Straight to the Bottom Line

The Art versus the Science of Feeding Dairy Cows, Part 3

By: Steve Martin

1/1/13

The past couple of months we have been discussing the art versus the science of formulating diets for dairy cows. We have noted some scientific and mathematical advances over the past 100 years that have changed the process significantly. In general, we detailed two mathematical approaches to calculating the nutrient composition of diets. The first of these has been the predominant method for diet formulation form many years and basically uses weighted averages of various nutrients to determine the value in the final diet. The second and more recent approach is to use a dynamic model that uses inputs from the diet into the rumen along with complicated math to predict the nutrient supply available for the cow.

Researchers have long been studying various blends of nutrients in diets and the production results that follow. In these studies, the inputs and production results can be noted and replicated many times with slight adjustments to evaluate changes in milk output. Another level of investigation was concurrent with this and focused not on the cow but on the microbial population that makes the rumen work. Basic microbiology and biochemistry was employed to dig deep into these small organisms and determine the results of various nutrient blends. The byproducts of this fermentation process are the primary nutrient supply for the cow. Through basic science, the fermentation results have been determined and prediction equations built to predict the results of various feed blends in a diet.

In addition to these newer models knowing the basic nutrient content of each feed ingredient, it also has information on how long will it take this ingredient to be fermented in the rumen. It assigns ingredients and nutrients in those ingredients to various speed or rate groupings called pools. An example of this would be a starch ingredient that has a gelatinized and small particle size that would be in fast pool compared to a coarse dry cracked corn particle that might be in a slower pool. Other nutrients including nitrogen and fiber are grouped in these same pools to attempt an estimate what blends of nutrients the rumen microbes will have to work with at the same time. In the past, we just assumed all was available at the same rate and that was not what was actually happening in the cow.

Another factor included in the newer models for the first time considered the positive or negative impacts that one ingredient may have on another. These impacts are called associative effects. A textbook example of these would be how increasing the grain content in a diet would have a negative impact on the actual digestibility of the fiber fed along with it. Or, on the positive side, a little fast nitrogen from urea added into the diet to come alongside the fast sugar in molasses. These two timed together helped both become more relevant in adding to the nutrient supply for the cow. In the older nutrition programs, there was no avenue for using these associative effects to predict performance. In the newer models, these have been included. This is an example of how what may have previously been considered the “art” of feeding cows was now included in the “science” part of the process.

Most of what we have discussed to this point has been issues related to how the various feeds blend together and are digested in the gut of the cow. There is an entire separate step included in the newer models that attempts to predict what happens to the nutrients as they are absorbed into the tissue of the cow. Very complicated prediction equations that include basic science on what happens in the liver and mammary system of the cow and measures like glucose, insulin and circulating levels of various forms of fatty acids come into play. These tissue level predictions have a “black box” feel to most formulating nutritionists but the repeatable results from a good model bolster their credibility.

The dairy cow is an extremely complicated machine that was created to use various microbiological and biochemical processes that result in her ability to process grain and roughage into sellable dairy products. A biological model used for ration formulation is an attempt to predict the results of various feed ingredient blends. With a healthy respect for the limitations of models and variability that will never be controlled, the use of newer formulation models should be a great tool for nutritionists to maximize profitable milk production.