

Chapter 5: The Lipids/Triglycerides, Phospholipids and Sterols

Types of Lipids

- Triglycerides (fats and oils)
 - most common type of lipid
- Phospholipids (ex. lecithin)
- Sterols (ex. cholesterol)

Functions

- Part of every cell membrane
- Energy (triglyceride stores in fat cells)
- Insulation of body temperature (role played by those fat stores just beneath the skin)
- Protection of vital organs (we have some fat cells that cushion these vital organs)
- Component of some hormones
- In foods lipids function to:
 - give foods flavor and aroma (doesn't bacon smell wonderful when it cooks - that's the fat breaking down!)
 - transport fat soluble vitamins
 - provide kcalories (remember that fat, specifically triglyceride, is one of the energy nutrients)

Triglycerides

- Glycerol
 - backbone for the triglyceride
 - glycerol molecule is the same in any triglyceride
 - note structure in text (Fig. 5-2)
- Three fatty acids
 - Fatty acids vary in:
 - length of the carbon chain
 - degree of unsaturation (see 3 categories below)

Saturated Fatty Acids

- Stearic acid: an 18-carbon, saturated fatty acid (see illustration in text)
 - this fatty acid is "saturated" with hydrogens

Monounsaturated Fatty Acids

- Oleic acid: an 18-carbon, monounsaturated fatty acid (see illustration in text)
 - do you see the *one* spot where hydrogens are missing?
 - nature fixes this empty space by putting a double bond in that spot, which is what gives it the unsaturated nature
 - the fatty acid can bend and flex at the double bond, giving unsaturated triglycerides their liquid (oil) characteristic

Polyunsaturated Fatty Acids

- Linoleic acid: an 18-carbon, polyunsaturated fatty acid (see illustration in text)
 - do you see the *two* spots where hydrogens are missing?

- o now we have 2 double bonds in this chain; any fatty acid chain with 2 or more double bonds is classified as polyunsaturated
- o Linoleic acid is one of two *essential* fatty acids (see information on essential fatty acids on page 145-147 of your text)

A Mixed Triglyceride

- In nature, triglycerides are composed of any combination of fatty acids and so have a "mixed" composition rather than being fully "saturated" or "unsaturated."
- Fatty acid make-up of some dietary fats: the above concept is illustrated in Fig. 5-5. Find the one(s) you use most often and see the make-up.

Hydrogenation

- Food processors hydrogenate oils to alter the texture of foods (create a firmer product) and to increase shelf life (stability)
 - o the process increases the amount of saturation in the food
 - o the process also creates trans fatty acids

Trans Fatty Acids

- This conversion allows for even more solidification of the product (can you see how the straighter trans form would allow the fatty acids to compact more tightly?)
- Research on the health effects of trans fatty acids have shown that they are as atherogenic as saturated fatty acids
 - o the amount of trans fat must be listed on the food label along with the amount of saturated fat (placing mono- and polyunsaturated levels on the food label is voluntary). "Trans-fat-free" products are becoming increasingly available.
- American Heart Association recommendations to reduce the dietary intake of trans fatty acids:
 - o use naturally occurring, unhydrogenated oil when possible (for example, canola or olive oil)
 - o limit the intake of processed foods made with hydrogenated products (margarine, shortening, doughnuts, chips, etc.)
 - o use margarine as a substitute for butter
 - choose soft tub margarines over harder, stick forms
 - choose margarines with liquid vegetable oil as the first ingredient
 - See Table. 5-3 in text

Phospholipids

- See structure in text (Fig. 5-8)
 - o Phosphate group is water soluble
 - o Lipid component is fat soluble
- This structure gives the phospholipid unique chemical properties that determine its functions
- Functions of Phospholipids
 - o important component of cell membranes
 - o emulsifier (see definition of emulsifier in text)
 - o food industry also uses them as emulsifiers in certain products like mayonnaise to help mix the fat and water soluble ingredients of the recipe; lecithin is one

example

- NOT an essential nutrient, though the health food industry may present it as such and promote supplementation.

Sterols

- Note structure of two examples in text
- Roles of cholesterol in the body
 - used to make the active form of Vitamin D
 - used by the liver to make bile
 - used to make sterol hormones, such as sex hormones, adrenal hormones
 - used in structural component of cell membranes
- Cholesterol in foods: as cholesterol is a different type of lipid than triglyceride, foods of animal origin have *both* triglyceride components and cholesterol components
 - the effect of dietary cholesterol is not as strong as that from saturated fat or *trans* fat but choosing foods with less cholesterol is certainly a healthy choice to make
 - cholesterol is not cooked out of the food you are preparing; you can see from the list of functions above that it is part of the cell membranes; the cholesterol is part of the animal tissue and is not lost in cooking
 - the fat you see drip off when you cook a hamburger on the grill is the *triglyceride* being broken down from around the tissue
 - fried chicken, then, has no more cholesterol than baked chicken, though the frying process does add more *triglyceride* to the food

ADA's (now Academy of Nutrition and Dietetics) position on the intake of

fats: the American Dietetic Association (Academy of Nutrition and Dietetics) offers an [official position on the dietary intake of fats and oils](#) which will summarize several of the concepts here and give you practical dietary examples of each.

Lipid Digestion: illustrations in your text or within the Power Point slides will be very beneficial as you work through this section.

- Problem exists in GI tract dealing with lipids: GI fluids are water soluble so lipid components separate
 - this means there is no significant digestion of lipid in the mouth or the stomach (see illustration in text, Fig. 5-12)
- Bile is secreted by the gallbladder into the small intestines to emulsify the lipid compounds
- Now **pancreatic lipase** (enzyme) can break the bonds of the triglyceride or phospholipid into the component parts
 - See Fig 5-11
- Cholesterol is not digested, but absorbed unchanged once it breaks away from the other elements in the food