Improving Dairy Cow Metabolism through Safflower Oil Supplementation[1]

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Introduction

Plasma concentration of non-esterified fatty acids usually increases in high-producing dairy cows around the time they give birth (parturition) due to mobilization of body fat stores. This results from the inability of the cow to consume enough energy to meet her requirements for maintenance and milk production (Drackley 1999). Blood non-esterified fatty acids are absorbed by the cow's liver, and if the liver takes up more fat than it can metabolize, these excess fatty acids are stored as triglyceride in the liver. This situation is known as fatty liver syndrome, and it results in decreased milk production and impaired reproductive efficiency of postpartum dairy cows. Thus, management practices that minimize postpartum adipose tissue mobilization may improve the cow's performance after parturition. The objective of this article is to summarize the effects of feeding diets enriched in saturated fatty acids, calcium salts of *trans* fatty acids, or calcium salts of safflower oil fatty acids on postpartum Holstein cow metabolism (Caldari-Torres et al. 2011).

Fat Sources

Fat sources used in dairy rations are commonly grouped into two major categories — natural fats and commercial or specialty fats. The natural fats are subdivided into plant and animal fats, whereas commercial fats are made by using animal or plant fats as starting materials.

Oil seeds are a natural source of fat and protein in diets for lactating cows. However, vegetable oils contain unsaturated fats, and these unsaturated fats may coat the feed particles or rumen bacteria and reduce fiber digestion and milk fat test. When natural fats are supplied as oil seeds, the oil is believed to be slowly released when the seed is chewed, which may help decrease the detrimental effects that fat has been shown to have on rumen fermentation and milk fat test (Amaral-Phillips et al. 1997). Oil seeds used in dairy rations include cottonseed, soybeans, canola, sunflower, and safflower seeds. These oil seeds differ in fatty acid profiles and may affect the cow's metabolism differently. The calcium salts of safflower oil used in the Florida study contain high concentrations of linoleic acid (i.e., > 60% of total fatty acids; Caldari-Torres et al. 2011), and the effects of calcium salts of safflower oil on dairy cow metabolism may be different from those of other sources of fat commonly used in dairy rations (i.e., MEGALAC or MEGALAC-R).

Tallow is derived from rendered beef fat, but can include other animal fats. It contains more saturated fatty acids than oil seeds and requires special handling equipment because it is solid or semi-solid at outdoor temperatures. Yellow grease is a by-product derived from the used cooking grease discarded by the restaurant industry. Yellow grease is more commonly used in beef feedlot rations than in rations fed to lactating dairy cows.

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Highly unsaturated fats such as yellow grease and vegetable oils can be toxic to rumen bacteria and negatively affect fiber digestion when fed to dairy cows in large amounts. One method to overcome this problem is the formation of calcium salts of free fatty acids. This complex is considered inert at the normal rumen pH range. The calcium–free fatty acid complex dissociates in the acidic environment of the abomasum, and the free fatty acids are then available for absorption in the small intestine. Ruminally inert fats, also known as specialty fats, are the most expensive and, from an economic standpoint, these should be used only after the amount of natural fat products (i.e., grains, forages, whole cottonseeds, whole soybeans, and tallow) exceed 5% of fat added to the diet (Amaral-Phillips et al. 1997).

The Effects of Calcium Salts of Safflower Oil on Dairy Cow Metabolism

One of the original concepts of feeding fat to lactating cows was to provide supplemental energy to potentially reduce body weight loss during early lactation. However, few research studies have provided data that support this concept. The extra energy consumed by feeding fat in early lactation primarily supports higher milk production. The fact that feeding fat does not appear to reduce loss of body weight during early lactation has led some dairy producers to avoid feeding high levels of fat until 30 days postpartum. This strategy will allow the cow to adjust to the lactation phase before fat is included in the diet. However, recent research data collected at the University of Florida indicated that transition Holstein cows fed a diet enriched in calcium salts of safflower oil produced less milk fat but established a positive energy balance sooner after calving than cows consuming diets supplemented with *trans* or saturated fatty acids (Figure 1; Caldari-Torres et al. 2011). The early return to positive energy balance after parturition was associated with greater increases of plasma insulin-like growth factor-I (IGF-I) and progesterone concentrations (Figure 2). These findings are important because both IGF-I and progesterone are positively related with fertility in postpartum cows. This research suggests that feeding fat supplements that suppress milk fat production during the early postpartum period may help minimize negative energy balance, reduce body fat mobilization, and improve blood concentrations of beneficial metabolic and reproductive hormones (Figure 2).

Implications for the Dairy Industry

Over the last few decades, genetic selection for high milk production has resulted in increased milk yield per cow.

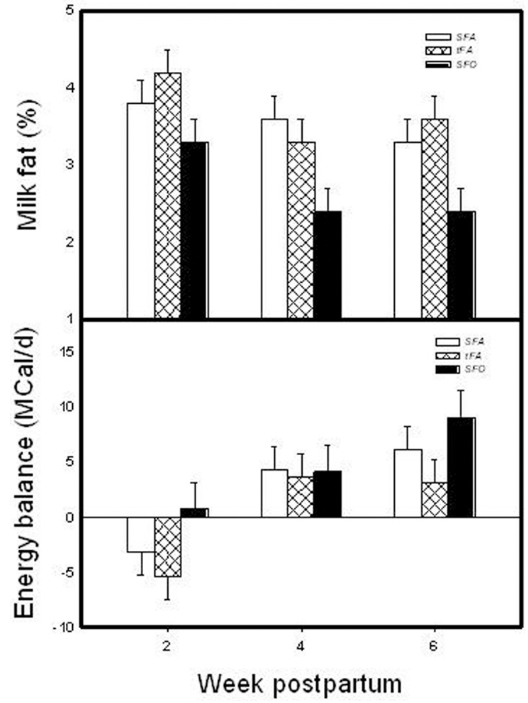

Figure 1. Milk fat concentration (top) and energy balance (bottom) of postpartum Holstein cows fed three sources of fat. Cows fed a safflower oil-supplemented diet (SFO) produced less milk fat but established a positive energy balance sooner after parturition than those consuming the *trans* (*t*FA) or saturated fatty acid (SFA) supplements.

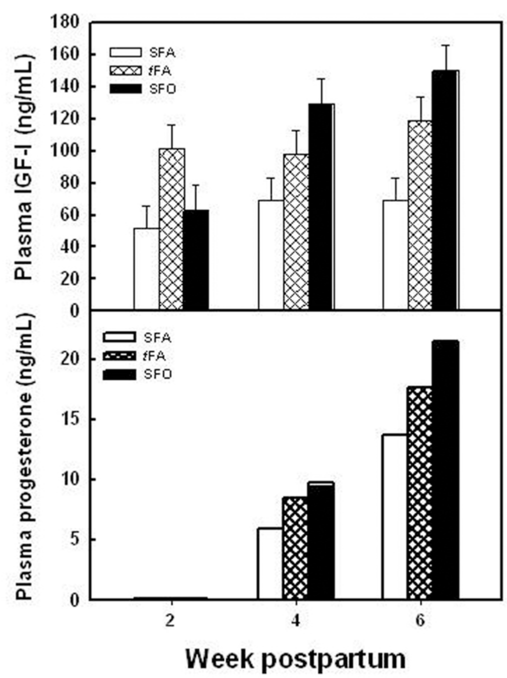

Figure 2. Plasma insulin-like growth factor-I (IGF-I, top) and progesterone (bottom) concentrations of postpartum Holstein cows fed three sources of fat. Cows fed a safflower oil-supplemented diet (SFO) had greater blood IGF-I and progesterone concentrations by week 6 postpartum than those consuming the *trans* (*t*FA) or saturated fatty acid (SFA) supplements.

As a result, use of feed-grade fat supplements to increase energy density of dairy rations is expected to continue on commercial dairy farms. When considering whether or not to add supplemental fats, the bottom line is to formulate a ration that is cost effective to feed the cows, allows cows to produce milk to their genetic potential, and fits a producer's feeding system. Additionally, data collected in Florida studies indicate that feeding fat supplements that decrease milk fat test during the early postpartum period may help minimize negative energy balance, reduce body fat mobilization, and improve blood levels of beneficial metabolic and reproductive hormones. Further testing is needed to determine if the improved metabolic status of the cow as a result of feeding calcium salts of safflower oil can lead to improved fertility in commercial dairy settings.

References

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