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Supplemental Fat For High-Producing Dairy Cows

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This NebGuide describes the various sources of supplemental fat available to dairy producers, and guidelines for their effective use in lactating cow rations.

Why Use Fat?

As milk production per dairy cow exceeds 20,000 to 22,000 pounds per lactation, higher energy feeds are necessary to meet the cow's increased nutritional requirements. Excellent quality forages are one way to meet these needs. High quality forages are the most economical and nutritionally safe way to balance high production rations. Using high quality forage always should be the primary goal; however, if this quality forage is unavailable or limited, correct fat supplementation becomes a consideration.

High producing cows, especially in early lactation (the first 120 days after freshening), are typically in negative energy balance. That is, energy intake is less than needed to meet the nutrient demands of milk production. Consequently, the cow mobilizes body nutrient reserves such as body fat to meet the energy demand. Fat fed in the ration provides 2.25 times the energy of carbohydrates normally supplied by grains. Generally, 1 pound of fat is roughly equivalent in energy value to 3 pounds of shelled corn. Due to fat's higher density, incorporating it into rations may be a successful way to get more energy into the cow with the same feed volume. This is one approach to meeting the energy requirements of higher milk production without the negative metabolic effects associated with high grain feeding. However, the wrong kind or amount of added fat can create negative metabolic problems. A producer should consider supplemental fat when high quality forages are not readily available and fat can be bought economically.

Types of Fats and Their Effects on Metabolism

The structure of true 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. The length of these fatty acid chains may vary from 16-22 carbons long and may be "saturated" or "unsaturated." Saturated fats have all bonds saturated with hydrogen, are generally of animal origin (tallow, grease), and are solid at room temperature. Unsaturated fats have at least one double bond because not all positions are filled with hydrogen. Unsaturated fats are primarily of vegetable origin (oils) and are liquid at room temperature.

Fatty acids are not fermentable and as a consequence are not a source of energy to rumen microbes. In addition, unsaturated fats are soluble in rumen fluid and may inhibit rumen fermentation and fiber digestion. Therefore, supplemental vegetable fats may serve as problematic in most dairy rations, especially when whole soybeans, cottonseeds, distillers grains or sunflower seeds are being fed. The amount of vegetable fat already in the ration is the key factor in deciding whether to add supplemental vegetable fat. For example, a ration containing soybeans may already have all of the vegetable fat advisable. However, saturated fats such as tallow generally are insoluble in rumen fluid, have little negative impact on rumen fiber digestion, and offer the most potential to supply energy for milk production.

Rumen microorganisms also may saturate fatty acids, in a process called biohydrogenation. Part of the reason the process occurs is to convert existing fatty acids into forms that may be less toxic to the microbes themselves. The process of biohydrogenation occurs when microbial enzymes attempt to completely saturate unsaturated fatty acids. During this time intermediate forms, or partially saturated fatty acids, may pass out of the rumen and be absorbed by the small intestine. In cases when high amounts of grain are fed and rumen pH may drop far below normal levels specific fatty acids may be formed (trans-10 18:1 and trans-10 cis-12

18:2) and these have been demonstrated to negatively influence milk fat formation. As a result milk fat production may be influenced by the amount of saturated fatty acid leaving the rumen as well as the type of intermediates that may also be present.

Practically speaking, feeding fat sources with high levels of oleic acid (unsaturated fat) appears to exceed the ability of rumen microbes to saturate (add hydrogen) fat. This may affect rumen microbial fat digestion and also may depress milk fat test. In some cases feeding supplemental fat has been shown to decrease milk protein by 0.1 percent or more. Percentages of unsaturated and saturated fats in common supplemental fat sources are given in Table I.

Table 1. Saturated and unsaturated fat composition of supplemental fat sources

Source	Saturated	Unsaturated
	----------percent----------	
Cottonseed	26	74
Soybean	15	85
Sunflower	12	88
Palm	51	49
Canola	6	94
Beef tallow	52	48
Pork lard	41	59

Considerations Prior to Using Supplemental Fat

1. Consider Herd Average.
   Generally, the most effective and economical methods for meeting the dairy cow's energy requirement for lactation includes: proper ration formulations, optimal feeding strategy, and harvesting, storing and feeding high quality forage as silage or hay. Consider supplemental fat as a potential ration ingredient only after annual milk production reaches 20,000 - 22,000 pounds per cow.

2. Consider Concentrates.
   A producer should consider feeding more grain and natural high-fat feeds before supplementing the ration with a pure fat source. The percentage of grain in the total ration dry matter should not exceed 50 percent to 55 percent to avoid metabolic disorders such as acidosis and milk fat depression. Increasing grain may not necessarily solve the problem of negative energy and may cause more problems. Including grain into a well mixed ration of the grain with the forage can help minimize these disorders.

3. Consider Economics.
   As with any ration ingredient, make sure the extra cost and/or labor of fat supplementation is covered by value of increased milk yield. (See Table II).

4. Consider Quality.
   Quality and analysis of fat sources vary enough to warrant careful selection of the supplier and testing of high fat feeds prior to incorporation into the ration.

Table II. Milk production responses needed to break even with increased ration costs

Cost of Supplementation	Price of Milk, $/cwt				
	10	11	12	13	14
$/day	—additional pounds of milk to break even—				
.05	.5	.5	.4	.4	.4
.10	1.0	.9	.9	.8	.9
.15	1.5	1.4	1.3	1.2	1.1
.20	2.0	1.8	1.7	1.6	1.4
.25	2.5	2.3	2.1	2.0	1.8
.30	3.0	2.7	2.5	2.3	2.2
.35	3.5	3.2	2.9	2.7	2.5
.40	5.0	3.7	3.4	3.1	2.9
.45	4.5	4.1	3.8	3.5	3.2
.50	5.0	4.6	4.2	3.9	3.6
.55	5.5	5.0	4.6	4.3	3.9

Sources of Supplemental Fat

Three basic types of supplemental fat currently available include: vegetable fats or oils (high in unsaturated fats); animal fats (high in saturated fats); and ruminally inert, protected (by pass) commercial fat sources. Table III summarizes the nutrient composition of common fat sources in each category. Multiply the pounds of seed dry matter fed per head per day by the percent fat in Table III to learn the pounds of fat on a dry basis being added to the base ration from each source.

Soybeans

Soybeans may be successfully fed to dairy cows raw, roasted or extruded; and whole, rolled or ground. Processing varies, so consider the source of soybeans for quality. Grinding or rolling may increase utilization, depending on the total ration, and may make handling easier. However, grinding or rolling may increase risk of rancidity for raw soybeans. Feeding the fat-containing seed appears to reduce the negative influence of soybean oil on fiber digestion in the rumen. Non-protein nitrogen sources such as urea should not be mixed with raw soybeans but can be mixed into the ration if the soybeans are roasted or extruded. In general, 4 to 5 pounds of raw soybeans may be fed daily in a balanced ration with no problems. Heat processing of soybeans is becoming more popular as a means to increase rumen escape protein. Exactly how heat affects fat is not known, but feeding rates of soybeans may be increased by 1 pound over raw soybeans without milk fat depression (maximum of 5 pounds per day).

Cottonseed

This feed is available as whole or fuzzy cottonseed and as delinted seed. Cottonseed combines protein, fiber and fat into one feed. Generally, delinted and whole cottonseed are equivalent in supporting milk production. Fat in cottonseed is primarily unsaturated, but is slowly digested and does not

Table III. Nutrient composition of supplemental fat sources (dry matter basis)

Source	Fat	Crude Protein	Acid Detergent Fiber	Neutral Detergent Fiber	Ca	P	NE_L
		----------%----------					Mcal/lb
Soybeans	18.8	42.8	10.0	17.8	.27	.65	.96
Cottonseed with lint	20.0	23.0	34.0	50.3	.21	.64	1.01
Sunflowers	44.4	20.0	16.7	—	—	—	1.43
Canola	40.2	21.7	11.9	29.8	—	—	1.36
Animal Fat	99.5	—	—	—	—	—	2.65
Protected Fats							
Energy Booster	100					2.70	
Megalac	83					2.96	
Dried Distilled Grains and Solids	13	31	17	34		.91	.93
Corn Glutan Feed	3	25	12	37		1.1	.87

Sources: NRC, 1989; J.G. Linn — Dairy Update, Issue 98.

decrease rumen digestion as seriously as most unsaturated fats. Adding whole cottonseed to rations typically increases milk fat percentage by 0.2 percent to 0.3 percent. If large quantities of cottonseed containing high levels of gossypol are fed, gossypol poisoning can occur in cattle. A safe recommendation is 6 to 7 pounds of cottonseed per cow daily.

Sunflowers

Sunflower seeds contain 30 percent to 40 percent oil, which is highly unsaturated. Up to 10 percent of the ration dry matter can be fed as rolled or whole sunflowers without milk fat depression. When seeds are ground finely, intake should be limited to 2 to 3 pounds per cow daily.

Canola Seeds

Based on research at the University of Alberta and Washington State University, rations can contain up to 6.5 percent of the dry matter as canola (rapeseed).

Dried Distillers Grains and Solubles (DDGS) and Corn Gluten Feed (CGF)

Although field nutritionists often view DDGS as a useful protein or nitrogen source, this feedstuff contains more than simply nitrogen. Beef nutritionists have documented that feeding distillers grains in place of corn grain is useful in providing energy and also preventing acidosis in feedlot cattle. Distiller's grains typically contain 34 percent neutral detergent fiber (NDF) and 13 percent fat on a dry matter basis. Nutritionists can also position CGF as a good source of digestible NDF as it contains approximately 37 percent NDF, of which 42 percent is believed to be digested over a 24-hour period; this is similar to corn silage or alfalfa haylage. The proportion of fat contained in CGF is lower that that of distillers grains (3 versus 13 percent DM) and in part explains why the energy content of distillers grains is higher the CGF.

Animal Fat

These sources include tallow, grease and animal/vegetable blends. Tallow is any fat with a melting point over 104°F, indicating more saturated fat content. Saturated fats have less impact upon the rumen, but are more difficult to handle because they are solid at room temperature. Band heaters or some other method will be needed to maintain the tallow in a liquid form.

Protected Fats

Ruminally protected fat sources which are commercially available escape fermentation and exert little negative effect on rumen fiber digestion. Megalac, one example of a commercial fat source, is a calcium salt of long chain fatty acids of palm oil. Energy Booster is primarily palmitic and stearic acids, and often is called prilled fat due to its shape.

How to Feed Supplemental Fat

1. High producing cows have the greatest potential need for supplemental fat, usually through the first 120 days of lactation.
2. To minimize depression in milk protein percentage, balance rations carefully for starches and sugars to maintain normal rumen fermentation.
3. Add fat gradually to rations over two to three weeks to overcome any palatability problems. The first pound of fat may come from an oilseed source. A second pound should come only from an animal product such as tallow to minimize any adverse ruminal effects on digestion.
4. If the ration ether extract level is over 5 percent, the unsaturated fatty acid levels should be evaluated and a protected fat source should be considered.

5. The higher the ration fiber levels, the more fat can be fed to dairy cattle. Mean rumen pH usually is higher in cows fed high fiber diets and as a result less trans fatty acids are produced.
6. Added fat may decrease fiber digestion and dry matter intake if not used properly. Be certain to maximize forage intake by feeding high quality forages. The level of neutral detergent fiber in the diet should be approximately 28 percent of ration dry matter. The level of calcium should be increased to 0.9 percent to 1 percent and magnesium increased to 0.25 percent to 0.30 percent of ration dry matter compared to rations without added fat, to counteract soap formation and loss of minerals in the manure. Be certain to meet the cow's requirements for crude protein, rumen undegradable protein and nonfiber carbohydrates (starches and sugars).
7. Fats should only be added to rations that are properly formulated and fed correctly.

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