# Milk Production and Nitrogen Utilization in Dairy Cows Fed Lactose as a Partial Replacement for Barley Starch

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Because sugars are more rapidly fermented in the rumen compared to starch, partial replacement of cereal grain starch with sugar could potentially improve ruminal nitrogen (N) efficiency by increasing the rate of energy supply for microbial protein (MP) synthesis. Our objective was to determine the effects of partial replacement of barley starch with dried whey permeate (DWP; lactose content of 83%) on DMI, milk yield and composition, ruminal fermentation characteristics, whole-body urea-N kinetics, and MP synthesis in dairy cows.

Eight Holstein cows (97 ± 10 days-in-milk; 733 ± 63 kg body weight) were used in a replicated 4 × 4 Latin square design with 28-d periods (18 d of adaptation and 10 d of measurements). Four cows in one Latin square were ruminally-cannulated to facilitate ruminal and omasal digesta sampling. Cows were fed a barley-based diet (3.5% total sugar [TS]; control), or diets that contained 6.5, 9.5 or 12.5% TS (DM basis). Dietary TS content was manipulated by adding DWP, which is a rich source of lactose. Diets were isonitrogenous (17.2% CP) and, by design, starch content of the control, 6.5, 9.5, and 12.5% TS diets were 24.3, 22.2, 21.2 and 19.1%, respectively.

Dietary treatment did not affect dry matter intake (mean = 26.6 kg/d), milk yield (mean = 34.9 kg/d), and milk protein and fat contents. As dietary TS increased, we observed a linear decrease ($P$ = 0.03) in ruminal ammonia-N concentration (12.1, 12.3, 10.9, and 9.4 mg/dL), whereas ruminal concentration of butyrate (12.8, 13.0, 14.1, and 14.9 mmol/L) linearly increased ($P$ = 0.04). Mean ruminal pH tended to change quadratically as dietary TS content increased. Dietary inclusion of DWP quadratically altered absolute amounts of both endogenous production and urinary elimination of urea-N. Although urea-N recycled to the gastro-intestinal tract tended to change in a quadratic manner, diets did not affect anabolic utilization of recycled urea-N. Omasal flow of bacterial N changed in a quadratic manner (with a peak attained at 9.5% TS content) when DWP partially substituted barley starch.

**Implications:** These results suggest that a dietary TS level of 9.5% potentially improves ruminal N efficiency by decreasing ruminal ammonia-N concentration and increasing omasal flow of bacterial N (i.e., increasing MP synthesis) in dairy cows fed DWP as a partial replacement for barley starch; however, production performance was unaffected.