

Facts about Fats

Fat supplements are used to increase energy density in lactating rations, particularly for fresh cows. The objective is to minimize the negative energy balance that cows experience in early lactation when milk output rises faster than feed intake. Profitable fat feeding demands an understanding of the properties of fats, the response that can be expected and their cost relative to other ration energy sources.

What are fats?

Fats (including oils which are fats that are liquid at room temperature) are mainly composed of *long-chain fatty acids* (LCFAs). As their name implies, LCFAs are long chains of carbon atoms with hydrogen atoms attached, as illustrated in the figure below. The most common fatty acids found in feed supplements are 16 and 18 carbons in length (see table). These can be found either combined with one or two other fatty acid as *di-* or *triglycerides*, or free, as *free fatty acids* (FFA). Most of the products used in dairy rations contain only small proportions of FFA but a few, notably Energy Booster®, Aristofat Golden Flake® and Megalac® are mainly FFA.

Our reason for using fats in dairy rations lies in their high energy density, relative to alternative energy sources such as barley. For example, a lactating cow can derive about 6.61 Megacalories (Mcal) of Net Energy for Lactation (NE_L) from a kilogram (kg) of tallow, compared to about 1.95 Mcal NE_L / kg from barley - a greater than threefold difference in favour of tallow.

Saturated and unsaturated fatty acids

When every carbon atom has the maximum number of hydrogen atoms attached (two), the fatty acid is *saturated*. When a pair of hydrogen atoms is missing (one from each of two adjacent carbons), the fatty acid is *mono-unsaturated*. If two or more pairs are missing, the fatty acid is *polyunsaturated*. These terms are familiar to most of us through the mass media and advertisements promoting the advantages of unsaturated fats and oils in our own diets.

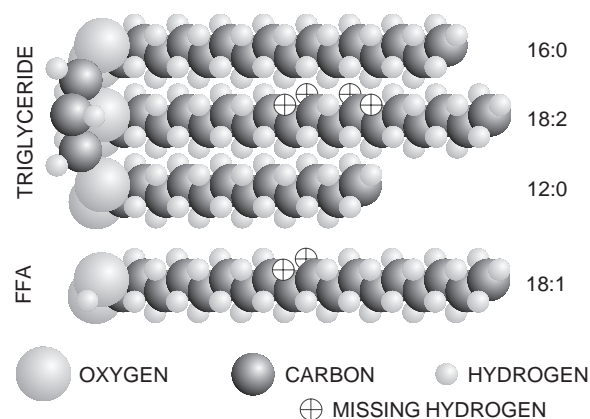
The table on the next page gives a breakdown of the fatty acids found in common fat and oil supplements used in dairy rations.

Melting point

Both FFA chain length and degree of saturation affect the melting point of fats. As chain length decreases, so does melting point. Stearic acid (18:0) melts at 71.2°C, palmitic (16:0) at 63°C and lauric (12:0) at 44°C.

The higher the proportion of unsaturated fatty acids in a product, the lower will be its melting point. In fact, all of the common unsaturated fatty acids are liquid at room temperature. Beef tallow, which contains about 47.5% unsaturated fatty acids, melts at around 42° C, while canola oil, with 93% unsaturated fatty acids, melts at -10° C.

Liquid vegetable oils are converted to solid margarines by *hydrogenation* which adds hydrogen atoms to unsaturated fatty acids and, therefore, increases their degree of saturation. This process is also used in the production of some of the *inert* or *bypass* fats used in dairy rations. For example, Aristofat Golden Flake® is a palm oil product which has been hydrogenated to raise its melting point to 48-52° C.



Long-chain fatty acids are present in fats as both di- or triglycerides and free fatty acids (FFA). 16:0 denotes a saturated fatty acid with 16 carbons and no hydrogens missing. 18:2 is an unsaturated 18 carbon fatty acid with two pairs of hydrogens missing.

Feeding Fat

When deciding on a fat supplement to add to your rations, consider the following :

- high concentrations of FFA can inhibit rumen fermentation, probably by combining with minerals such as calcium and magnesium in rumen fluid. Therefore, when feeding raw fat supplements containing more than 1-2% FFA, dietary calcium and magnesium levels must be raised.
- unsaturated fatty acids interfere with rumen fermentation, either by coating feed particles or through toxic effects on rumen microbes. This may be related to the fact that unsaturated fatty acids are liquid at the cow's body temperature (39°C).

Although liquid oils (such as canola oil) may be easier to handle than solid fats (such as tallow), their low degree of saturation may inhibit digestion and reduce intake.

- when unsaturated fatty acids are exposed to air, oxidation produces rancidity. Although most products will contain an antioxidant such as ethoxyquin, fats that have been stored for some time before processing and addition of antioxidant may have already become rancid. Even a slight amount of rancidity will reduce palatability and intake.
- stearic acid (18:0) is not very digestible in the small intestine, particularly in the triglyceride form. Recent research results indicate that, although hydrogenation may improve rumen inertness, the resulting increase in stearic acid may reduce the ultimate digestibility of some 'inert' fats.

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Fatty Acid	from beef packer		from processor		Canola Oil	bypass fat supplements ⁴		
	Edible Tallow ¹	Inedible Tallow ¹	Inedible Tallow ²	Yellow Grease ³		Energy Booster ⁵	Alifet ⁶	Megalac ⁷
	----- % of total fat -----							
12 : 0			0.1	3.1				
14 : 0	3.0	3.0	2.0	2.3		2.0	3.0	1.5
16 : 0	25.0	25.0	22.5	16.1	4.0	47.0	27.0	44.0
16 : 1	2.5	2.5	3.6	2.0			1.0	
17 : 0	1.5	1.5	0.5	0.3				
18 : 0	21.5	21.5	13.5	8.2	2.0	36.0	37.0	5.0
18 : 1	42.0	42.0	44.4	32.6	55.0	14.0	31.0	40.0
18 : 2	3.0	3.0	9.4	28.7	26.0	1.0	1.0	9.5
18 : 3			0.7	4.3	10.0			
20 : 1			1.4	0.8	2.0			
minor FA ⁸	1.5	1.5	3.2	2.6	1.0			
Fat %	99.0	99.0	99.0	99.0	99.0	99.0	92.0	82.5
Unsat %	47.5	47.5	60.4	68.8	93.0	15.0	33.0	49.5
FFA %	< 0.35	< 4	1.5 - 2.5	5 - 10	4 - 6	98	< 5%	95
MP °C	41 - 42	41 - 42	41 - 42	30 - 35	-10	49 - 52	57	NA
NEI Mcal/kg ⁹	6.61	6.61	6.61	5.12	6.57	6.73	5.27	5.40
Price \$/kg ¹⁰	0.64	0.61	0.50	0.44	0.85	1.54	1.69	1.58
¢/Mcal	9.7	9.2	7.6	8.6	12.9	22.9	32.1	29.3
¹ 100% beef tallow				⁶ hydrogenated tallow combined with starch				
² mixed species tallow				⁷ calcium salts of palm oil free fatty acids				
³ refuse cooking fats and oils				⁸ present at less than 1% of total				
⁴ examples only - others are available				⁹ calculated energy values				
⁵ hydrogenated free fatty acids				¹⁰ prices vary considerably - check and compare				