Chemistry 1010

The Chemistry of Food:
Fats and Oils
For the rest of this unit, we will be talking about the chemistry of food.

From a scientific point of view, what are the chemicals in food useful for?

- providing energy
- raw material for building and repairing tissues
- participate in chemical reactions
What's in food?

macronutrients – major components of food
- carbohydrates
- fats and oils
- protein
- water

micronutrients – components of food found in smaller amounts
- vitamins
- minerals

non-nutrients – other things added to food
- artificial sweeteners, preservatives, etc
Fats and Oils

Today we will continue our discussion of macronutrients by looking at the chemistry of fats and oils.

What are fats and oils primarily useful for?

they provide energy

How do fats compare with carbohydrates at providing energy?

carbohydrates: 4 calories per gram
fats: 9 calories per gram

What percentage of calories are recommended to come from fat?

30%
What are some other things fats are useful for?

- carry flavor
- create a feeling of fullness
- energy storage
- store fat-soluble vitamins
- cushion organs
provide insulation

form cell membranes

protect nerves (myelin sheath)
Of course, too much stored fat can be a health hazard.

Obesity is connected to higher risks of:

- Hypertension
- Type 2 diabetes
- Coronary heart disease
- Stroke
- Gallbladder disease
- Osteoarthritis
- Sleep apnea and respiratory problems
- Some cancers (endometrial, breast, and colon)

Most Americans have difficulty with...

- too much fat
- the wrong kinds of fats

...in their diet.
So, what do fat molecules look like?

- 3 ester groups
- 3 long carbon chains

During digestion, fats are broken down into

three fatty acids

Glycero
Types of Fats

There are two main kinds of fats.

Saturated fats are made from fatty acids that have:

only C-C single bonds in their chains

Unsaturated fats are made from fatty acids that have:

one or more C=C in their chain
Unsaturated fats may contain monounsaturated or polyunsaturated fatty acids:

**monounsaturated**

![Monounsaturated fatty acid diagram](image1)

one C=C

**polyunsaturated**

![Polyunsaturated fatty acid diagram](image2)

2 or more C=C
Saturated fats usually come from: animal sources

chicken, beef, pork, milk, butter, etc

exception: fish usually have unsaturated fats
Unsaturated fats usually come from: **plant sources**

corn oil, olive oil, canola oil, avocados, nuts

exceptions: **tropical oils**

coconut oil, palm kernel oil
Physically, saturated fats are usually: 

![solid image]

while unsaturated fats are usually:

![liquid image]

Also, unsaturated fats often spoil easily,

while saturated fats usually have a longer shelf life.
Of course, foods don't actually have just one kind of fat.
It has also been recently discovered that there are two important categories of unsaturated fats.

**omega-3 fatty acids**

- found in: flax seeds, salmon, walnuts

**omega-6 fatty acids**

- found in: corn oil, sunflower oil, safflower oil, soybean oil

The concern is that most people get plenty of omega-6 fatty acids, but not enough omega-3 fatty acids.

- omega-6: doubled from 1940 levels
- omega-3: 1/6 of 1850 levels
Processed Fats

Unsaturated fats can be chemically changed to saturated fats by a process called **hydrogenation**.

\[
\text{unsaturated fats} + \text{H}_2 \rightarrow \text{saturated fats}
\]

Why would we want to do this?

- gives the oils a longer shelf-life
- makes them easier to spread!
- keeps oils from separating
- plant-based oils are cheaper

Most processed foods contain **partially hydrogenated oils**.

- some of the unsaturated fats are changed, some not
Unfortunately, the process of partial hydrogenation has a side effect:

it produces trans fatty acids

Natural fatty acids have a U-shaped C=C.

Trans fats were considered an advantage by the food industry:

long shelf life, but listed as unsaturated fat

Unfortunately, they have been linked to:

heart disease, breast cancer
Rather than banning trans fats outright, a law was passed requiring the amount of trans fat to be listed on the nutritional label.

It is estimated that at least 30,000 deaths due to coronary disease could be prevented by eliminating trans fats.

How will this make a difference?

consumers will choose products that don't have trans fats

Kraft has voluntarily eliminated partially hydrogenated oils from their products.

However, if it is under 0.5 g, it can be listed as 0 g. Look for partially hydrogenated oils on the label!
Health effects of fats

Which fats are good for you?

- monounsaturated fats
- polyunsaturated fats (especially omega-3 fats)

Which fats are bad for you?

- saturated fats
- trans fats