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Does Feeding Distillers Grains to Dairy Cows Affect Milk Components?

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This NebGuide discusses whether milk production is affected by including distillers grains in the diets of dairy cows.

Introduction

Almost 5 billion gallons of ethanol are produced each year in the United States. This production results in more than 36 million tons of the feed byproduct, distillers grains. These feedstuffs are then marketed as wet distillers grains plus solubles or further dried, creating dried distillers grains plus solubles. The expected expansion of the corn-ethanol industry will result in even greater availability of distillers grains. This projected increase will continue to provide an increasingly cost effective source of energy and protein for dairy cows. The dairy cow's ability to utilize these fibrous, high protein feedstuffs aligns the dairy industry into a position to capture this emerging opportunity.

A common concern surrounding the inclusion of distillers grains into dairy diets is the potential negative effect on milk fat and protein synthesis. When fed at modest levels, distillers grains should not directly affect either. However, inclusion of this feedstuff into a poorly a balanced ration may have troubling consequences. Recent research surrounding the incorporation of distillers grains into dairy diets indicated that they may be included at 20 percent or more of the diet dry matter in well balanced diets without affecting total milk yield or milk components. Thus, when considering the inclusion of distillers grains into dairy diets, one should be aware of major factors known to affect milk protein and fat production and be sure to deliver a ration that avoids these negative consequences.

Milk Protein

Milk protein is a valuable component of milk and as a result considerable research has been conducted to determine the major factors affecting it. Probably the two most well understood factors affecting milk protein include ration energy and protein content and utilization. Because distillers grains are commonly added to rations to contribute both, the following discussion will attempt to outline how diets may be formulated to contain distillers grains may be fed without negatively affecting milk protein synthesis.

Dietary Protein

Amino acids are building blocks for both tissue and milk proteins. As a consequence, in order to synthesize protein the small intestine must absorb amino acids. These amino acids are primarily supplied by rumen bacteria and bypass protein. Recently our growing understanding of protein nutrition and utilization has lead us to consider the use and supply of individual amino acids during ration balancing procedures. Limiting amino acids are defined as those amino acids that are in shortest supply. Methionine is most limiting in rations that depend upon soy or animal protein for major rumen undegradable protein supply. In rations that are formulated to contain high of corn products, the supply of lysine is believed to be more limiting. In diets containing 20 percent distillers grains, the supplementation of ruminally protected lysine and methioine may result in an increase in milk protein percent and yield. When balancing diets containing high levels of distillers grains, nutritionists should evaluate the proportion of predicted lysine and methinone in the metabolizable protein fraction. More specifically, nutritionists should strive for a lysine to methionine ratio of 3.0:1.0. Although in most situations, this benchmark may be difficult to reach, nutritionists may improve the amino acid profile of the ration by increasing the inclusion rate of high lysine protein supplements such as fish meal or soy products.

Ration Energy Content

A substantial number of scientific studies have been conducted to evaluate the effects of energy intake on content and yield of milk protein. Most research has demonstrated this effect by increasing the amount of grain. Diets replacing corn and soybean meal with distillers grains have been demonstrated to have a higher available energy content. Although these differences may, in part, be explained by differing concentrations of fat, these diets also contain greater amounts of digestible fiber. Additionally, they also contain less starch and should result in lower ruminal lactic acid production and higher pH, ultimately reducing the risk and problems associated with rumen acidosis. Practically reducing the incidence of acidosis may increase ration digestibility and feed intake, two factors that result in an increase in energy supply to the animal.

Milk Fat

Although scientists have not fully discovered all of the possible causes of milk fat depression, over the last several years considerable research has focused on this problem and this information may be applied to practical ration balancing decisions. One purpose of this article is to outline critical factors that may affect milk fat production and should be considered when adding distillers grains to lactating cow diets. Probably the two most well understood factors are the type of fat included in the ration and the incidence of rumen acidosis.

High Levels of Unsaturated Fatty Acids

The structure of fat, or triglyceride, is composed of a three-carbon backbone structure called glycerol, with a fatty acid chain attached to each of the three carbons. Fatty acid chains vary in length and may be saturated or unsaturated. Saturated fats are named so because all bonds are saturated with hydrogen atoms. These are generally fats of animal origin (i.e. tallow), and are solid at room temperature. Unsaturated fats are so named because they have at least one double bond. Feeding ingredients that contain high levels of unsaturated fats are known to contribute to milk fat depression. These fats may be absorbed in the small intestine and ultimately impede the mammary gland's ability to produce fat. Some common feeds containing high concentrations of unsaturated fat include roasted soybean, whole cottonseed, sunflower seed, and corn distillers grains. It is now generally understood that a build up of the unsaturated fatty acid, linoleic acid in the rumen may lead to events that can cause milk fat depression. Distillers grains are a rich source of linoleic acid, but usually only cause milk fat depression when combined with other ingredients that are also rich in unsaturated fat. It is possible to formulate rations high in distillers grains without high levels of linoleic acid. Practically this may mean that the inclusion of feeds such as whole cottonseed or roasted soybeans are not included or fed in low amounts. If these ingredients are expected to supply protein, alternative sources that are lower in fat should be considered.

Although most of the distillers grains available today are high in fat, this should not always be assumed. The evolving ethanol industry is continually striving to maximize ethanol production efficiency and production of useable co-products. Changes associated with this progress will provide innovative new byproduct feeds that may be quite different than those commonly produced. For example, some byproducts of the ethanol industry may be produced and marketed to be lower in fat. These feedstuffs will be higher in fermentable fiber and, as a result, easily incorporated into a dairy ration. In addition, simple changes to plant production goals and production efficiency have a significant impact on the feeding value of byproducts produced. As a consequence of these changes the chemical composition of these byproducts should be analyzed so that producers and nutritionists do not rely upon inaccurate book values.

Rumen Acidosis

It is well known that diets that are either high in starch containing grains or deficient in coarse roughages may result in a decline in the concentration of fat in milk. Because both of these factors result in lower rumen pH, it is believed that cows experiencing rumen acidosis also produce milk with lower concentrations of fat. Why would rumen pH affect milk fat production? It is believed, at least in part, that this effect is due to some activity of rumen microbes. Rumen microorganisms hydrogenate unsaturated fatty acids, in a process called biohydrogenation. During this time, intermediate forms, or partially saturated fatty acids, may pass out of the rumen and be absorbed by the small intestine. Some of these intermediate forms (trans-10 fatty acids) negatively influence milk fat formation. Furthermore, the formations of these fatty acids are believed to be the direct result of rumen microbes operating in an low pH environment.

Given this understanding of rumen fermentation, several considerations should be taken into account when adding distillers grains to lactating cow diets. First, ensure the ration has adequate effective fiber. Effective fiber is that portion of the diet that is believed to stimulate rumination, chewing activity and saliva secretion. This should maintain healthy rumen function and normal pH levels. Effective fiber is usually greater in high fiber and coarse particle sized forages and low in fine particle sized feeds such as distillers grains. Nutritionists or dairy managers should not necessarily use this logic to infer that feeding distillers grains will result in lower rumen pH because rations may be formulated to contain distillers grains and adequate effective fiber. Each formulated ration should be evaluated to determine a possible risk of acidosis. It is important to also consider the total ration particle size using the Penn State Particle Separator. When using this device, be sure that at least 5 percent to10 percent of the particles are at least three quarters of an inch long and retained on the top sieve. In addition, no more that 20 percent should pass through the last sieve (measuring 0.07 inches) and land on the bottom pan. Furthermore, the diet should contain at least 26 percent NDF but high levels of distillers grains may result in total ration NDF to be as high as 35 percent.

As in all dairy rations, diets containing distillers grains should not contain high concentrations of grain. The National Research Council recommends that rations should contain 30 percent to 40 percent non-fiber carbohydrates. Currently many dairy nutritionists also evaluate the concentration of starch in the ration, with common recommendations ranging from a minimum of 21 percent to a maximum of 27 percent. It is important to point out that the cow's requirement is for energy and not starch per say. Consequently, starch levels at the upper end of these recommendations are not necessary to meet the energetic needs of the cow and may actually limit milk fat production due to rumen acidosis. In fact, distillers grains may be added to the diet as a low lignin and readily fermentable carbohydrate source. This practice, may in part, replace energy contributed by grain; and a diet including distillers grains may not need high levels of starch to supply needed energy.

Summary

The U.S. corn milling industry represents a valuable partnership in food and energy production. Dairy diets may contain high amounts of co-products such as distillers grains; but their addition may require some changes in the amounts and types of other ingredients included. In evaluating these rations, both nutritionists and producers should be mindful of the diets' supply of individual amino acids, fat and energy as well as the effects on rumen pH. In considering these factors, the dairy industry will be better equipped to handle the inevitable increase in the supply and availability of ethanol co-products.

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