Casein milk proteins:

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CASEIN proteins have both a high food value and a high typicality for them out of casein replacer (CMR) formulations. Direct skim milk is occasionally made available from government stores through inventory rotations. With recent increase in demand for milk protein components, milk protein concentrate and other milk protein sources are utilized in CMR formulations. Whey proteins from cheese manufacturing are the usual source of proteins for CMR.

Since milk is expressed from cheese curd formation, it contains no caseinate proteins and does not form curds in the abomasum of a calf. Veterinarians must read the CMR label to determine if curd-forming proteins are utilized in the product. Mireille et al. (1984) demonstrated that curd formation occurs at very low concentrations of caseinate protein, utilizing a 3% caseinate solution for their experiments. Field experience indicates that concentrations of caseinate protein that will form visible curds within the lumen of the abomasum.

Caseinate proteins’ physical form in whole milk is casein micelles. These micelles contain calcium, potassium, sodium, and magnesium ions in chemical association with specific caseinate proteins. Normally, curd-forming colloidal calcium phosphate, which is best visualized as a mineral-based adhesive, is formed from the whey proteins.

Although these authors did not identify diarrhea in calves with reduced curd formation in the abomasum reduced when abomasi were collected. The authors noted that nutrient retention in the abomasum with curd curd formation was greater than nutrient retention measured in calves that were cannulated in the duodenum. The data they collected were considered the best data set possible from intact, physiologically normal calves. The authors postulated that retention of both crude protein and crude fat within milk curd formations in the abomasum allowed more time for gastric acid and enzyme action, resulting in the gradual release of these important nutrients into the small intestine for further digestion.

The authors noted the benefits are due to the smaller quantities over several hours of these important nutrients into the small intestine for further digestion. For control calves, curd formation was assessed in vitro for each daily milk feeding. Milk was taken from a lactating Holstein herd. These important nutrients into the small intestine for further digestion. For control calves, curd formation was assessed in vitro for each daily milk feeding. Milk was taken from a lactating Holstein herd. The famotidine calves recorded significantly higher average daily gain and percent of bodyweight gain than control calves at any time post-feeding. Famotidine-treated calves did not demonstrate curds in the abomasum at two (P < 0.05), four (P < 0.01), and six (P < 0.01) hours post-feeding compared to other sampling times (P > 0.01). At 14 days, curd formation scores were significantly higher in the control calves at two (P < 0.01), four (P < 0.01), and six (P < 0.01) hours post-feeding.

Cruywagen and Brissan (1990) conducted an elaborate experiment evaluating the impact of curd formation in an anatomically intact Holstein calves that were two to four days of age. No duodenal cannulation was performed, but rather, all of the abomasum was surgically removed, intact from four animals each, at one, two, four and six hours post-feeding. Abomasal curd formation was prevented at one-hour abomasal pH of 4.5 by precipitation of calcium with an oxalic acid-sodium bicarbonate buffer solution prior to feeding. Calf growth was followed and retention of both crude protein and crude fat within milk curd formations in the abomasum reduced significantly and resulted in much less structured and smaller milk curds. Abomasal pH was not altered.

The authors determined that curd formation in the abomasum is the amount of digesta released to the duodenum and resulted in a slower release of both crude protein and crude fat. This effect was noted at each of the time periods post-feeding when abomasals were collected. The authors noted that nutrient retention in the abomasum with curd curd formation was greater than nutrient retention measured in calves that were cannulated in the duodenum. The data they collected were considered the best data set possible from intact, physiologically normal calves. The authors postulated that retention of both crude protein and crude fat within milk curd formations in the abomasum allowed more time for gastric acid and enzyme action, resulting in the gradual release of these important nutrients into the small intestine for further digestion. Other authors have noted the same phenomena and also reported beneficial effects of abomasal curd formation on nutrient digestibility and weight gain, further postulating that the benefit is due to the slower release of nutrients from the abomasum (Hill et al., 1970; Gourley, 1972; Roy, 1974; Jenkins et al., 1980; Jenkins and Enmons, 1982; Nokajczuk and Zielinski, 1983). All of these authors reported a higher frequency of diarrhea in calves with reduced abomasal curd formation.

In reported data, some comparing whey/casein-blended CMRs, reduced curd formation did not impair digestibility or call performance (Blouchard et al., 1973; Thivend et al., 1980; Petit et al., 1989; Cruywagen et al., 1990). Cruywagen and Hoorn (1991) reported no significant impact of reduced curd formation on bodyweight gain. The authors noted that the reduction in curd formation was prevented by or reduced. Calcium precipitation prior to feeding does inhibit curd formation, but this process does not inhibit gastric acid and enzyme action, although it does reduce retention time in the abomasal. As reported formation in a call consuming only whey protein sources is immaterial (Capper et al., 1992).

Field assessments

Practicing food animal veterinarians have been trained to evaluate the quality of CMRs that contain caseinate proteins — i.e., those formulated with skim milk, dried milk or milk protein concentrate — by assessing milk curd formation in the abomasum. CMR ingredients that were poorly processed with excessive heat and drying are denatured to the extent that insoluble complexes of casein proteins and lactose caramelize the protein via the Maillard reaction (Adrian, 1974; Pronczuk et al., 1973; Oste and Østensen, 1984). These poorly processed casein proteins do not clot adequately in the abomasum and are not digested by the newborn. Veterinarians must review the ingredient list on a CMR label to determine if caseinate proteins are included in the formulation. CMRs manufactured exclusively with whey proteins will not clot in the abomasum, and their digestion is not dependent upon abomasal retention time. The lack of curd formation in the abomasum discovered in a call consuming only whey protein sources is immaterial (Capper et al., 1992).

Needed?

If the call has a functional abomasum and the caseinate proteins have not been denatured by the Maillard reaction, they will clot. Cud formation allows an extended time for gastric digestive processes to occur and for the controlled release of partially hydrolyzed caseinate proteins and milk fat into the duodenum. This physiologically controlled release of smaller quantities over several hours post-feeding may help resolve the problem of caseinate protein digestion. There is no need to prevent it.

The question arises concerning the impact of milk or CMR treated with citric acid for abomasal feeding. If the milk product or CMR contains caseinate proteins, would the citric acid chelate enough calcium to prevent curd formation in the abomasum? It is doubtful that citric acid would remove enough calcium to prevent all curd formation. There is still considerable curd formation in milk fed to calves.