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## Starch in Dairy Cattle Diets During Times of High Corn Prices

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Increased corn prices have created great interest in the potential for feeding reduced-starch diets. One option for formulating reduced-starch diets is to partially replace corn grain with high-fiber, low-starch byproduct feedstuffs. Another option is the partial replacement of corn grain with corn silage to reduce purchased feed costs, also resulting in reduced-starch diets.

### Effects on Milk Production

Lactation performance responses to reduced-starch diets from four recent continuous-lactation experiments are reviewed in this article. Three trials were from University of Wisconsin-Madison (UW; Gencoglu et al., 2010; Ferraretto et al., 2011a,b) and evaluated high-fiber, low-starch byproduct feeds as partial corn grain replacers, while a trial from the Ohio Agricultural Research and Development Center (OARDC; Weiss et al., 2011) evaluated the partial replacement of corn grain with corn silage. The neutral detergent fiber (NDF) from forage concentrations were 20 to 21 percent across all diets with 5 to 10 percent units less starch for reduced-starch (RS) than normal-starch (NS) diets in the UW trials. For the OARDC trial, NDF from forage concentrations were 23 and 26 percent for the NS and RS diets, respectively, with 5 percent units less starch for RS than NS diets. Across the four trials, the earliest and latest days in milk (DIM) at trial initiation were 51 and 114 days, respectively, and treatment length ranged from 10 to 14 weeks. Milk yield for cows fed the NS diet ranged from 38 kg to 52 kg/cow/d across the four trials.

### Changes in Dry Matter Intake

Dry matter intake (DMI) was greater for RS than NS in the UW trials, but lower for RS than NS in the OARDC trial. Greater DMI for RS than NS in the UW trials may be related to reduced ruminal propionate concentration (Allen, 1997; Beckman and Weiss, 2005) leading to increased meal size and consequently greater DMI (Allen et al., 2009). Firkins (1997) suggested that increased digestibility and passage rate of byproduct NDF can allow for increased NDF intake relative to forage NDF, which could explain the difference in DMI response for RS between the UW trials and the OARDC trial. In other words, rumen fill likely limited DMI in the OARDC trial (23 to 26 percent NDF from forage), but not in the UW trials (20 to 21 percent NDF from forage), where metabolic control of DMI appears to have been more likely (Allen et al., 2009).



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## Milk Yield Responses

Actual milk yield was similar for cows fed RS and NS in the UW trials with soy hulls (SH) (Gencoglu et al., 2010; Ferraretto et al., 2011b), but tended ( $P < 0.07$ ) to be 4 percent lower for RS than NS in the UW trial with whole cottonseed (WCS) and wheat middlings (WM; Ferraretto et al., 2011a). Because WCS and WM are moderate-protein ingredients, they partially replaced both corn grain and soybean meal (SBM) in the RS diet. Greater ruminal protein degradation for these ingredients compared to SBM along with reduced rumen microbial protein production for RS may have decreased metabolizable protein flow, which could partially explain the decrease in milk yield (NRC, 2001). Actual milk yield was lower ( $P < 0.05$ ) for RS than NS in the OARDC trial and was consistent with the DMI response in that trial. Responses for milk yield corrected for concentrations of fat, protein and lactose (solids-corrected milk, or SCM) were inconsistent for the UW trials with either greater ( $P < 0.03$ ; Gencoglu et al., 2010), trend for lower ( $P < 0.08$ ; Ferraretto et al., 2011b), or similar ( $P > 0.10$ ; Ferraretto et al., 2011a) SCM observed for RS compared to NS. The SCM yield was lower ( $P < 0.05$ ) for RS than NS in the OARDC trial and was consistent with the actual milk yield and DMI responses in that trial. Body weight gain was not different for cows fed RS compared to cows fed NS across the four trials.

## Feed Efficiency Results

Feed efficiencies, across the four trials, were reduced for RS compared to NS by 5 to 12 percent for milk/DMI and by 4 to 11 percent for SCM/DMI. Reduced feed efficiency (FE) for dairy cows fed RS diets creates an economic concern for nutritionists desiring to use this formulation strategy to reduce diet cost per unit of dry matter (DM). Midwest USA Spring-2011 market prices for feed ingredients and milk were applied to ration composition, DMI and milk production data from the four trials to estimate feed costs and income over feed cost (IOFC). Feed costs per unit DM were reduced in all trials by 3 to 8 percent for RS. Feed costs per cow per day for RS, however, were increased for two trials by 3 to 5 percent and decreased for two trials by 5 to 10 percent. Estimates of IOFC were unaffected in one trial, increased in one trial by 4 percent for RS, and decreased in two trials by 6 to 7 percent for RS.

FE and IOFC results indicate that for high-producing cows in early to mid-lactation, partially replacing corn grain with NDF from either high-fiber byproducts or corn silage to formulate RS diets was not beneficial. Reduced market prices for high-fiber byproducts relative to corn grain and soybean meal would improve the economics of feeding RS compared to NS diets. Use of higher-quality corn silage with reduced NDF content and (or) greater NDF digestibility when partially replacing corn grain with corn silage in RS diets may improve responses compared to the trials reviewed herein, and further research is warranted. Furthermore, RS diets formulated by partially replacing starch with fiber may offer more potential for beneficial responses when fed to lower producing, later lactation cows than evaluated in the trials reviewed herein; potentially less concerns about rumen fill limitations to DMI and milk yield when partially replacing starch with forage NDF or reduced FE when partially replacing starch with byproduct NDF (Allen, 2008).



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