

Evaluating alternatives to corn in dairy rations

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With the price of corn nearly doubling over the past year, producers are looking for more economical alternatives. As a nutritionist in the field, I frequently hear questions related to this situation: How low can I take starch without impacting milk production? Can I really replace some of the starch with sugar? If I use a byproduct, what are the ramifications? This article is to help sort out some of the confusion and help you in evaluating alternatives to corn in rations.

The nutrients

Let's first look at the nutrients in a typical dairy ration. The diet offered to cows is usually about 50 percent water. For simplicity's sake, we're going to look at the nutrients on a dry matter (DM) basis (i.e. without the water). The largest portion of the cow's diet is made up of carbohydrate, followed by protein and then by fat and ash (**Figure 1**). Since corn is 85 percent carbohydrate, let's look at the carbohydrate portion of the diet in more detail.

- Cows do not have a requirement for starch. Instead, they have a requirement for fermentable carbohydrates

(FC), which includes starch, soluble fiber and sugar. The cow uses the rapidly fermentable carbohydrates to provide energy to rumen microbes, which consequently helps optimize the conversion of feed into volatile fatty acids (VFA) and amino acids.

- It's important to match up carbohydrate and protein sources so that they have relatively similar rates of rumen degradation. For example, grass silage contains a high proportion of soluble protein, which degrades very quickly in the rumen, so a sugar source would be a good match to work in synergy due to its quick rate of rumen degradation. Cows should have a mixture of carbohydrate sources in the diet that have varying rates of

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- There is a minimum requirement for neutral detergent fiber (NDF), which ranges between 25 and 34 percent depending on the level of other carbohydrates in the diet. Diets should contain at least 20 percent physically effective fiber (or peNDF), which is the proportion of fiber in the diet that maintains normal rumen function and motility and stimulates cud chewing in the cow.

Common byproducts used

Table 1 lists corn and byproducts that are commonly used as replacements for corn grain in dairy rations. When looking at the nutrients, certain

trends become clear – these byproducts are greater in protein and lower in fermentable carbohydrates (FC) relative to corn grain.

In addition, nutritionists need to watch the amount and type of fat being provided by byproducts. With the exception of corn gluten feed and corn gluten meal, total fat is increased in these byproducts and more than 50 percent of this fat is unsaturated (as shown by the high amount of rumen unsaturated fatty acid load, abbreviated RUFAL). Excessive amounts of unsaturated fat in the diet (RUFAL greater than 500 grams per day or unsaturated fat greater than 2.2 percent of total diet DM) will likely result in milk fat depression. In my opinion,

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Table 1 Common byproducts used

1 lb DM	DM	CP	Sugar	Starch	Soluble fiber	FC	NDF	NEL	Total fat	RUFAL
	– % DM –							Mcal/lb.	g	
Corn	88.0	9.0	1.5	74.8	0.8	77.1	8.1	1.08	18	15
Bakery byproducts	94.8	13.0	12.3	56.3	2.0	70.6	4.1	1.13	36	25
Brewers grains - dry	92.7	23.6	2.8	13.8	6.4	23.0	39.6	0.77	38	26
Brewers grains - wet	24.0	29.0	1.5	10.3	5.9	17.7	38.6	0.80	35	25
Corn gluten feed	89.7	24.0	13.1	14.3	5.1	32.5	31.5	0.86	15	11
Corn gluten meal	92.7	65.5	1.6	18.1	3.0	22.7	5.5	0.98	11	9
DDGs	88.8	30.3	3.4	12.2	10.4	26.0	23.3	0.90	52	43

Abbreviations: DM = Dry matter; CP = Crude protein; FC = Fermentable carbohydrates = Sugar + Starch + Soluble fiber; NDF = Neutral detergent fiber; NEL = Net energy of lactation; RUFAL = Rumen unsaturated fatty acid load

Alternatives to corn in dairy rations, cont'd from front

corn gluten feed is the best choice from this list, as it has a moderate FC content, and lower grams of total fat and RUFAL relative to corn. However, any of these byproducts can work with the right mix of ingredients and the proper inclusion rate.

Cost does matter! I recommend evaluating corn and byproducts on a cost per Mcal basis, since corn is used mostly to supply energy to the cow. Calculation: Cost (dollars per pound -\$/lb) ÷ NEL (Mcal per

pound lb) = Cost/ Mcal

For example: Corn costs \$210 per ton. The cost per pound would be \$0.105.

NEL of corn = 1.08 Mcal per pound

$0.105 (\$/\text{lb}) \div 1.08 (\text{Mcal}/\text{lb}) = 0.097 (\$/\text{Mcal})$

Then evaluate the other byproduct sources to determine if you can get one for a lower cost on an energy basis.

Recommended strategy:

Evaluate byproduct sources based on availability, cost on an energy basis and nutrient profile (with bias towards greatest FC, lowest RUFAL).

Replace corn or a portion of corn with byproduct.

Review levels of FC (aiming for 32 to 42 percent), NDF (aiming for 25 to 34 percent), peNDF (aiming for minimum of 20 percent) and RUFAL (aiming for

less than 500 grams per day or less than 2.2 percent of diet DM).

If satisfied with levels, continue to number 4. If not satisfied, try another byproduct or add corn back into ration at a lower rate of inclusion. If more FC needed, consider adding a sugar or soluble fiber source.

If room in the ration is an issue, a sugar may be the solution, as it's energy dense and high in FC. If sugar appears feasible, consider a product with additional organic acids, which help rumen microbes convert lactic acid to VFAs and reduce subclinical acidosis.

If level of FC is adequate and energy is needed, consider adding a supplemental fat source to the ration.

Re-evaluate RUFAL. If it's over 500 grams per day, re-evaluate the ration changes. **PD**

Figure 1

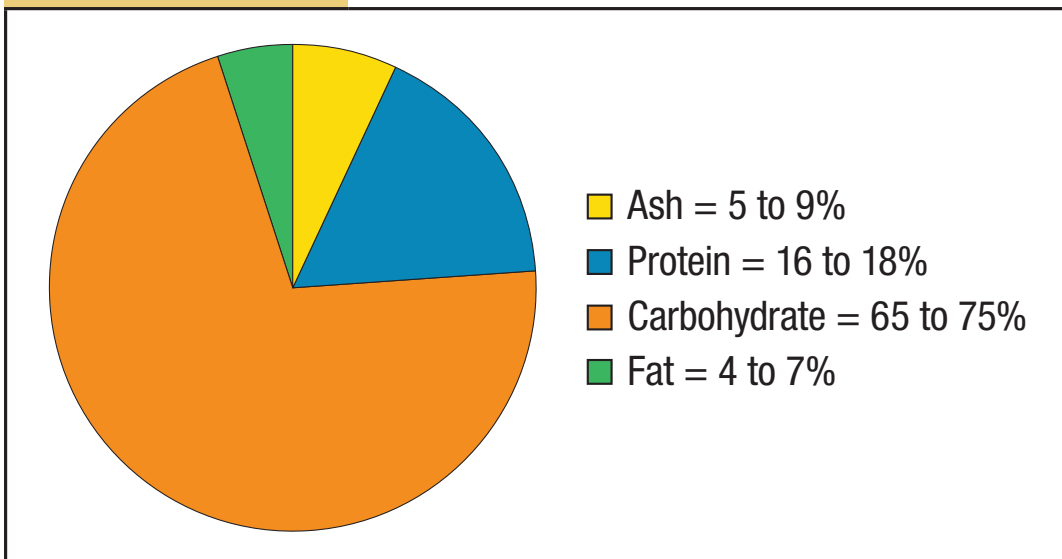
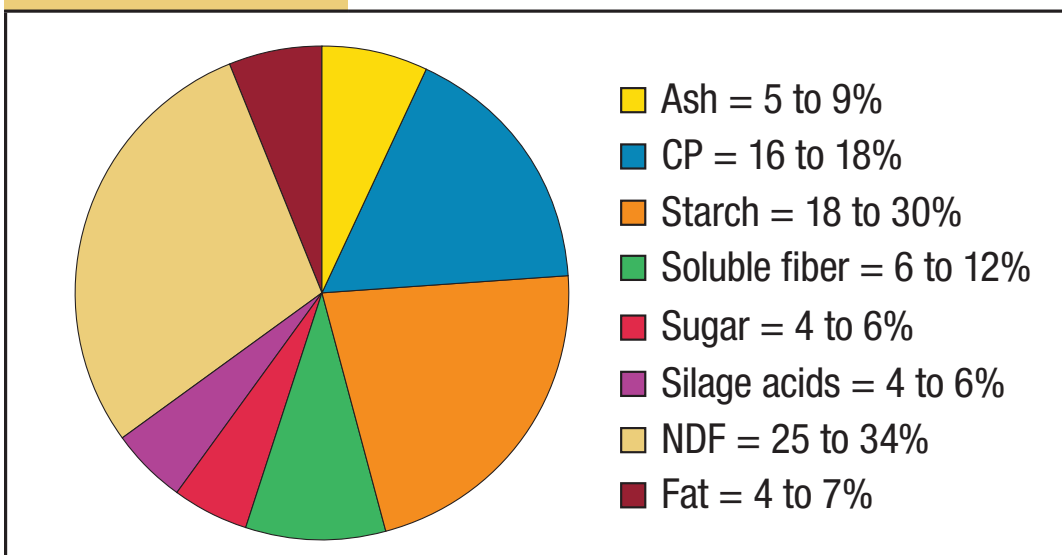


Figure 2



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