Nutritional Strategies to Improve Colostrum Yield in Dairy Cattle

N. Litherland[1], W. Weich[1], L. Davis[2], S. Emanuele[2], and H. Blaloc[2]
[1]University of Minnesota, St. Paul, MN
[2]Quality Liquid Feeds, Dodgeville, WI

Moderate energy high fiber (MEHF) diets designed to prevent consumption of energy in excess of nutrient requirements by dairy cows prepartum have gained considerable popularity in the field over the past ten years. Although MEHF diets have reduced the incidence of metabolic disorders associated with excessive prepartum energy intake intermittent periods of alarmingly low colostrum yield has been identified as a key problem with MEHF diets. Reasons for periodically low colostrum yield are not clear but are likely linked to prepartum nutrition and management. There is a paucity of data describing factors regulating colostrum yield in dairy cattle, however, some investigations have been conducted in gestating ewes. Mellor et al. (1987) demonstrated that underfeeding energy to gestating ewes reduced prenatal udder development and colostrum yield and delayed the postnatal transition to milk production. Additionally, in these underfed ewes, the growth hormone to insulin ratio increased markedly during the last two weeks prior to lambing. There was a delayed decrease in circulating concentration of progesterone in the underfed ewes and the slow withdrawal of progesterone was associated with a delay in lactogenesis. Progesterone concentrations decreased before lambing in all ewes but in under-fed ewes the authors concluded that the decrease in progesterone was too small to initiate normal colostrum production. Perhaps dairy cows fed MEHF diets low in starch experience similar untimely hormone changes that reduce colostrum yield.

The absorption of maternal immunoglobulins (IgG) across the small intestine during the first 24 hours after birth, termed passive transfer, helps to protect the calf against disease until its own immune system becomes functional. Because producers rarely know the concentration of IgG in colostrum, it is currently recommended that calves be fed 10% to 12% of their body weight of colostrum at first feeding (4.5-5.4 kg for a 45-kg calf) to deliver 100 g of IgG. Therefore it is critically important to the health of the calf that an adequate amount of quality colostrum is available. In a recent national survey, it was reported that 19% of dairy heifer calves tested suffered from failure of passive transfer (NAHMS, 2007). In that same study, only 40% of heifer calves were reported to have been fed four or more quarts (~5.0 kg) of colostrum within the first 24 hours (NAHMS, 2007), indicating that increasing the volume of colostrum fed is still an area of opportunity for most dairy producers.

Sixty multiparous Holstein and crossbred cows, balanced by 305ME and parity, were used in a 2 × 2 factorial design (forage: wheat straw vs. grass hay and supplemental energy source: starch vs. sugar) for a combination of four prepartum treatments: 1) Wheat straw (WS) + corn (WSC) (12.5% CP, 42.2% NDF, 20.1% starch, 3.6% sugar and 1.45 Mcal/kg NE_L), 2) WS + molasses-based Liquid Feed (LF) (WSL) (12.7% CP, 41.8%NDF, 18.7% starch, 6.3% sugar and 1.45 Mcal/kg NE_L), 3) Grass hay (GH) + corn (GHC) (13.8% CP, 37.8%NDF, 20.1% starch, 5.1% sugar and 1.56 Mcal/kg NE_L), 4) GH + LF (GHL) (13.9% CP, 37.4%NDF, 18.7% starch, 7.9% sugar and 1.56 Mcal/kg NE_L). The LF diets provided 2.7% of diet dry matter as supplemental sugar. Prepartum diets were formulated to meet NRC, 2001 recommendations at 12.7 kg DMI/d. Treatments were fed from dry-off until calving; 41 ± 2.0 days. Data were analyzed using Proc Mixed in SAS with a factorial arrangement of treatments. WSC and GHC tended ($P = 0.08$) to consume more starch and WSL and GHL cows consumed more ($P < 0.05$) sugar prepartum. DMI averaged 13.3, 12.8, 15.0 and 13.6 kg/d SEM = 0.9; $P = 0.45$), calf birth weight averaged 46.1, 48.3, 49.1, 48.0 kg ($P = 0.91$; SEM = 3.0) and first-milking colostrum yield averaged 9.2, 9.6, 9.0, and 10.9 kg for WSC, WSL, GHC, and GHL ($P = 0.67$; SEM = 1.6). Among treatments, 13.3% of cows produced < 5.0 kg of colostrum. Second milking colostrum DM was higher for sugar vs. starch supplement ($P < 0.05$). Pearson correlations for colostrum yield, prepartum intake of DM, OM, CP, NDF, ADF, starch, and DMI one week prepartum were not significant. Colostrum yield tended to be positively correlated with prepartum sugar intake ($P = 0.07$). Colostrum DM % tended to be higher for WSL compared with WSC ($P = 0.07$; SEM = 1.2) and averaged 26.6, 31.1, 30.8, and 28.3 for WSC, WSL, GHC, and GHL. Liver triglyceride and colostrum yield were positively correlated ($P < 0.05$) on d 7, 14 and 28 postpartum. Colostrum yield and circulating NEFA were positively correlated ($P < 0.05$) at 7 d prepartum and 1 d postpartum.

A summary of colostrum yield from two research studies conducted at the University of Minnesota in which 120 multiparous cows were fed MEHF diets showed that twenty seven percent of cows failed to produce at least 5 kg of colostrum (Figure 1). Our labs future research will focus on understanding relationships between prepartum nutrition and colostrum yield.

In summary, prepartum dietary sugar supplementation tended to increase colostrum yield and colostrum solids yield. Other factors regulating colostrum yield should be investigated further. Colostrum yield may be a predictor of circulating NEFA and liver triglyceride and could serve as a tool to identify cows that are at risk for excessive liver lipid deposition. Using colostrum yield as a tool for identification of at risk cows may provide an opportunity to employ management strategies to reduce the risk of metabolic disorders in these individuals.

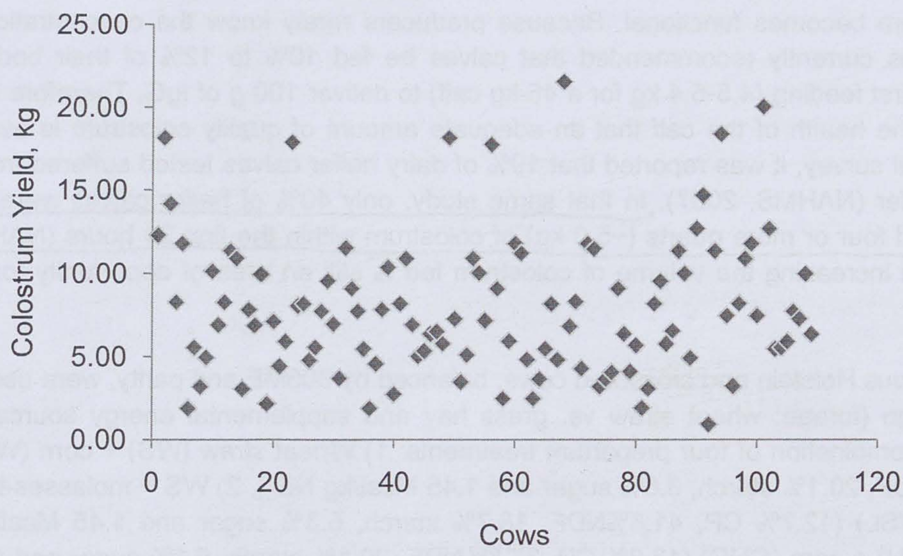

Figure 1. Colostrum yield for 120 cows on two research trials conducted at the University of Minnesota Dairy Teaching and Research facility in 2009 and 2010.