

### Lecture 2:

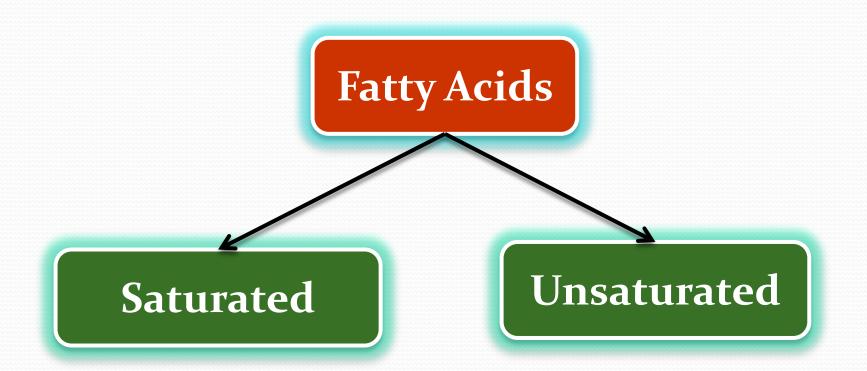
## Fats (Lipids)



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### **Types of Fats:**



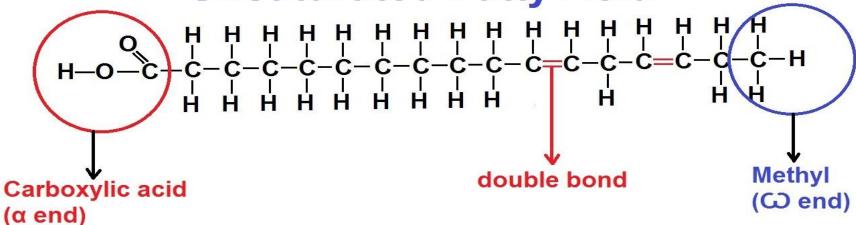
 Based on the presence or absence of double bonds, fats are classified into saturated and unsaturated groups.

• Double bonds are sets of carbons that store higher amounts of energy and are chemically very active.

### **Fatty Acid Structures:**

### **Saturated Fatty Acid**





• Saturated Fat (SF) is a fat that has no double bonds at all.

• Monounsaturated Fat (MUSF) is a fat with only one double bond.

 Polyunsaturated Fat (PUSF) is a fat that has two or more double bonds in its structure.

### **Saturated Fatty Acids:**

Short Chain	Medium Chain	Long Chain
(2-5 carbons)	(6-12 carbons)	(> 12 carbons)
Butyric acid Propionic acid Valeric acid	Caproic acid Caprylic acid Capric acid Lauric acid	Myristic acid Palmitic acid Stearic acid

### **Basics:**

• Fats are macronutrients.

 To maintain optimal health, the body needs all three kinds of fatty acids.

• Fats make about 15% of total body weight of an average person.

One gram of fat provides 9 calories.

### **Food Sources of Different Types of Fats:**

Saturated	Monounsaturated	Polyunsaturated
Animal based: - Beef - Butter - Chicken - Dairy products - Egg yolk - Lamb - Pork Plant based: - Coconut oil - Hydrogenated margarine - Palm oil - Vegetable shortenings	Almond oil Avocado Canola oil Cashews Olive oil Peanuts Pecans Pistachios	Omega - 3: - Chia seeds - Fish - Flaxseeds - Hemp seeds - Pumpkin seeds - Walnut Omega - 6: - Black currant oil - Borage oil - Corn oil - Evening primrose oil - Grapeseed oil - Poppyseed oil - Safflower oil - Sesame oil - Soybean oil - Sunflower oil - Walnut oil - Wheat germ oil

#### Percentage of Different Fats in Different Oils and Food Items:

Oils or Food	Saturated Fat	Monounsaturated	Polyunsaturated
Items		Fat	Fat
Almond butter	10	60	30
Avocado oil	10	75	15
Butter	65	30	5
Canola oil	5	60	35
Coconut oil	93	5	2
Corn oil	15	25	60
Cottonseed oil	25	20	55
Lard	40	50	10
Olive oil	15	75	10
Palm oil	50	40	10
Peanut oil	15	50	35
Pistachio oil	15	55	30
<b>Safflower oil</b>	10	10	8o
Soybean oil	15	25	60
<b>Sunflower oil</b>	10	20	70
Tallow	54	45	1

### **How Much Fat Do We Need?**

 According to health authorities, the total daily intake of fats in an average person should be about 25% of total daily calories or 65 grams a day, whichever counts lower.



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#### • Example 1:

Suppose your totally daily calories are 3000. Twenty five percent of your calories would be 750.

Since 1 gram of fat generates 9 calories, 750 divided by 9 equals to 83.

Your total daily fat intake should be 65 grams, because 65 is smaller than 83.

#### • Example 2:

If your total daily calories are 1800, twenty five percent of it would be 450, which is equal to 50 grams of fat.

Your total daily fat intake should be 50 grams, because 50 is smaller than 65.

### Daily Needs of Fats:

Fat	Daily intake
Total fat	65 grams
Total saturated fat	20 grams
Cholesterol	300 milligrams

### **Cholesterol:**

- Cholesterol is the main sterol synthesized by the body.
- The total body content of cholesterol in an average person is about 35 grams, which is primarily incorporated in the cell membranes and a small amount is in the blood.

• The liver synthesizes approximately 70% of the body's total cholesterol.

 Daily production of cholesterol in the body varies between 0.5 and 2 grams.

### **Food Sources of Cholesterol:**

Foods	<b>Serving Size</b>	Cholesterol (mg)
Beef, cuts	100 grams	80
Cheese		
-Cottage cheese 1%	100 grams	10
-Cheddar cheese	100 grams	100
-Swiss cheese	100 grams	80
Chicken, roasted	100 grams	80
Egg yolk	One medium	210
Cream cheese	100 grams	110
Fish		
-Tuna, canned	100 grams	50
-Sardines, canned	100 grams	140
Lamb		
-Cuts	100 grams	80
-Raw	100 grams	370
Liver, chicken	100 grams	600
Milk		
-Skim	1 cup	5
-1%	1 cup	10
-2%	1 cup	20
-3.25% (Whole milk)	1 cup	30
Pork		
-Cuts	100 grams	80
-Raw	100 grams	370
Shrimp	100 grams	190
Turkey, roasted	100 grams	100
Yogurts	1 cup	10 – 30

### Triglyceride:

• Triglyceride (TG) constitutes approximately 95% of the fats in the body and foods.

• It is the stored form of fat and made of glycerol attached to three fatty acids.

 Glycerol is water – soluble and short chain carbohydrate.

### **Triglyceride:**

**Glycerol** + 3 Fatty Acids





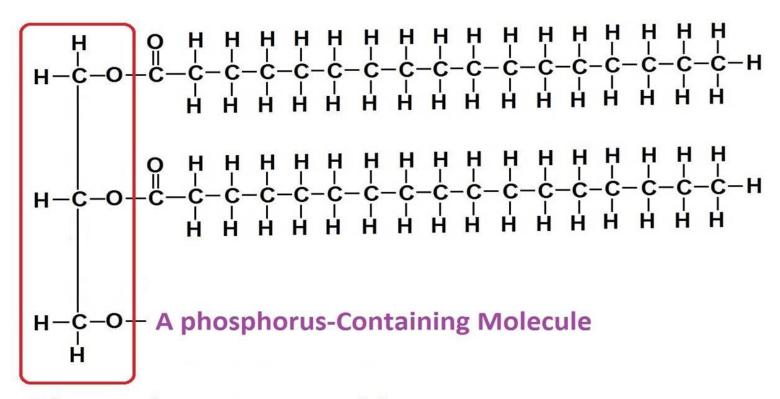
### Phospholipids (PL):

• They are a class of fats and a major component of all cell membranes.

• Their structures are very similar to triglyceride:

Glycerol + two fatty acids + a phosphoruscontaining molecule.

### Phospholipid:

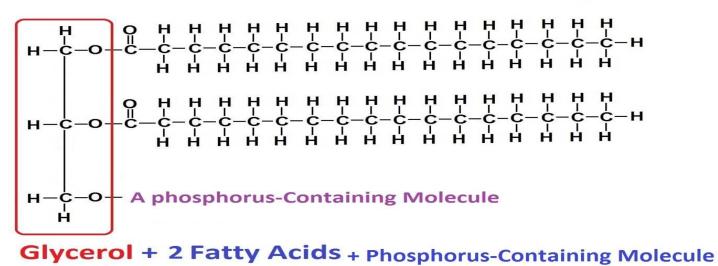


**Glycerol** + 2 Fatty Acids + Phosphorus-Containing Molecule

#### **Triglyceride:**

**Glycerol + 3 Fatty Acids** 

#### **Phospholipid:**

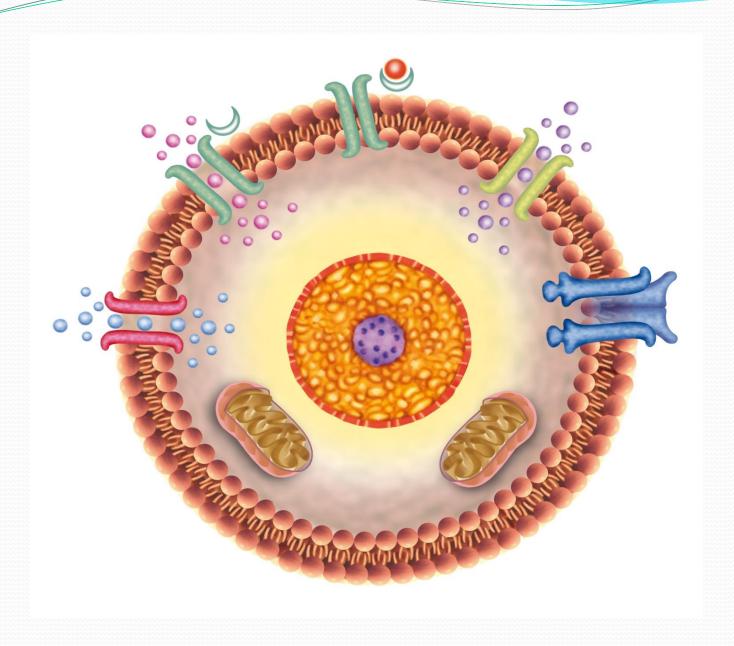


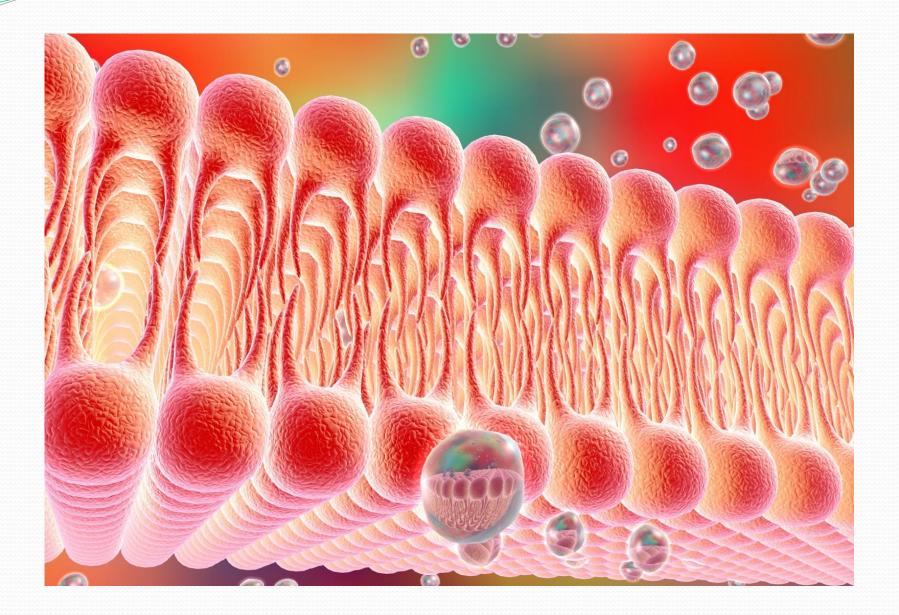
#### **Phosphorus-Containing Molecule:**

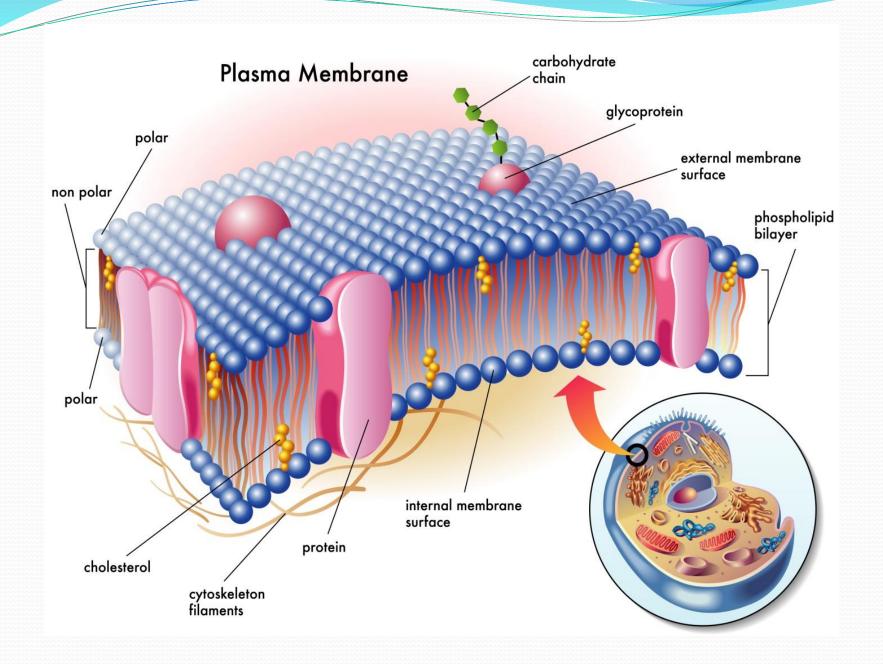
- 1) Phosphatidylcholine (PC) (Lecithin).
- 2) Phosphatidylinositol (PI).
- 3) Phosphatidylserine (PS).

#### Lecithin:

- Is the most studied PL.
- Derived from soybeans.
- Used widely as a food additive in margarine, shortening, chocolate, ice cream and processed baked foods such as cakes.







### Sphingolipid (SL):

- Closely related to phospholipids.
- A class of lipids that contains sphingoid.
- Sphingomyelin is a unique SL found in the membranes of the nerve cells especially myelin sheath. It plays an important role in signal transmission across the cell.

# Functions of Fats in the Body (Why Do We Need Fats?):

- Fats have many life supporting functions in the body.
- 1) They are a big part of cell membrane, keeping the cell stronger against invasion by microorganisms and damage by chemicals.
- 2) They have a key role in the nervous system.

3) They are important in the formation of sex hormones.

4) They play a crucial role in forming bile acids and vitamin D.

5) They are potential sources of energy by generating 9 calories per one gram.

- 6) They act as a protective blanket, shielding the internal organs from trauma and cold, especially the heart, kidneys, liver, spleen, and spinal cord. About 4% of the body's fat is in the protective blanket.
- 7) Fat under the skin helps prevent from heat loss and protect the body against external temperature changes. In fact, the subcutaneous fat helps people tolerate extreme cold by acting a thermal insulation.

## 8) Fats facilitate absorption of vitamins A, D, E, and K.

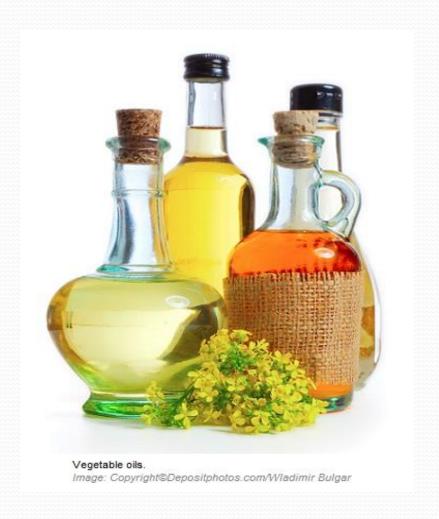


A butter curi.
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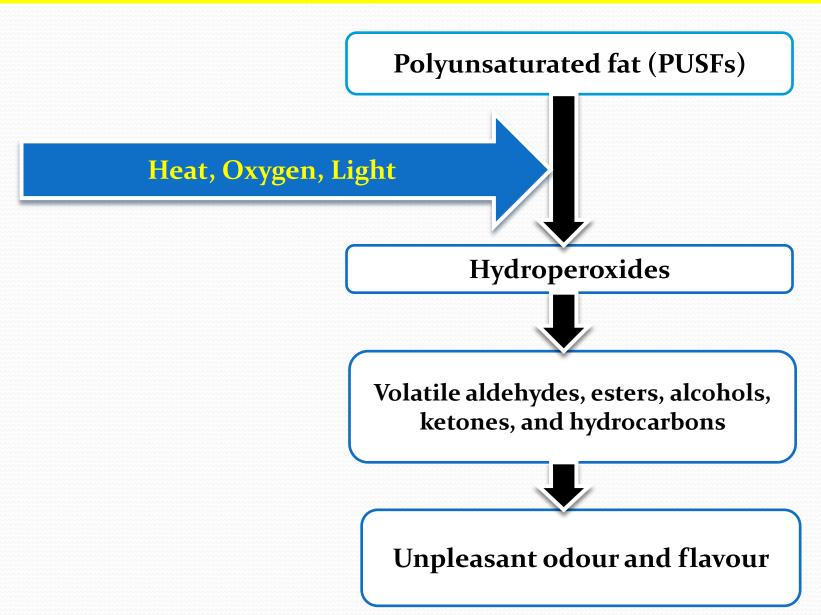
• 9) Lipids are good hunger suppressors. After ingesting fats, it takes about 3 to 4 hours for the stomach to deliver them to the small intestine. In facts, lipids stay longer in the stomach, decreasing the release of hunger hormone, ghrelin, followed by a decrease in hunger feeling.

### Three Issues with Fats:

- Rancidity.
- Hydrogenation.
- •Trans Fats.



#### Rancidity (lipid peroxidation):



### Rancidity:

To prevent from rancidity, antioxidants are usually added to PUFAs:

- Vitamin-E.
- B-Carotene.
- BHT (Butylated hydroxytoluene).
- BHA (Butylated hydroxyanisole).
- Extracts from antioxidant herbs such as sage, rosemary, or thyme.

## **Hydrogenation:**

 It is a process in the food industry in which hydrogen is added to PUFAs.

- Why hydrogenation?
- 1) In order to ship PUSFs easier and shelve them for long time .
- 2) To lesser rancidity.

• Problems with Hydrogenation?

1) Lowers the quality of the oil.

2) Converts some unsaturated fats to trans-fats.

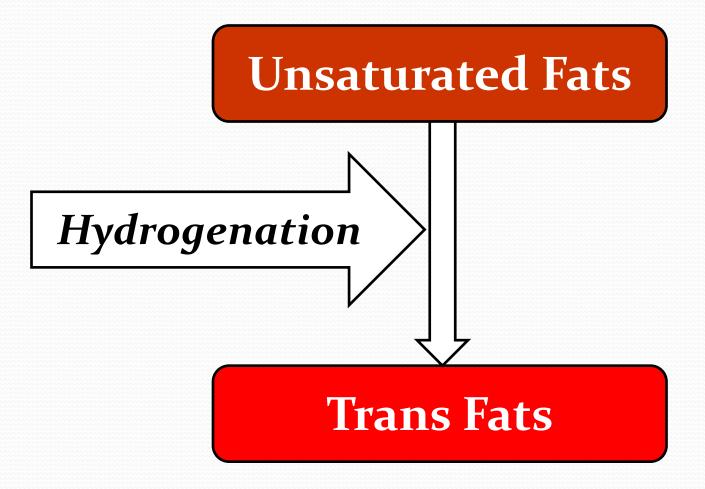
3) Partially hydrogenated fat should be a red flag, pointing to the presence of altered PUSFs and trans-fat in the product!

#### **Trans-Fat:**

 Trans fat is an unsaturated fat with trans-isomer fatty acids. Chemically, trans fat is a fat molecule that contains one or more double bonds in trans configuration.

- Trans fats are either monounsaturated or polyunsaturated, but never saturated.
- Trans fat is made by adding hydrogen to vegetable oil through a process called *hydrogenation*, which makes the oil less likely to spoil.

### **Trans-Fats:**



# **Saturated**

**Trans** 

 Using trans fats in the manufacturing of foods helps foods stay fresh longer, have a longer shelf life and have a less greasy taste.

 Foods with Trans fat: crackers, cookies, cakes, doughnuts, muffins and French fries.

### **Health Risks of Trans Fats:**

Trans fats increase the risk of developing the following conditions:

- 1) LDL cholesterol.
- 2) Heart diseases.
- 3) Cancers.
- 4) Alzheimer's disease.
- 5) Infertility in women.
- 6) Obesity.
- 7) Metabolic syndrome.
- 8) Liver dysfunction.

#### **Trans Fat Regulations:**

Many countries have their own regulations about transfats, but they are very similar to each other.

On June 20, 2007, the Trans Fat Task Force from Health Canada gave two recommendations:

- 1) Limit the trans fat content of vegetable oils and soft, spreadable margarines to 2% of the total fat content; and
- 2) Limit the trans fat content for all other foods to 5% of the total fat content, including ingredients sold to restaurants.

Health Canada closely monitors the actions of the industry via the Trans Fat Monitoring Program to make sure that the industry is making progress in meeting the 2% and 5% limits of the total fat.

Portion de 3/4 lasse (52 y)		
Teneur par portion		Avec 2 tasse lait 1 %
Calories	200	250
% valeur quotidienne		
Lipides 3 g <sup>†</sup>	5 %	7 %
saturés 0,4 g + trans 0 g	2 %	4%
Cholestérol 0 mg	0%	2 %
Sodium 95 mg	4 %	6 %
Detection 000	- 0 0/	dF O/

- As outlined in the Food and Drug Regulations in Canada, the amount of trans fats can be labelled as "o g" in the Nutrition Facts Table and the product may be labelled as "trans-fat free" if the following conditions are met:
- The food:
- A) contains less than 0.2 g of trans fat per
  - reference amount and serving of stated size, or
  - serving of stated size, if the food is a prepackaged meal; and
- B) meets the conditions set out for "low in saturated fats".

#### **Digestion and Metabolism:**

• 1) Digestion starts from the mouth.

 2) Fats change into short chain FAs in the small intestine followed by getting absorbed and carried to the liver. • 3) If the digestive system is working well, up to 95% of the fats in foods are absorbed into the body.

• 4) A very small amount of fats is excreted through colon.

#### **Homework:**

- 1) Describe the functions of fats in the body.
- 2) List the names of oils or food items that contain saturated, monounsaturated and polyunsaturated fats (five examples for each).

