Fat Feeding Facts

1. Definitions

Fats are compounds which are generally soluble in organic solvents (i.e. ether) and generally insoluble in water. Nutritionally, equal weight of fat has 2.25 times more energy than protein or carbohydrates.

Ether extraction is a crude fat analysis. Extraction of a sample using this solvent has been the standard assay for fat. But the assay also extracts compounds which are soluble in ether besides fat. This could include phospholipids, waxes, etc., in addition to fatty acids and triglycerides. This would result in an overestimate of true fat content.

Acid hydrolysis. The standard fat assay is ether extraction. But some fats may be more physically or chemically held in a sample, so an ether extraction would not extract all of the fat and would thus underestimate fat content. To remedy this, acid hydrolysis would be done first before the ether extraction.

Triglycerides are the major form of fat. For instance, grains and oil seeds have fat components in th**e** form of triglycerides--a glycerol "backbone" which has 3 fatty acids attached to it. Hence, the name tri-glycerides. Since glycerol is an alcohol/carbohydrate, it has less energy than fat in the form of fatty acids.

Free fatty acids are fatty acids which are not attached to glycerol in the form of triglycerides. Free fatty acids have been hydrolyzed or "freed" from a triglyceride.

Total fatty acids describes all the fatty acids in a sample whether they are free or in the form of triglycerides.

Carbon length of fatty acids. Individual fatty acids vary in their number of carbon atoms. Fatty acids produced in rumen fermentation are the shortest fatty acids with acetic having 2 carbons, propionic having 3 carbons, and butyric having 4 carbons. Since these fatty acids are so short, they are volatile; and are the only fatty acids that are absorbed through the rumen wall into the blood stream of the cow. These become the major energy source for a cow. Fatty acids are designated as short chain with < 8 carbons, medium chain with 8-14 carbons, and long chain with ≥16 carbons.

Saturated Fatty Acids. Each carbon atom in a fatty acid can have 4 other atoms attached or bonded to it. Two of those bonds are with adjacent carbon atoms in the fatty acid chain. That leaves the other 2 attachments to the carbon atom open for hydrogen atoms. If all hydrogen atoms are attached to adjacent carbons, those bonds are "saturated" with hydrogen atoms.

Unsaturated Fatty Acids. If each carbon bond is not saturated with hydrogen atoms, that fatty acid is termed "unsaturated" and constitutes a double bond. If a fatty acid has one unsaturated double bond, it is termed a mono-unsaturated fatty acid (MUFA). If there are 2 or more unsaturated double bonds in a fatty acid, that is termed a polyunsaturated fatty acid (PUFA). Individual fatty acids are designated such as C18:1; which means there are 18 carbons (C) in the fatty acid chain, and there is 1 double bond.

Biohydrogenation is the process by which rumen bacteria convert unsaturated to saturated fatty acids.

Iodine (iodine absorption) value. The amount of unsaturization of fatty acids can be quantified by reacting fat with iodine. Iodine is absorbed by double bonds in fatty acids, and this is quantified as the amount of grams iodine taken up by 100 grams of the fatty acids. Thus, the lower the iodine value, the more saturated a fat source is. This can be as low as 7-10 for a very saturated oil such as coconut, to as high as 170-204 for a very unsaturated linseed oil.

Melting point. Unsaturated oils and fatty acids are liquid at room temperature. As saturation increases, the melting point increases. For example, 18 carbon fatty acids have the following melting points: linoleic (2 double bonds) 23ºF, oleic (1double bond) 56°F, and stearic (no double bonds) 157°F.

Calcium salts of fatty acids are formed by treating fat with calcium hydroxide to form a calcium ion attached to each fatty acid. This makes an insoluble fat source.