Dairy Technical Bulletin

Impact of NFC Source on Metabolizable Protein Production and Animal Performance

Stephen M. Emanuele Ph.D. PAS - QLF Dairy Business Development Manager

The objective for this short article is to present evidence that NFC sources do not have the same impact in the rumen and you can influence metabolizable protein supply by using specific NFC sources in the diet. The traditional approach to NFC is that all NFC is equal as long as it gets fermented in the rumen. An example of this approach is formulating diets for a specific NFC % or amount of NFC. For example, many nutritionists will formulate diets for 38 – 42% NFC and supply 20 – 22 pounds of NFC as part of diet dry matter. The new concept or idea is that the type of NFC does matter in the diet and that the value of certain NFC sources is dependent on ruminal pH. For example, the fermentation of pectin and beta-glucans are pH dependent. If you have a high ruminal pH (> 6.5), the fermentation of pectin and beta-glucans is extensive and these carbohydrates can replace NFC from corn and corn silage. If ruminal pH is low (< 6.0), then the fermentation of pectin and beta-glucans in the rumen is reduced and you generate less microbial growth and less microbial protein from these carbohydrates. The implication is that when ruminal pH is low, feeds such as beet pulp, citrus pulp, barley silage and alfalfa silage will generate less microbial growth and less microbial protein then feeds containing starch and sugar as their major NFC type.

Feeds that Lower Ruminal pH.

Since ruminal pH does influence the value of certain NFC sources, it is important to understand which NFC sources are most likely to depress ruminal pH. Ruminal pH is depressed when the production of volatile fatty acids from ruminal fermentation exceeds the metabolism and absorption of these volatile fatty acids. The most potent acid is lactic acid and a short term build up of lactic acid in the rumen will depress ruminal pH. When ruminal pH falls to less than 6.0, fiber fermentation is depressed, rumination is decreased and the environment in the rumen favors the growth of ***Streptococcus Bovis*** and other bacteria that thrive at low ruminal pH. These organisms that thrive at low ruminal pH produce lactic acid as the main end-product of carbohydrate fermentation and thus they continue to keep ruminal pH below 6.0. To prevent a drop in ruminal pH use NFC sources in your diets that generate acetate and butyrate as the end-products of carbohydrate fermentation and use NFC sources that stimulate the growth of bacterial species that utilize lactic acid as an energy source. Starch is one NFC source that when fermented in the rumen can lead to the production of lactic acid and a decrease in ruminal pH. When sugars are used in the diet at 10% or less of diet DM, ruminal pH is higher compared to diets containing high concentrations of starch because the end-products of sugar fermentation are butyrate and acetate and these acids do not depress ruminal pH to the same extent as lactic acid. Sugars also stimulate the growth of the lactic acid utilizing bacteria ***M. Elsdenii*** and the growth of rumen protozoa and rumen fungi. These changes in the rumen ecosystem lead to higher ruminal pH when sugars are fed in the diet in place of starch.

NFC Source Does Effect Animal Performance.

The feeding of dairy cattle is a mixture of art and science and we learn the art through experience and trial and error. Some of the art in feeding dairy cattle is learning about associative feed effects. Associative feed effects occur when the combination of two or more feeds has a positive or negative effect on animal performance or rumen function. The most well know associative feed effect is the reduction in forage intake and NDF digestibility when too much starch is added to the diet. Another associative feed effect is the impact of condensed corn distiller's syrup (CCDS) and condensed corn steep liquor (CCSL) and feeds containing them on rumen function and animal performance. Both CCDS and CCSL supply a mixture of amino acids, peptides, sugar, and microbial enzymes that has been shown to stimulate microbial growth in the rumen. Data from a paper published in the August 2010 issue of the J. Dairy Science illustrates the concept that NFC source can influence metabolizable protein yield and animal performance. Metabolizable protein comes from microbial protein production in the rumen and dietary protein that escapes from the rumen and is digested and absorbed in the small intestine. In most diets, microbial protein accounts for 50 – 55% of the metabolizable protein yield. So feeds containing CCDS and CCSL influence metabolizable protein yield by having an impact on microbial protein yield in the rumen. In the J. Dairy Science paper, NFC from ground corn and corn silage is replaced by NFC from wet distiller's grain, wet corn gluten feed or two combinations of wet distiller's grains and wet corn gluten feed. Even though the diets contained the same CP and predicted ME and MP contents, there were significant differences in animal performance on the diets. Based on animal performance, diets containing 15% wet distiller's grains (WDGS) or a combination of wet distiller's grains and wet corn gluten feed (WCGF) at 15% or 30% of diet DM, resulted in more ME and MP available for milk production compared to the control diet. This is an example of a positive associative feed effect. The replacement of corn grain with WDGS and WCGF had a positive effect on milk yield and milk protein production. Milk production efficiency (4% FCM/DMI) was 1.75 on the control diet and 1.79 on the diet with 15% WCGF and 1.77 on the diet containing 7.5% WDGS and 7.5% WCGF. There was a trend *(P =0.10)* for lower milk production efficiency (1.63) on the diet that contained 15% WDGFS and 15% WCGF. This lower efficiency was due to a DMI of 56 pounds on this diet compared to a dry matter intake of 49 pounds on the control diet. Cows consuming diets containing WDGS and a combination of WDGS and WCGF produced 5.8 – 7 pounds more milk than cows on the control diet. Based on milk yield and milk components, the most profitable diets in this trial contained a combination of WDGS and WCGF. How can we explain these differences between diets? Diets containing WDGS and WCGF would be higher in sugar, lower in starch, higher in organic acids and other fermentation byproducts. Sugar and some organic acids such as malic acid have been shown to stimulate the growth of rumen organisms. Based on estimates of microbial protein yield from the excretion of purine derivatives, diets containing WDGS and WCGF generated more microbial protein then the control diet. The excretion of purine derivatives was significantly lower on the control diet compared to the other 4 diets *(P = 0.04)*. The diet containing 15% WDGS and 15% WCGF would supply 0.63 pounds of sugar from these feeds. The diet containing 15%WCGF would supply 0.34 pounds of sugar from this feed. Estimated microbial protein production on these diets (WCGF15 and WDGS+WCGF 30M) was between 4.42 and 4.5 pounds which was 13 – 15% higher than the control diet. This implies that these diets generated more MP than the control diet. Take home messages from this trial are that: 1. WDGS and WCGF contain compounds that stimulate microbial growth in the rumen more than starch from corn grain and 2. NFC source in the diet does influence DMI and milk yield and milk components.

Impact of Molasses, Sugar and Liquid Feed on Animal Performance.

When one reviews the recent research where starch from corn was replaced by sugar from molasses or liquid feeds, it is clear that sugar impact the rumen differently than starch. In 6 of 7 trials, dry matter intake was increased when sugar replaced starch in the diet. This supports the belief that high starch diets depress feed intake because high concentrations of propionate reach the liver and this leads to the liver sending signals to the brain to reduce feed intake. High sugar diets increase butyrate and not propionate and butyrate is used to synthesize milk fat and as an energy source by the rumen tissues. In 6 of 7 trials, when sugar replaced starch as part of the NFC in the diet, milk fat yield was increased (Avg. = +0.17 lb). This may be caused by greater NDF digestibility which has been reported in some feeding trials with molasses. In 5 of 7 trials, replacing starch from corn with sugar from molasses or liquid feed may have generated more ME from the diet because in 5 of 7 trials milk yield was increased by more than 2 pounds. The average increase in milk yield across all 7 trials was 4 pounds. The greatest responses occurred in diets that contained 50% or more forage. The poorest response occurred on a diet with 44% forage and all the forage was from corn silage. This diet was low in forage NDF % and effective fiber.

What Makes QLF Liquid Feeds Different From Corn and Soybean Meal?

QLF liquid feeds do contain Louisiana sugar cane molasses but it is the combination of this molasses with CCSL, CCDS and condensed whey that cause the observed animal responses. The sugars in the cane molasses stimulate microbial growth and the organic acids and fermentation byproducts in the CCSL and CCDS further stimulate microbial growth. The condensed whey supplies lactose and natural protein. The lactose is converted to butyrate and the natural protein in whey supplies amino acids to the rumen bacteria. When QLF liquid feeds are used in the diet there is less ration sorting and higher forage intake and this leads to a healthier rumen ecosystem. The result of a healthier rumen ecosystem is more DMI, less off-feed situations and more milk fat production.

Quality Liquid Feeds
3586 Hwy 23 North
Dodgeville, WI 53533
1-800-236-2345
www.qlf.com