achieved through maximizing starter intake, but how much is internal development being compromised? Is the ruminant being created to maximize future feed efficiency and have a healthy gastrointestinal tract? Developing the rumen at such a rapid pace resulted in acidotic conditions and may necessitate the need for a fiber source at a benchmark amount of grain consumption.