Chapter 18

Use of Reduced-Oil DDGS in Dairy Cattle Diets

Introduction

“Typical” DDGS contains 10 to 12% crude fat and can be fed to lactating dairy cows at levels up to 30% of dry matter intake, without negatively affecting milk yield or milk fat content (Schingoethe et al., 2009). However, despite these research results representing numerous experiments, dairy nutritionists have been reluctant to feed more than 10 to 20% of dry matter intake because of concerns of possible depression in milk fat content.

Results from a survey of 10 dairy cattle nutritionists showed that the primary reason that distillers grains was restricted in dairy diets was due to its high fat content, and half of these nutritionists believed that the high concentrations of unsaturated fatty acids in distillers grains reduced fat content of milk (Owens, 2009). Furthermore, almost all (90%) of these nutritionists indicated that the dietary inclusion rate of distillers grains could be increased in dairy diets if a portion of the oil was removed, but believed that the cost of distillers grains should be reduced proportionately based on the reduction in energy content due to oil extraction. These nutritionists estimated that the price of oil extracted distillers grains should be reduced by 2 to 50% (average 24%). These results are consistent with those of 2 other surveys showing that variation in crude fat content of distillers grains was a concern to dairy producers (NASS, 2007), and fat content was a significant factor in their decisions about using distillers grains in their diets (Garcia, 2012, personal communication).

Results from these surveys clearly indicate that high fat content and high concentrations of unsaturated fatty acids in distiller’s grains are a primary concern for dairy nutritionists and dairy producers. Therefore, partial oil removal from DDGS is an advantage for lactating dairy cows and may allow increased dietary inclusion rates in order to avoid excess total dietary fat and its potential negative effects on milk fat concentration and yield.

Relationship of fatty acid composition in distiller’s grains and their effects on the rumen environment

The oil in distillers grains is comprised primarily of unsaturated fatty acids, with linoleic acid (C18:2) and oleic acid (C18:1) representing 59% and 25% of total fatty acid content, respectively. Bauman and Griinari (2001) showed that the presence of unsaturated fatty acids in the rumen and an altered rumen environment causing incomplete bio-hydrogenation are the two conditions that can reduce milk fat. The unsaturated fatty acid concentration in the rumen is a major factor that contributes to changes in the microbial population and an increase in the conjugated linoleic acid isomer trans-10-cis-12 (Jenkins et al., 2009), which, along with other intermediaries, are potent inhibitors of milk fat synthesis (Griinari et al., 1998). In addition, the free fatty acid content of oil in distiller’s grains can negatively affect rumen fermentation (Jenkins et al., 1993). Chalupa et al. (1984) showed that when fatty acids are supplied as triglycerides to the diet, there were no significant changes in rumen fermentation, but when free fatty acids were fed, production of propionic acid increased and the production of acetic, butyric, and total volatile fatty acids decreased. Therefore, free fatty acids affect rumen fermentation more than triglycerides, and their antimicrobial activity increases with their degree of unsaturation. Moreau et al. (2011) reported that the free fatty acid content of DDG and DDGS was 7.4% and 9.1%, respectively, compared to corn with 2.3%. Noureddini et al. (2009) reported similar concentrations of total free fatty acids (7.4%) in distillers grains, with the majority (75%) being unsaturated free fatty acids. Therefore, the concentration of free fatty acids in distillers co-products is an important consideration relative to dietary inclusion rates and potential impact on milk fat concentration and yield.

Effects of feeding reduced-oil DDGS on milk production and composition

One study has been published related to the effects of feeding reduced-oil DDGS (RO-DDGS) on milk production and composition in lactating dairy cattle, but no studies have been conducted to determine the effect of DDGS oil extraction on net energy content. Researchers at South Dakota State University (Mjoun et al., 2010a) evaluated lactation performance and amino acid utilization of cows fed increasing amounts of RO-DDGS. Four diets containing 0, 10, 20, or 30% RO-DDGS (on a dry matter basis) and replacing soybean meal, were fed to 22 multiparous and 19 primiparous Holstein cows for 8 weeks. Reduced-oil DDGS contained 34.0% crude protein, 42.5% NDF, 3.5% crude fat, and 5.3% ash.

There was no effect of increasing levels of RO-DDGS on dry matter intake, crude protein intake, or milk production (**Table 1**). Milk production efficiency (defined as energy-corrected milk divided by dry matter intake) tended to increase linearly with increasing levels of RO-DDGS in the diet, but efficiency of nitrogen utilization was not affected. Milk fat percentage increased, and milk fat yield tended to increase linearly with increasing levels of RO-DDGS, whereas milk protein percentage responded quadratically (2.99, 3.06, 3.13, and 2.99%, respectively for diets containing 0 to 30% RO-DDGS), and protein yield was not affected (**Table 1**). Total percentage of milk solids increased, and total milk solids yield tended to increase linearly as the diet inclusion rate of RO-DDGS increased.

Table 1. Dry matter intake, milk yield, and milk composition of dairy cows fed increasing levels of reduced-oil DDGS (RO-DDGS) .

	0% RO-DDGS	10% RO-DDGS	20% RO-DDGS	30% RO-DDGS
Dry matter intake, kg/day	22.7	23.0	23.7	22.2
Crude protein intake, kg/day	4.0	4.1	4.2	4.0
Milk yield, kg/day	34.5	34.8	35.5	35.2
Milk production efficiency[1, 2]	1.47	1.53	1.49	1.61
Nitrogen efficiency[3]	25.5	27.0	25.8	26.0
Milk fat, %[4]	3.18	3.40	3.46	3.72
Milk fat yield, kg/day[4]	1.08	1.19	1.23	1.32
Milk protein, %[5]	2.99	3.06	3.13	2.99
Milk protein yield, kg/day	1.03	1.07	1.10	1.06
Milk total solids, %[4]	12.10	12.39	12.40	12.67
Milk total solids yield, kg/day[2]	4.15	4.35	4.43	4.45

[1]Milk production efficiency = energy-corrected milk divided by dry matter intake.
[2]Linear increase ($P < 0.06$)
[3]Nitrogen efficiency = milk N (kg/day)/N intake (kg/day).
[4]Linear increase ($P < 0.05$).
[5]Quadratic effect ($P < 0.02$).

These researchers concluded that adding up to 30% RO-DDGS (dry matter basis) to mid-lactation Holstein cows did not adversely affect milk production or dry matter intake, and increased milk fat percentage and yield. Although feeding up to 30% RF-DDGS supported similar lactation performance as the 0% RO-DDGS, soybean meal diet, amino acid balance may have been optimal when 20% RO-DDGS was fed. However, in a subsequent study, Mjoun et al. (2010b) evaluated ruminal degradability and intestinal digestibility of protein and amino acids in soybean meal, extruded soybeans, and corn distillers grains co-products (DDGS, high-protein DDG, modified wet distillers grains with solubles, and RO-DDGS) and concluded that the amino acid availability from distillers grains co-products is comparable to that of soybean meal. This indicates that RO-DDGS has similar protein digestibility and amino acid utilization compared to other distillers co-products, soybean meal, and extruded soybeans.

Kalscheur (2005) conducted a meta-analysis of 24 experiments and found that “typical”, high fat distiller’s grains only cause a milk fat depression when diets contained less than 50% forage or provided less than 22% NDF from forage. Therefore, RO-DDGS will have less effect on modifying the rumen environment and reducing milk fat concentration and yield.

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