Fat Feeding Facts

4. Dry Matter Intake (DMI)

Fats are added to rations for lactating dairy cows in order to increase energy intake, particularly in early lactation when DMI is limited relative to energy requirements for the cow's increasing level of milk production. Adding fat does increase energy density of rations since it has 2.25 times more energy per unit of weight compared to protein or carbohydrates. But if adding fat decreases DMI, then energy intake is compromised and will not be that much greater as desired. Cows do not like greasiness and this can reduce DMI; but that is a palatability issue related to physical characteristics due to using enough liquid fats to cause greasiness. The understanding that fat ***can*** reduce DMI metabolically was discovered more recently.

Calcium salts of fatty acids (CSFA) are created by treating fat (usually triglycerides) with a base—greater than 7 pH. The traditional way of making homemade soap was to gather and treat leftover cooking oil with lye (sodium hydroxide). The saponification reaction that occurred had hydrolyzed the triglycerides into free fatty acids (FFA) and glycerol; and attached a sodium ion to each FFA. This process makes a water soluble "soap". To make such a "soap" insoluble as a salt, calcium hydroxide is used instead of sodium hydroxide. This makes a dry free flowing fat which has good handling properties, and which does not melt. Over 30 years ago when the first CSFA were made in the U.S., a palm fatty acid distillate was used instead of tallow or lard because it was cheaper. It also has a greater unsaturated fatty acid content, but the impact of this was not understood until about 15 years later. There was some recognition of DMI reduction with CSFA, but it was believed this was a palatability issue. However, attempts to cover up or mask the taste/odor of CSFA were not successful in eliminating this problem.

The key study to understanding DMI related to fatty acid (FA) composition was done by Harvatine and Allen as reported in 2005 (JDS 88:4018-4027). They used a mostly saturated free fatty acid (SFA) source vs a CSFA source (UnSFA) to create difference levels of dietary FA saturation. Cows used in the trial were in mid-lactation, but for only a 2-week period because extensive rumination monitoring and blood sampling was done during that short period.

	SFA	**UnSFA**	***P* <**
DMI, lb/d	60.3	58.8	**0.01**
Milk, lb/d	92.0	93.4	0.09
Milk protein, %	3.07	3.02	**0.02**
Rumination time, min/d	535	510	**0.001**
Insulin, IU/ml	12.8	10.1	**0.001**
CCK, pmol/L	12.5	14.1	0.10
NEFAs, µM	89.3	115.5	**0.001**

At first glance, it looks like the UnSFA had increased feed efficiency because, while DMI decreased for cows on this treatment, they maintained milk production with some numerical increase. How was this possible? The answer lies in looking at ***all*** of the data. Note that cows fed UnSFA had decreased blood insulin associated with their lower DMI, some numerical increase in the gut hormone cholecystokinin (CCK), and a somewhat surprising increase in NEFAs (non esterified fatty acids) which are released into the blood stream when cows mobilize body condition. Thus, the cows were able to maintain milk production over this short time period when DMI decreased by mobilizing body condition. When CCK is released in the small intestine as some unsaturated FFAs escape biohydrogenation in the rumen, this causes the nerve which controls rumination to reduce rumination time; and this in turn results

in lower DMI. All of these actions are related to the increased dietary level of unsaturated FA. It is not due to the CSFA *per se*, but because most CSFA use unsaturated fatty acid sources.

Other studies have also observed the effect of higher levels of UnSFA on reducing DMI through the same metabolic mechanism. Thus, the key to not having DMI decreases in dairy cows when utilizing a fat supplement is to use fat sources which are high in saturated FFAs. The 2001 National Research Council Dairy Nutrient Requirements recognized this interrelationship when it stated on page 31 that: "Calcium salts of fatty acids decreased DMI by 2.5% for each percentage unit in the diet above the control……..Added hydrogenated fatty acids and triglyceride did not decrease DMI."

Thus, the more unsaturated FAs that are present in a ration, the more likely DMI will be reduced. And the likelihood of decreasing milk fat % also increases.