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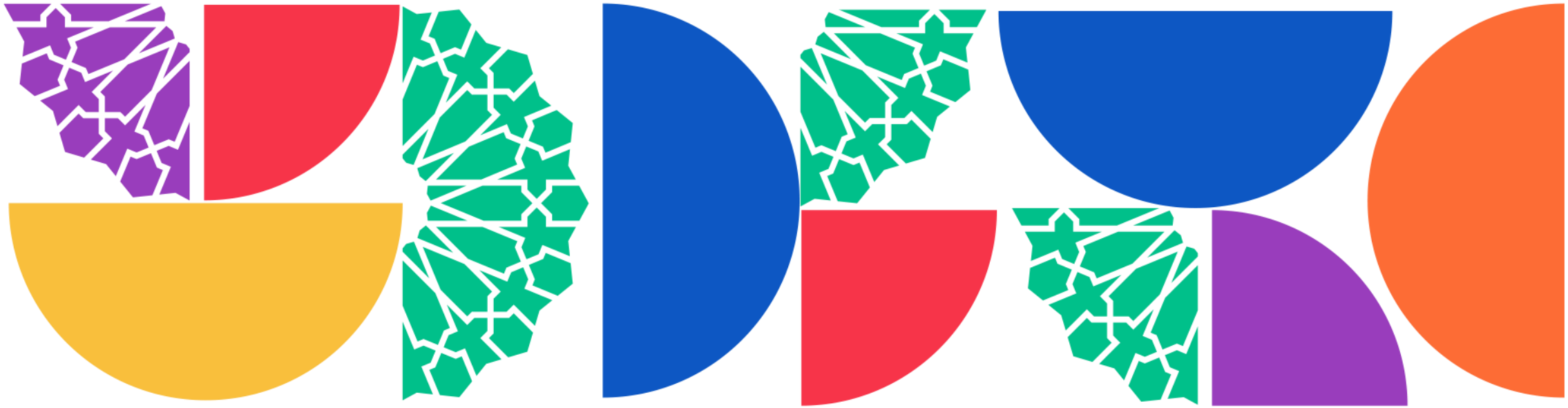
Health Awareness and Nutrition:

Department of Clinical Nutrition and Dietetics
College of Health Sciences

Lecture 5:Lipids

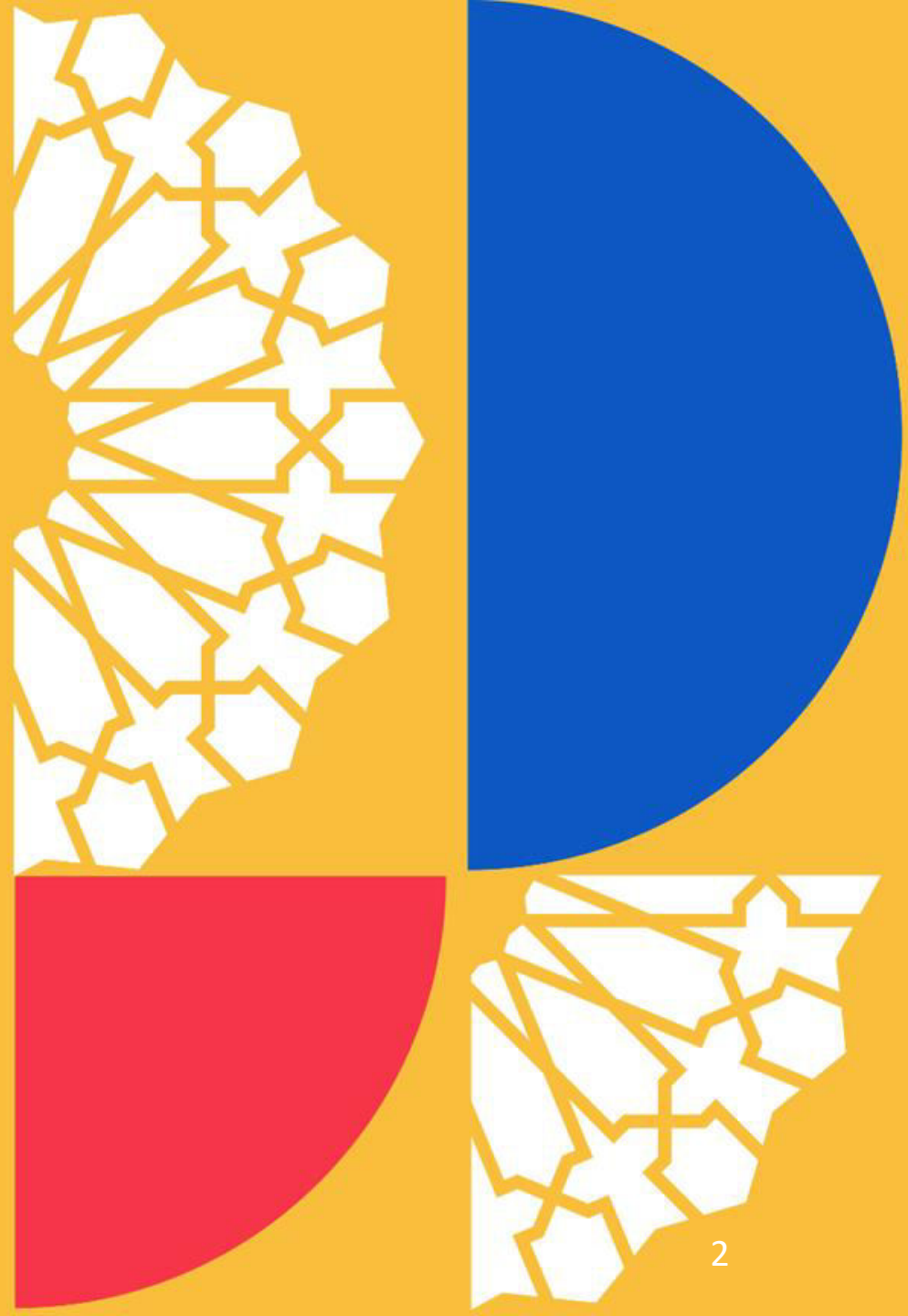


Introduction

Lipids are organic compounds that are insoluble in water but soluble in organic solvents like chloroform, ether, and benzene.

Body fat constitutes approx. **10-30%** of total weight (10-20% for adult **males**, 20-30% for adult **females**.)

Accumulation of **1 Kg of fat** (adipose tissue) corresponds to **7700 Kcal** *(kilocalories)* of energy.



Introduction

Dietary fats come in two forms.

- **Fats**: semi-solid at room temperature (25°C)
- **Oils**: liquid at room temperature

Sources of fats and oils:

Animal fats: butter, margarine, milk, cheese, egg, meat and fish

Vegetable fats: peanuts, sesame seeds, nuts (walnuts, almonds, and pistachios) and coconut

Vegetable oils: olive, soy, sunflower, corn, canola and cottonseed oils.

Fat: Sources and Types

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Sources

- **Animal fats** → Butter, margarine, milk, cheese, eggs, fat of meat & fish
- **Vegetable fats (oils)** → Seeds of peanut, sesame, nuts (whole nut, peanuts), coconut

Types

- **Visible fat** → ***Separated from their natural source, used mainly in cooking***
  Butter, margarine, oil, white parts in meat
- **Invisible fat** → ***Not visible to naked eyes. Part of natural food***
  Part of milk, cheese, nuts, salad dressings

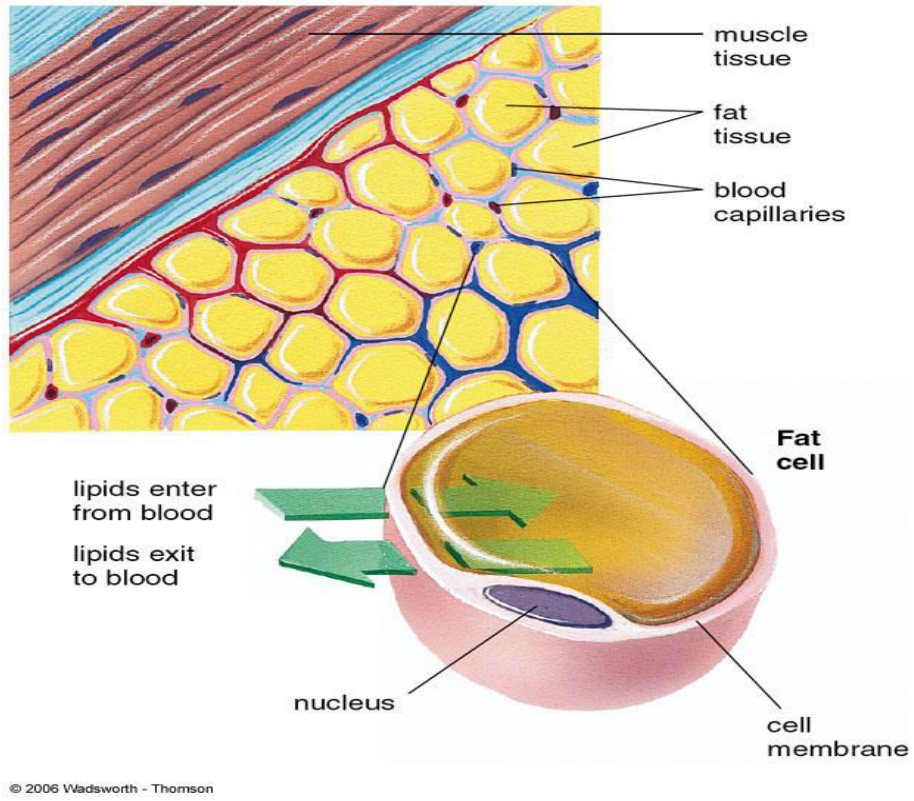
Food with visible fats

Food with invisible fats

Function of fat in the body

1. Storage form of energy

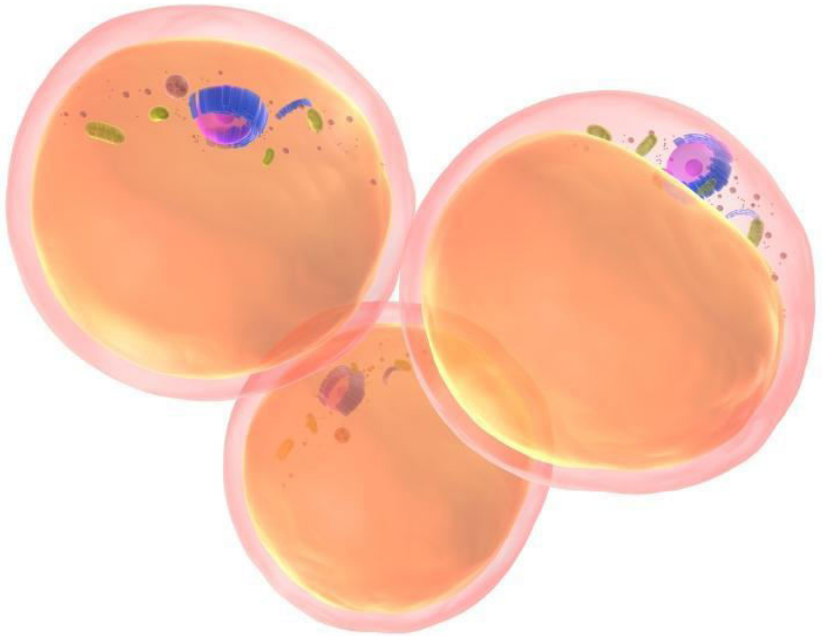
- Fat (triglycerides) is the **body's chief storage form for excess energy consumed**
- Fat is stored in specialized cells called **fat cells or adipocytes** that have the ability to enlarge almost indefinitely
- Concentrated source of energy:
  - **1 g of fat gives 9 Kcal**



Function of fat in the body

2. Shock absorber

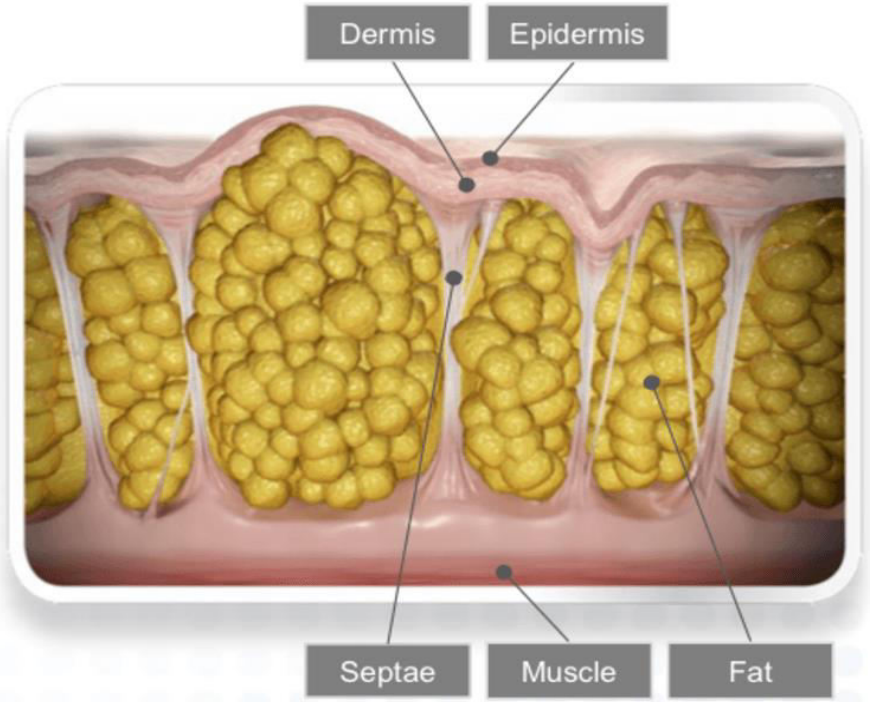
- Fat surrounding the internal organs (heart, liver, intestines…) serves as **shock absorbers**



Function of fat in the body

3. Insulating layer

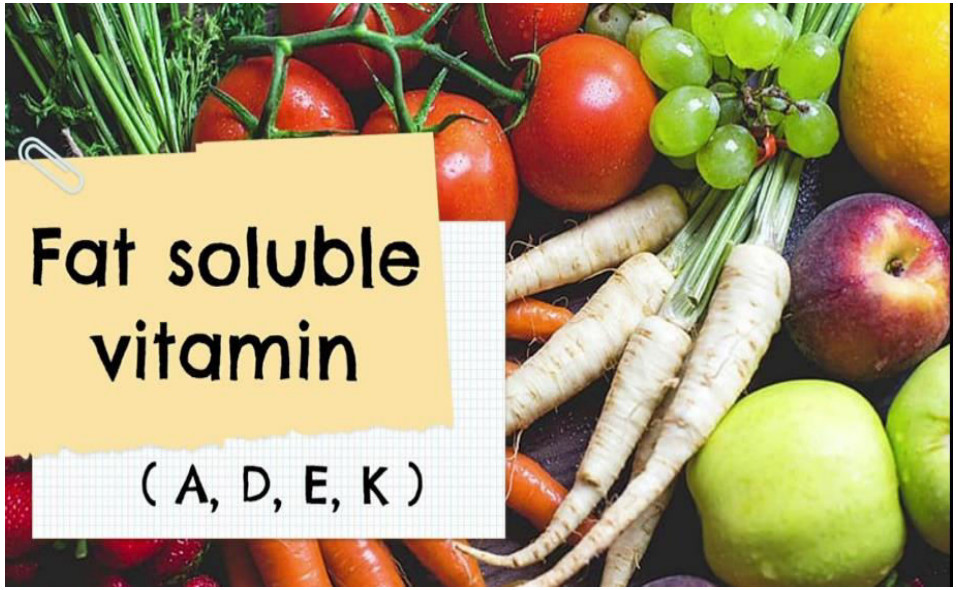
- The fat blanket under the skin (adipose tissue) serves as an **insulating layer** against temperature extremes.
- Fat is a poor conductor of heat, so the layer of fat beneath the skin helps keep the body warm
- Fat is also **part of all cell membranes**



Function of fat in the body

4. Storage place for some vitamins

- Vitamins A, D, E, and K are only soluble/found in fat-rich foods and stored in fat within our body



Function of fat in the body

5. Provide taste and satiety

- Fat contributes to **taste** and sensory appeal of foods
- People naturally like high-fat foods
- Flavors
- Tenderness
- Fat **slows digestion** and provides satiety (feeling full)

Function of fat in the body

6. Essential fatty acids

- Essential fatty acids (omega 3 and omega 6) are needed by the body for growth and structural integrity of cell membranes

7. Cholesterol

- Cholesterol helps in the formation of steroid hormones & bile acids

Classification of lipids

Lipids are classified as:

- Simple lipids (**triglycerides)**
- Compound lipids **(phospholipids)** ex.: lecithin in eggs
- Derived lipids (**Sterols or cholesterol**)

The human body can synthesize triglycerides, phospholipids and cholesterol

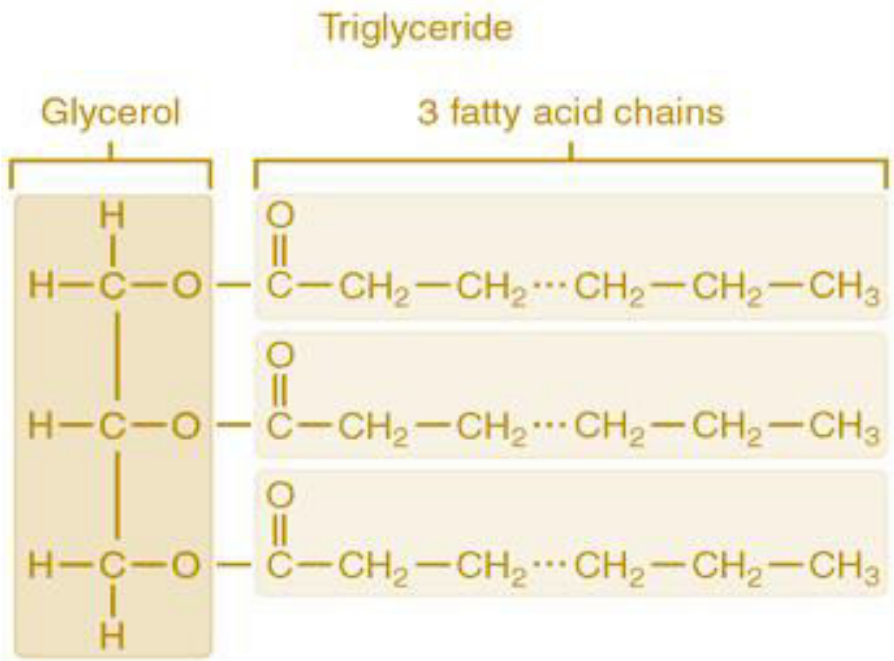
Simple lipids

1. Triglycerides

The most common form of fat in food and the body

Triglyceride= 3 fatty acids + 1 glycerol

- Triglycerides: Animal and plant origin
- Triglycerides are found in semi-solid fats and liquid oils

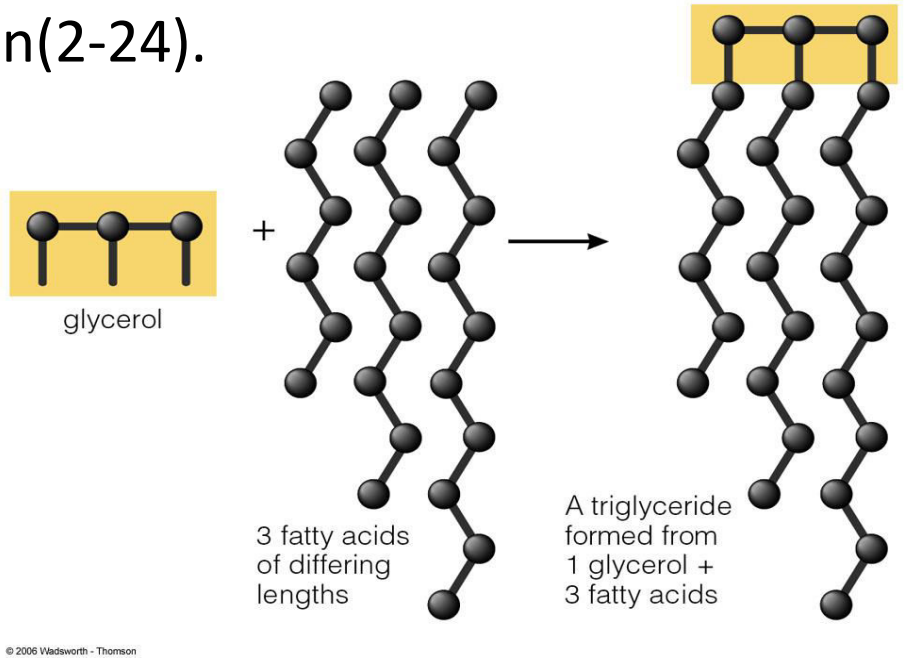


Triglycerides - Fatty acids (FA)

- Each FA has a long chain of **carbons and hydrogen** and at the end a **carboxyl group COOH**
- Each FA differs by **length** and **saturation**
- FA have an even # of carbon(2-24).

- ***Examples***:

→ **Olive oil (18 carbons)**
→ **Palm oil (16 carbons)**

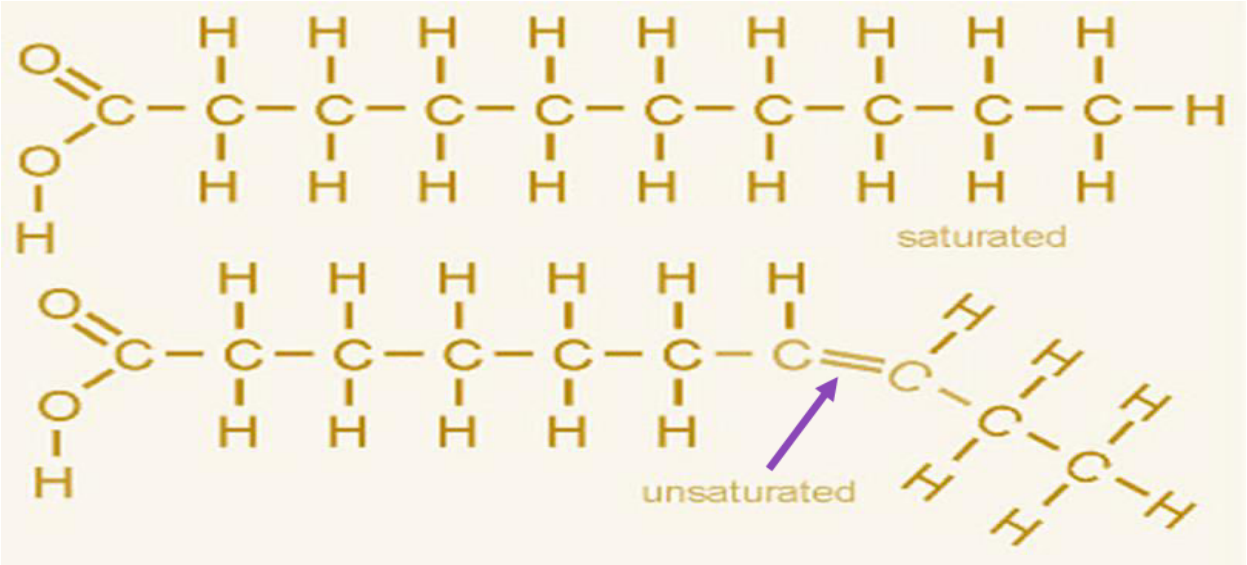


Triglycerides - Fatty acids (FA)

- **The FA can be:**

→ Saturated: (no double bonds)

→ Unsaturated: (1 or more double bonds)



Triglycerides - Fatty acids (FA)

FA are classified according to their degree of saturation (number of double bonds)

- **Saturated Fatty Acids (SFA)**

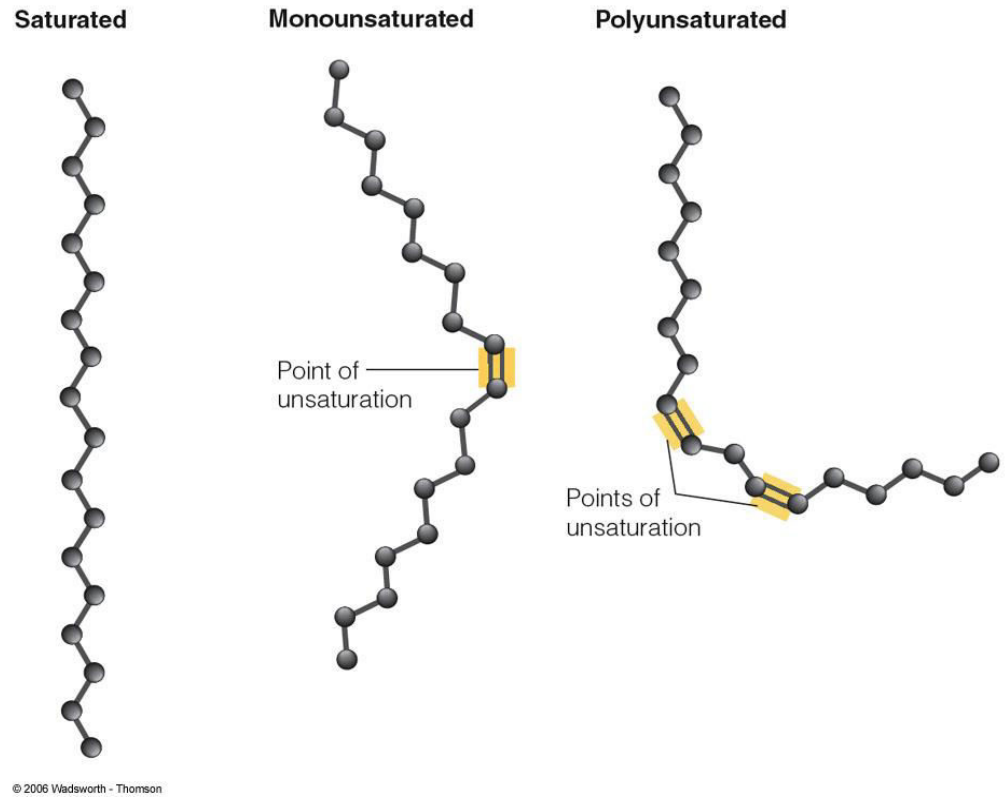
→ no double bonds

- **Monounsaturated Fatty Acids (MUFA)**

→ one double bond

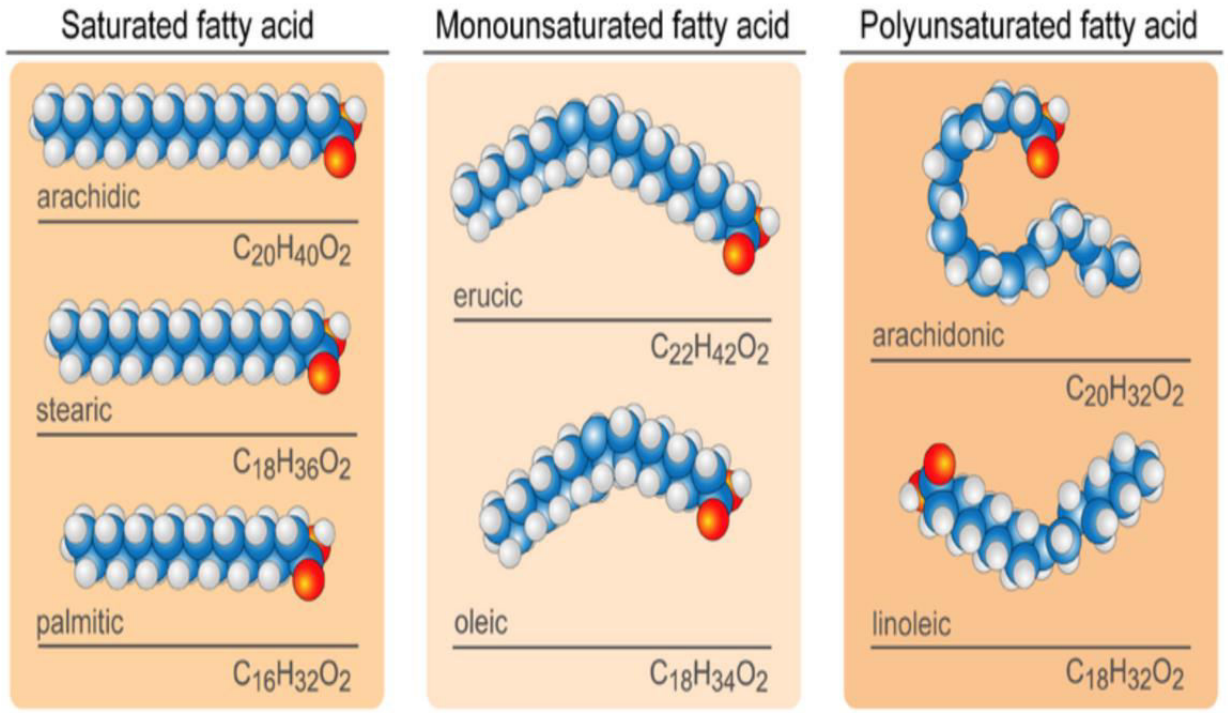
- **Polyunsaturated Fatty Acids (PUFA)**

→ two or more double bonds



Triglycerides - Fatty acids (FA)

The vast majority of triglycerides contain more than one type of fatty acid.



Triglycerides - Fatty acids (FA)

- In general, vegetable oils and fish oil are rich in **unsaturated FA**
- Unsaturated FA tend to be more **liquid** at room temperature (oils)
- Unsaturated FA are more healthy

- While animal fats are rich in **saturated FA**
- SFA tend to be more **solid** at room temperature
- Saturated FA are more unhealthy

Triglycerides - Saturation

- **Firmness**

→ The *degree of unsaturation* influences the **firmness** of fats at room temperature

- **Stability**

→ Saturation also **influences stability** - all fats become spoiled when exposed to oxygen

→ Saturated fats are *most resistant* to oxidation and least likely to become rancid

- **Hydrogenation**

→ A chemical process by which **hydrogens are added** to monounsaturated or polyunsaturated fatty acids *to reduce the number of double bonds*, making the fats *more saturated* (solid) and more resistant to oxidation

Triglycerides - Fatty acids (FA)

Saturated F.A.

Found in:

- Animal products: beef, chicken, fish
- Dairy products (milk and cheese)
- Butter and margarine
- Coconut and palm oil

Triglycerides - Fatty acids (FA)

Unsaturated FA

1. MUFA (oleic acid)

Found in:

- Olive oil, canola oil, peanut oil
- Avocado

Triglycerides - Fatty acids (FA)

Unsaturated FA

2. PUFA (linolenic acid and linoleic acid) OR omega 3 and 6

Found in:

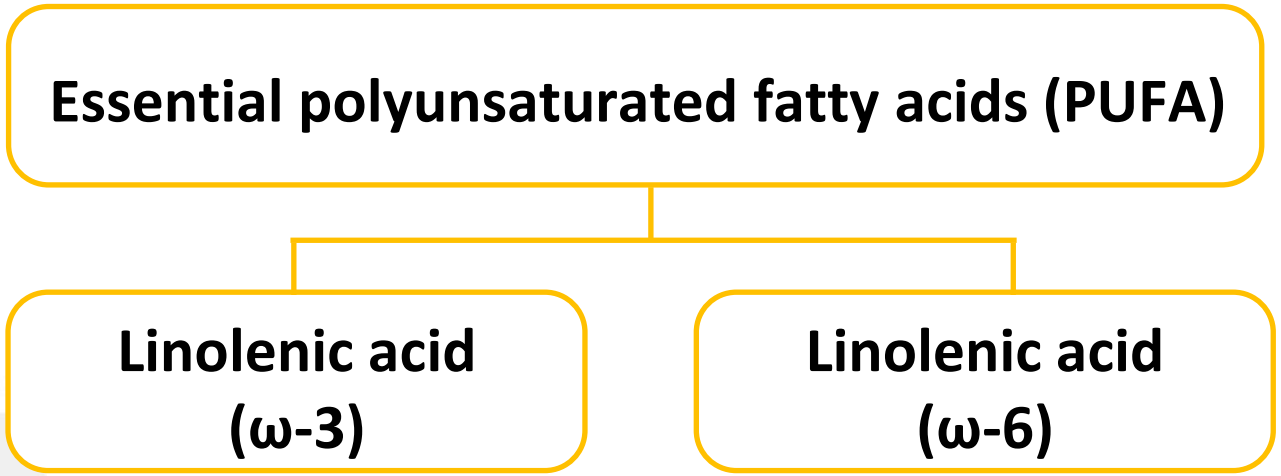
→ **Omega 3**

Vegetable oils (canola, soybean, flaxseed),walnuts, flaxseeds, fatty fish (mackerel, salmon, sardines)

→ **Omega 6**

Vegetable oils (corn, sunflower, safflower, soybean, cottonseed), nuts, seeds

Triglycerides - Fatty acids (FA)



- **Cannot** be synthesized in the body and thus need to be supplied from the diet
- Are nutritionally essential fatty acids and thus are *the only lipids* that are required components of the human diet
- Essential for **brain and nerve** development and promote **normal growth** and **vision**
- Recommended to eat fish a **minimum 2 times per week**
- Sometimes is taken as a supplement (ω3 = fish oil)

Triglycerides - Fatty acids (FA)

Trans fatty acids

- Trans fats are created in an industrial process that transform liquid vegetable oils to make them more solid through **hydrogenation**

- Companies like using trans fats in their foods because they are:

→ **Easy to use**

→ **Inexpensive to produce**

→ **Can be used many times in commercial fryers**

Triglycerides - Fatty acids (FA)

Trans fatty acids

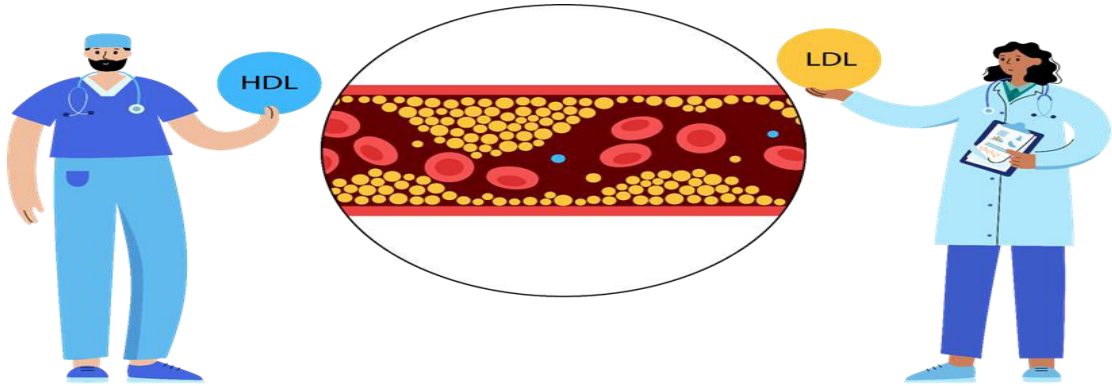
Found in:

- Fried foods like french fries and doughnuts
- Pastries, pie crusts, biscuits, pizza dough, cookies, crackers
- Margarines and shortenings

Triglycerides - Fatty acids (FA)

How do trans fats affect health?

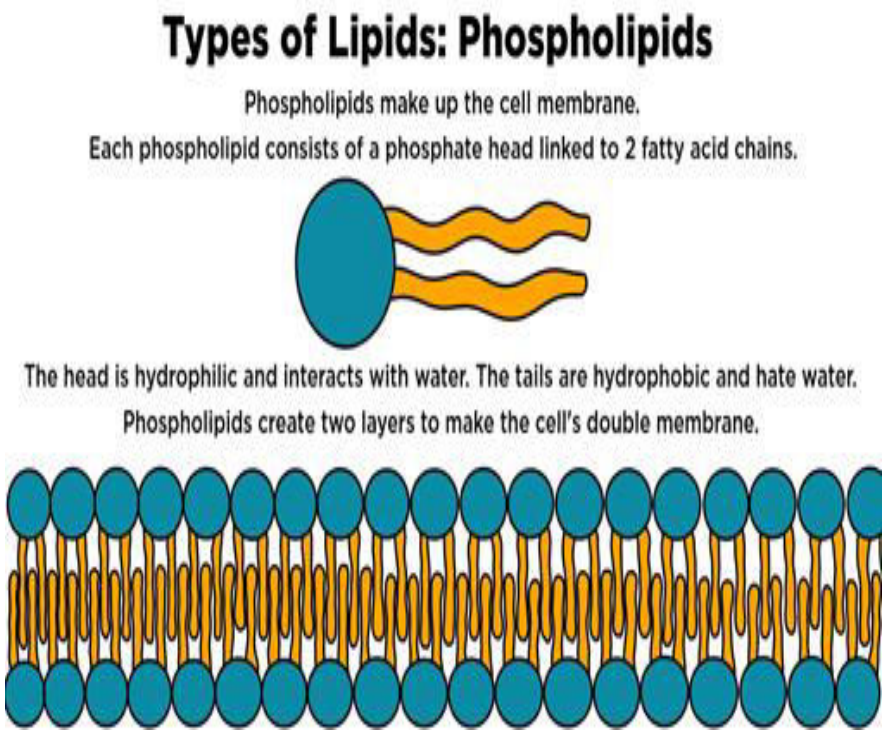
- Trans fats raise bad **(LDL)** cholesterol levels and lower good **(HDL)** cholesterol levels
- Eating trans fats *increases* the risk of developing **heart disease and stroke**



Compound lipids

2. Phospholipids

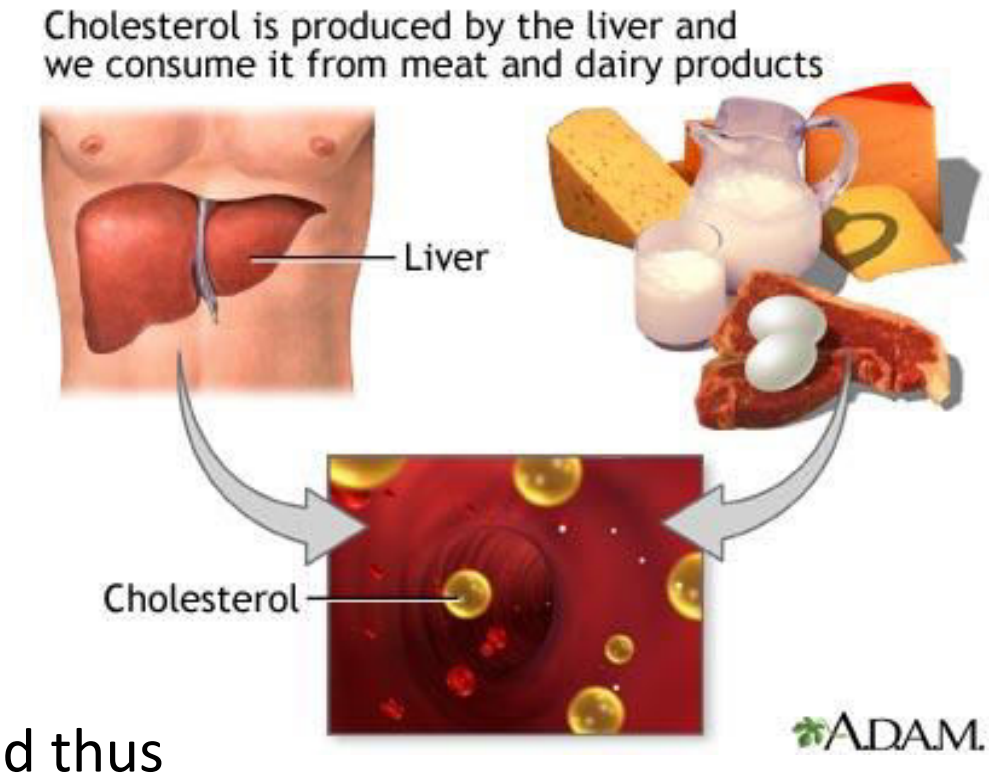
- The best-known phospholipid is **lecithin**
- **In the body**, phospholipids are part of cell membranes
- **The food industry** uses phospholipids as emulsifiers to mix fats with water
- Phospholipids are also found naturally in foods
- **Food sources:** sources of lecithin are eggs, liver, soybeans, wheat germ, and peanuts



Derived lipids

3. Sterols

- The most famous sterol is **cholesterol**
- Sterols other than cholesterol are **naturally found in all plants**
- Plant sterols interfere with cholesterol absorption, and lower blood cholesterol levels
- Cholesterol is synthesized in the liver of humans as well as obtained from animal products in the diet
- However, our body makes enough cholesterol and thus there is no need to get extra cholesterol from the diet



Cholesterol

Cholesterol in the blood is transported in two forms of lipoprotein particles

- **Low density lipoprotein (LDL)**

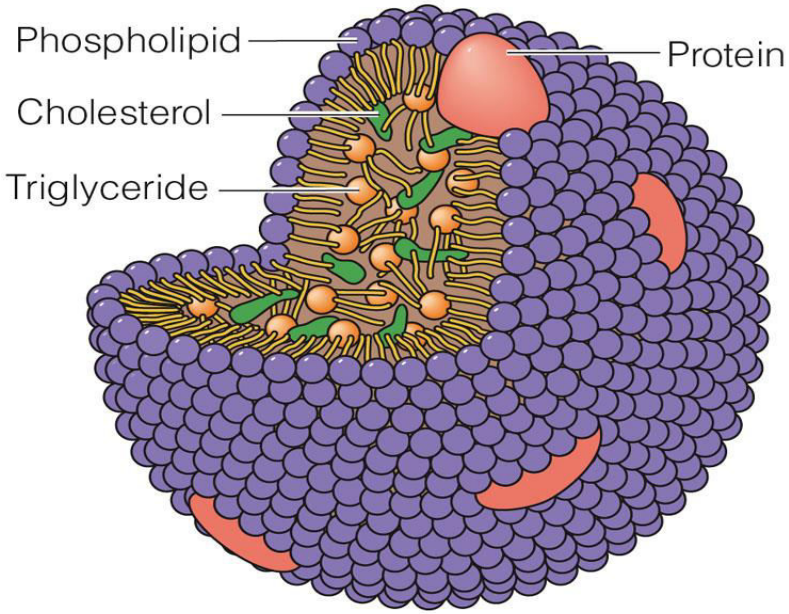
  Called the unhealthy cholesterol

  - *They can build up in the walls of the arteries, making them hard and narrow*

- **High density lipoprotein (HDL)**

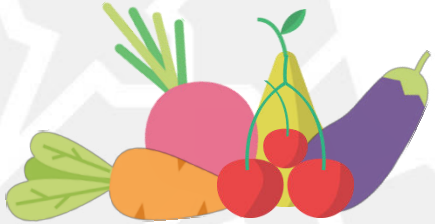
  Called the healthy cholesterol

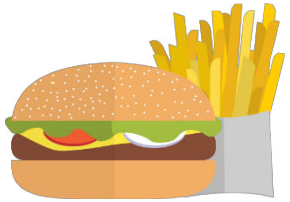
  - *They can pick up excess cholesterol and take it back to the liver*



A typical lipoprotein

High Cholesterol





What to eat?

- Olive and vegetable oils
- Fish
- Fruits and vegetables
- Nuts, walnuts, almonds
- Whole grains

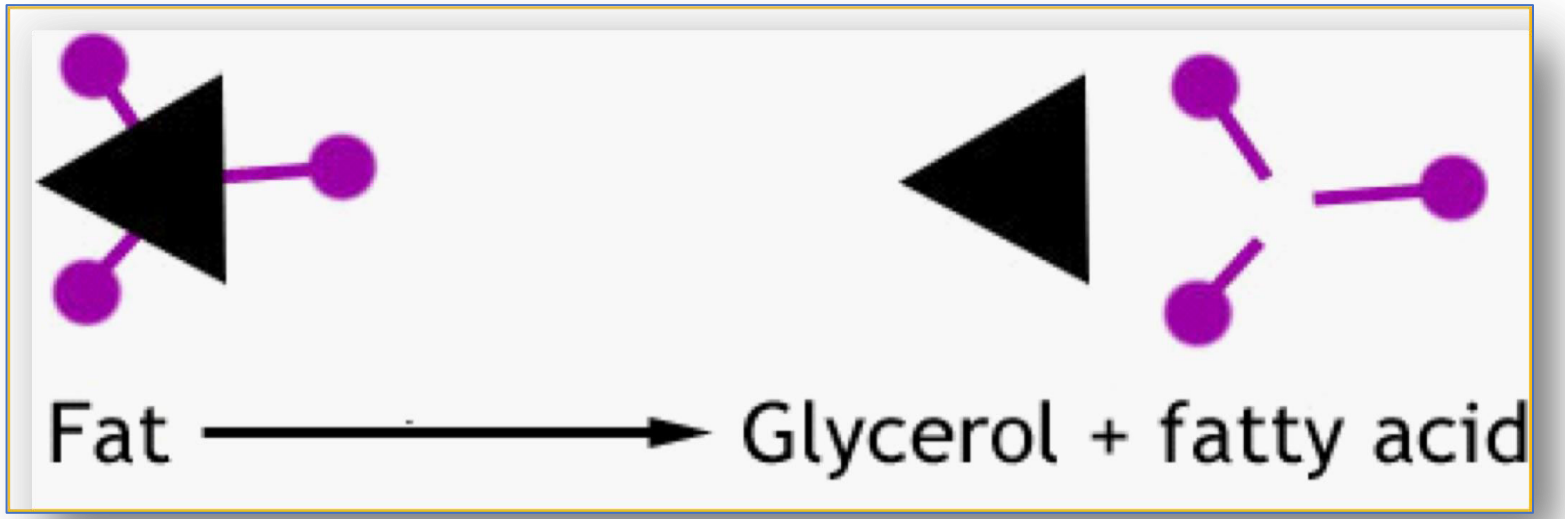
What to limit?

- Fried foods
- High fat dairy (milk and cheese)
- High fat desserts and salad dressing
- Red meat
- Butter and margarine

Lipid digestion

Goal of fat digestion:

Breakdown triglycerides
→ Monoglycerides, fatty acids, and glycerol

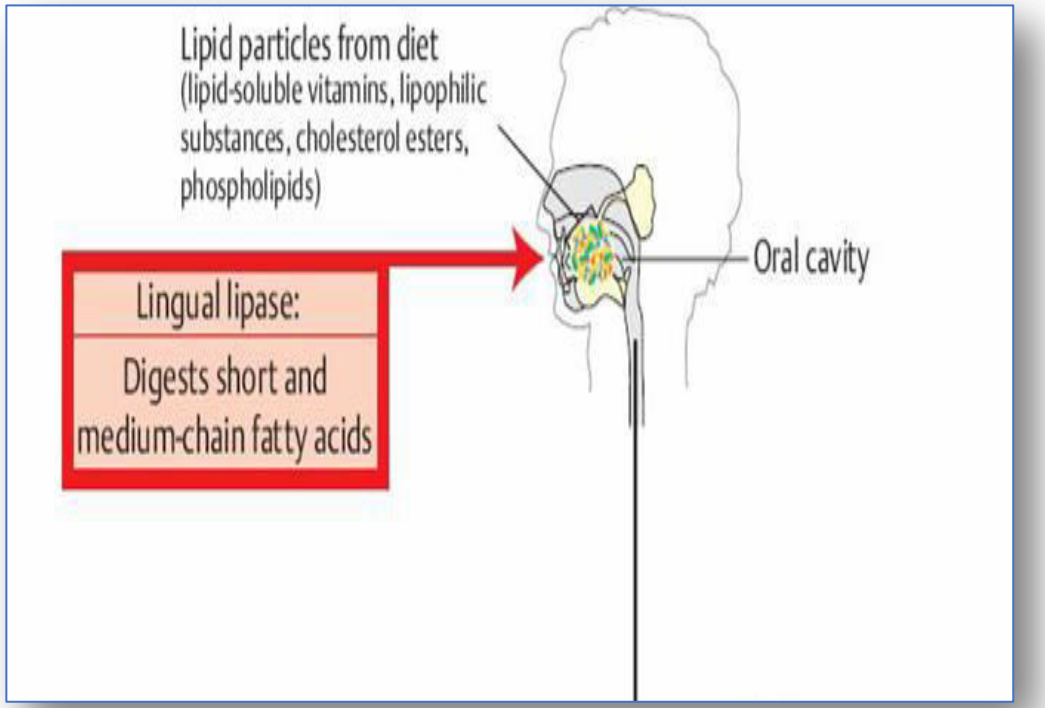


Lipid digestion

- **In the mouth:**

→ Hard fats begin to melt when they reach body temperature

→ **Lingual lipase:**
An enzyme that starts digestion in the mouth

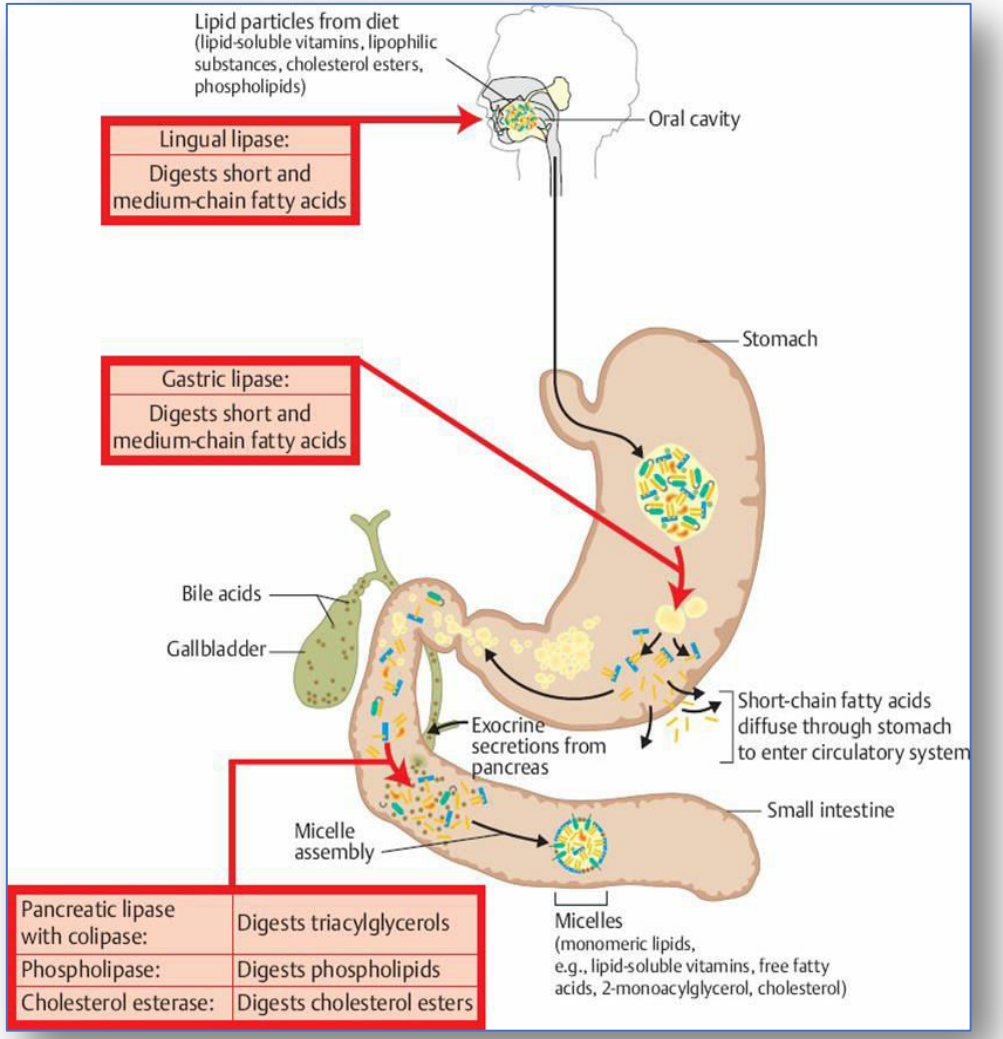


Lipid digestion

- **In the stomach:**

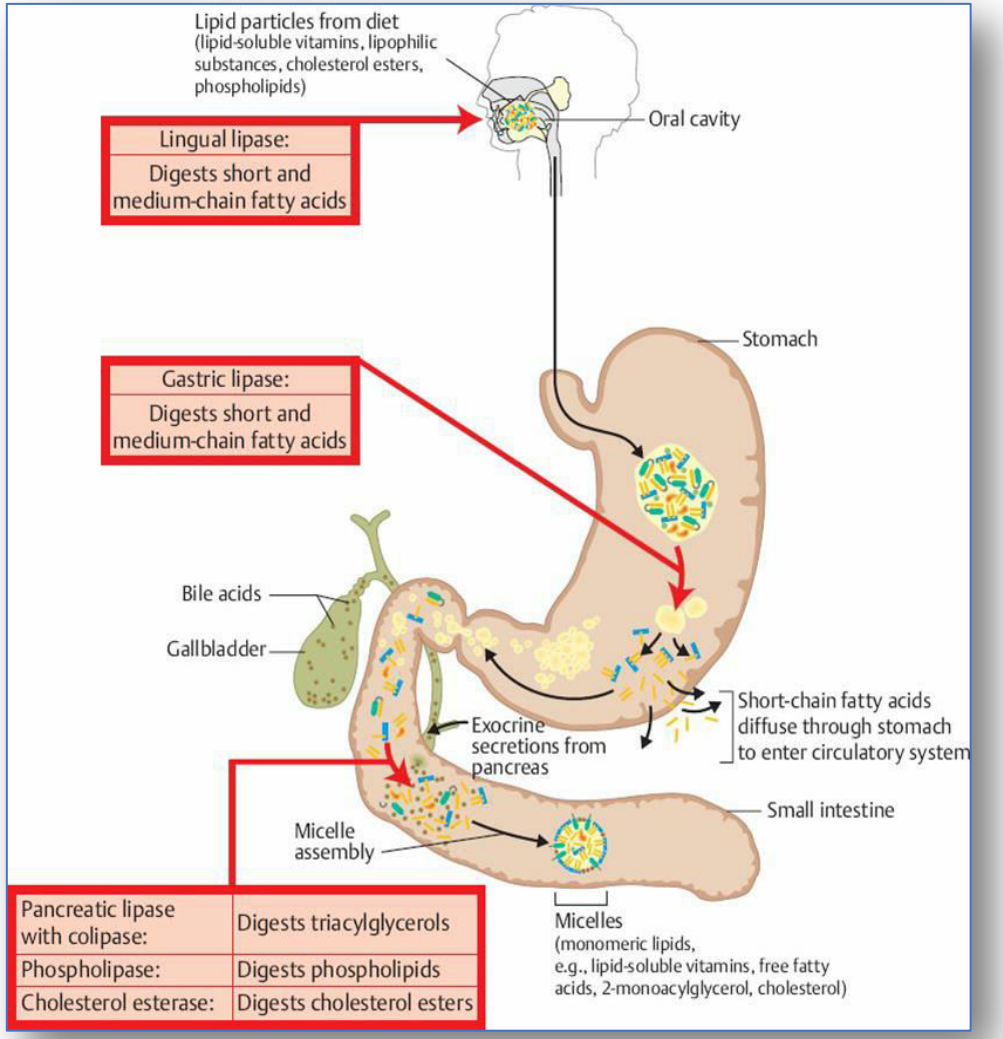
→ Strong muscle contractions (churning action mixes fat with water and acid)

→ **Gastric lipase:**
Enzyme that breaks down fat in the stomach



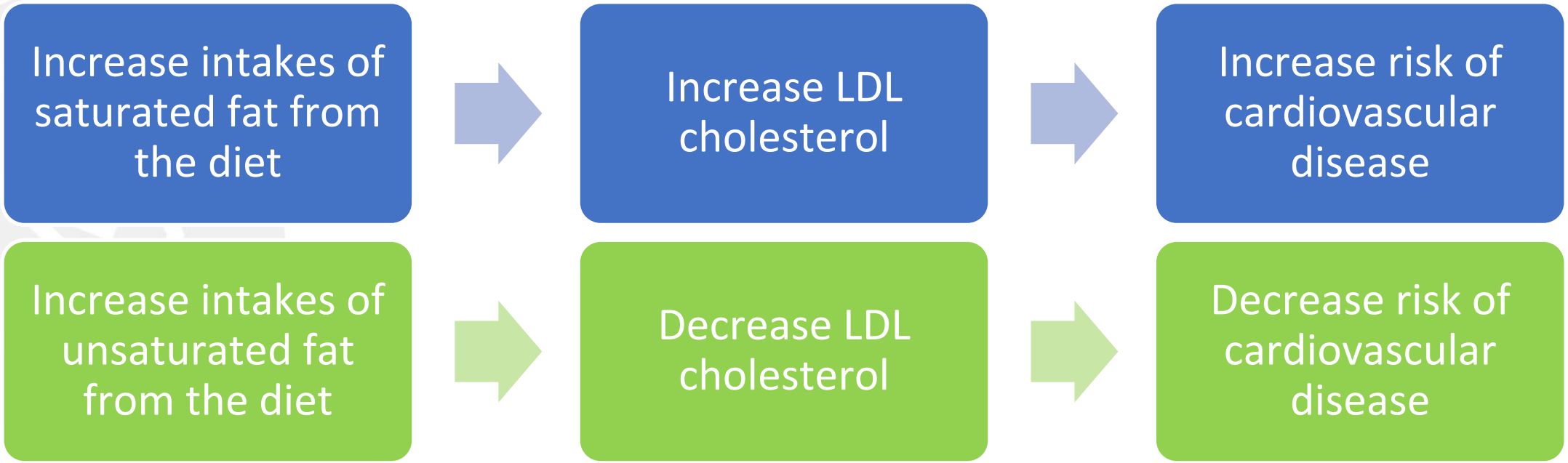
Lipid digestion

- **In the small intestines:**
  - **Cholecystokinin (CCK):** A hormone that makes the gall bladder release bile
  → acts as an emulsifier
  - **Pancreatic lipase:** An enzyme from the pancreas breaks down triglycerides and phospholipids
  → monoglycerides, glycerol, fatty acids



Health effects of lipids

- **The blood lipid profile** reveals the concentrations of various lipids in the blood
- Both the **amounts** and **types** of fat in the diet influence the risk for disease



Recommended intake of fats

Total Fat

→ **20 to 35 % of daily energy**

Divided between:

→ SFA (7-10%)

→ MUFA (15-20%)

→ PUFA 5-10%

→ Trans FA: as low as possible (Less than 1%)

Omega 3 and Omega 6

→ **Omega 3 =** 0.6-1.2%

→ **Omega 6 =** 5-10%

Cholesterol

→ **300 mg per day**

Nutrition Facts and fat on labels

Nutrition Facts

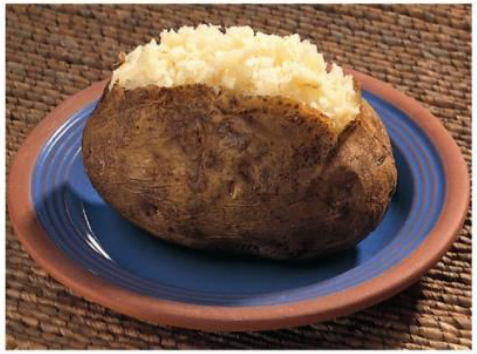
Amount Per Serving

Potato (5 ounces) with 1 tablespoon butter and 1 tablespoon sour cream

Calories 400	Calories from Fat 250
	% Daily Value
Total Fat 28g	**43%**
Saturated Fat 18g	**90%**
Cholesterol 37mg	**12%**

Whole milk (1 cup)

Calories 150	Calories from Fat 70
	% Daily Value
Total Fat 8g	**12%**
Saturated Fat 5g	**25%**
Cholesterol 24mg	**8%**



Plain potato (5 ounces)

Calories 150	Calories from Fat 0
	% Daily Value
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Cholesterol 0mg	**0%**

Fat-free milk (1 cup)

Calories 90	Calories from Fat 0
	% Daily Value
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Cholesterol 5mg	**2%**

Making wise choices

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Watch out for hidden fat or invisible fat

- Whole milk, cheese, pastries, cookies, hot dogs, crackers, walnuts, avocados, fast-foods

Check the Nutrition Facts labels of foods

- If fat is one of the first ingredients listed → it is probably a high-fat product
- If partially hydrogenated vegetable oil is one of the first three ingredients → significant source of trans-fatty acids

Making wise choices

Replace high-fat food

→ with specially manufactured lower-fat versions

Eliminate much of the fat

→ used in seasonings, toppings and salad dressings

Remove the fat

→ from high-fat foods (trim all visible fat and skin from meat and poultry)

Be aware that “fat-free” does not mean “calorie-free”

→ moderation in the use of fat-reduced products which could still be energy dense

Making wise choices

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Methods of cooking

→ Recommended methods of cooking include steaming, baking, broiling, grilling or stir-frying in small amounts of oil low in saturated fat but deep-fat frying and pan frying methods should be avoided

Eats fruits and vegetables regularly

→ antioxidant properties (carotenoids, vitamins C and E) → reduce LDL oxidation in the bloodstream and thus slow the progression of CVD

Modify recipes by using low fat ingredients

Find lower-fat foods

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Information for your interest!

Calories, fat, and saturated fat in cooked ground meat patties

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Higher in fat ← → Lower in fat

Regular ground beef 23% fat	Ground chuck 16% fat	Commercial ground turkey[a] (with skin ground in) 13% fat	Ground round 10% fat
			
260 cal/3 oz[b]	220 cal/3 oz[b]	200 cal/3 oz[b]	180 cal/3 oz[b]
4½ tsp fat 8 g saturated fat	3 tsp fat 6 g saturated fat	2¼ tsp fat 3 g saturated fat	1½ tsp fat 4 g saturated fat

Fats and health

- Fatty acid chain length and saturation affects TG's physical characteristics and storage properties (solid vs. liquid)
- **Unsaturated** fatty acids are usually **liquid** at room temperature and **healthy**
- The more **saturated** the fat the more **solid** it is at room temperature and is usually **unhealthy** (with the exception of fish)
- SFA and trans fatty acids are unhealthy and when eaten in excess increase the risk of heart disease and increase LDL levels (unhealthy blood cholesterol)

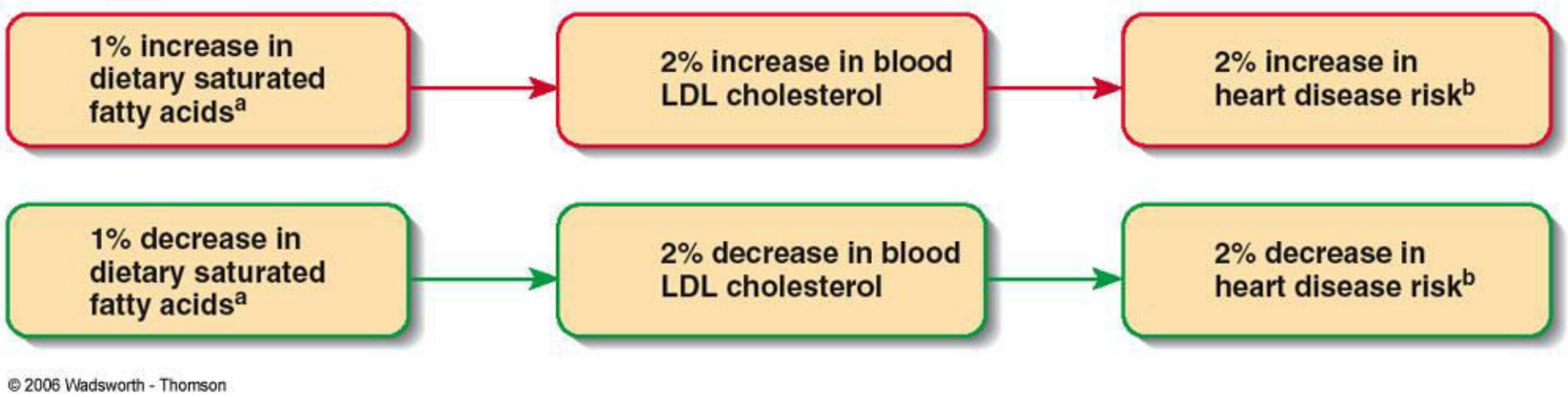
Fats and health

Effects of eating different kinds of fatty acids on health	
MUFA & PUFA	Lowers LDL **cholesterol** and increases HDL **cholesterol** (*good cholesterol*)
Saturated Fatty Acids & Trans Fatty Acids	Raises LDL **cholesterol** (*bad cholesterol*)

Fats and health

High intake of saturated and trans fats

- High LDL in the blood
- Increased risk of atherosclerosis / strokes / heart attacks



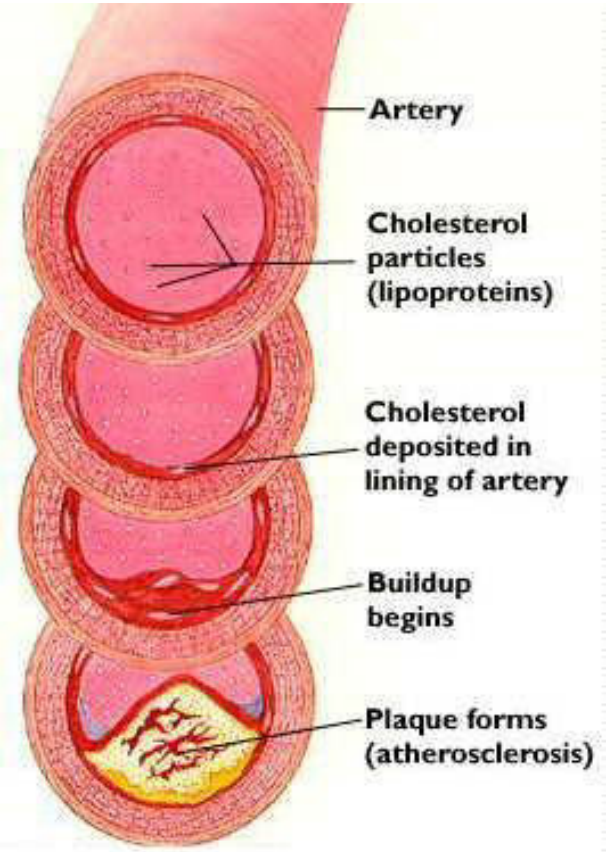
Fats and health

High intake of saturated and trans fats

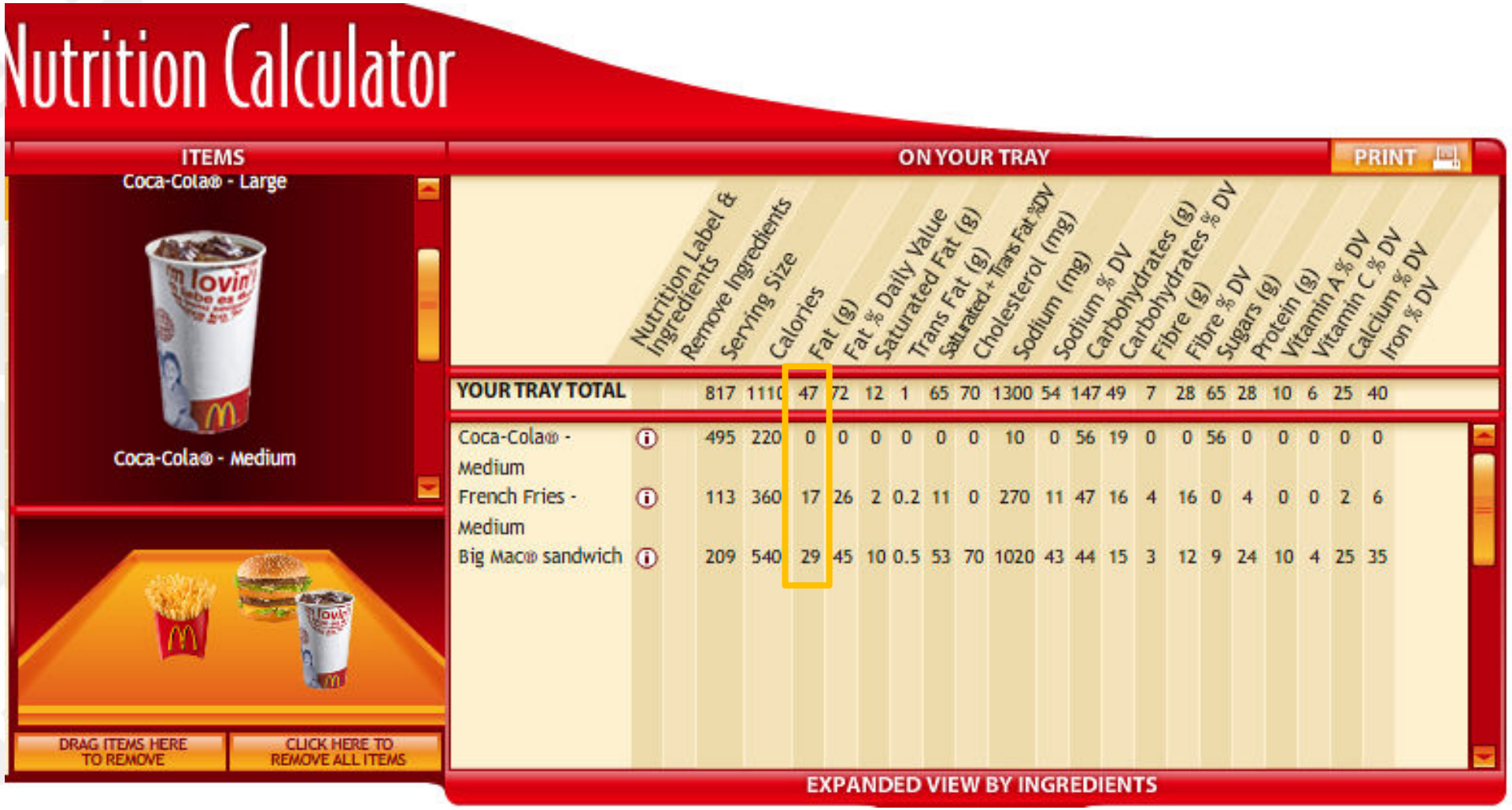
- Increase the risk of certain cancer
- Increase the risk of obesity

High intake of MUFA and PUFA and especially omega 3 (ω3)

- Very beneficial for health and protects against heart disease



Choosing healthier fast food



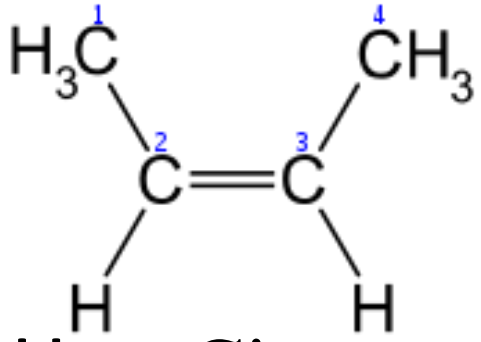
1-NATURE


ITEMS
Diet Coke® - Large
Diet Coke® - Medium
DRAG ITEMS HERE TO REMOVE
CLICK HERE TO REMOVE ALL ITEMS
ON YOUR TRAY
PRINT
Nutrition Label & Ingredients
Remove Ingredients
Serving Size
Calories
Fat (g)
Fat % Daily Value
Saturated Fat (g)
Trans Fat (g)
Saturated + Trans Fat %DV
Cholesterol (mg)
Sodium (mg)
Sodium % DV
Carbohydrates (g)
Carbohydrates % DV
Fibre (g)
Fibre % DV
Sugars (g)
Protein (g)
Vitamin A % DV
Vitamin C % DV
Calcium % DV
Iron % DV
YOUR TRAY TOTAL 682 530 26 40 6 0.4 32 30 980 41 59 20 5 20 2 17 4 2 10 10
Diet Coke® - Medium 495 1 0 0 0 0 0 0 20 1 0 0 0 0 0 0 0 0 0 0
French Fries - Small 71 220 11 17 1.5 0 8 0 170 7 30 10 3 12 0 2 0 0 2 4
Chicken Snack Wrap® 116 310 15 23 4.5 0.3 24 30 790 33 30 10 3 12 2 14 4 2 10 6
EXPANDED VIEW BY INGREDIENTS

Hydrogenation

A chemical process by which hydrogens are added to fatty acid double bonds

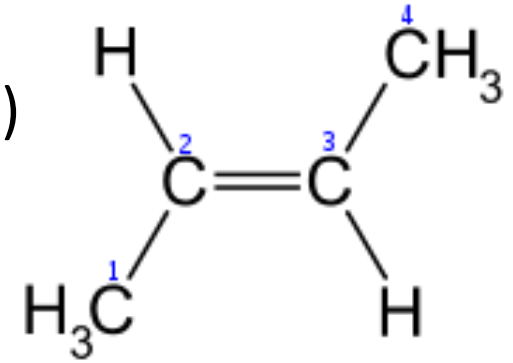
Unsaturated fats are more prone to oxidation due to the instability of the double bond



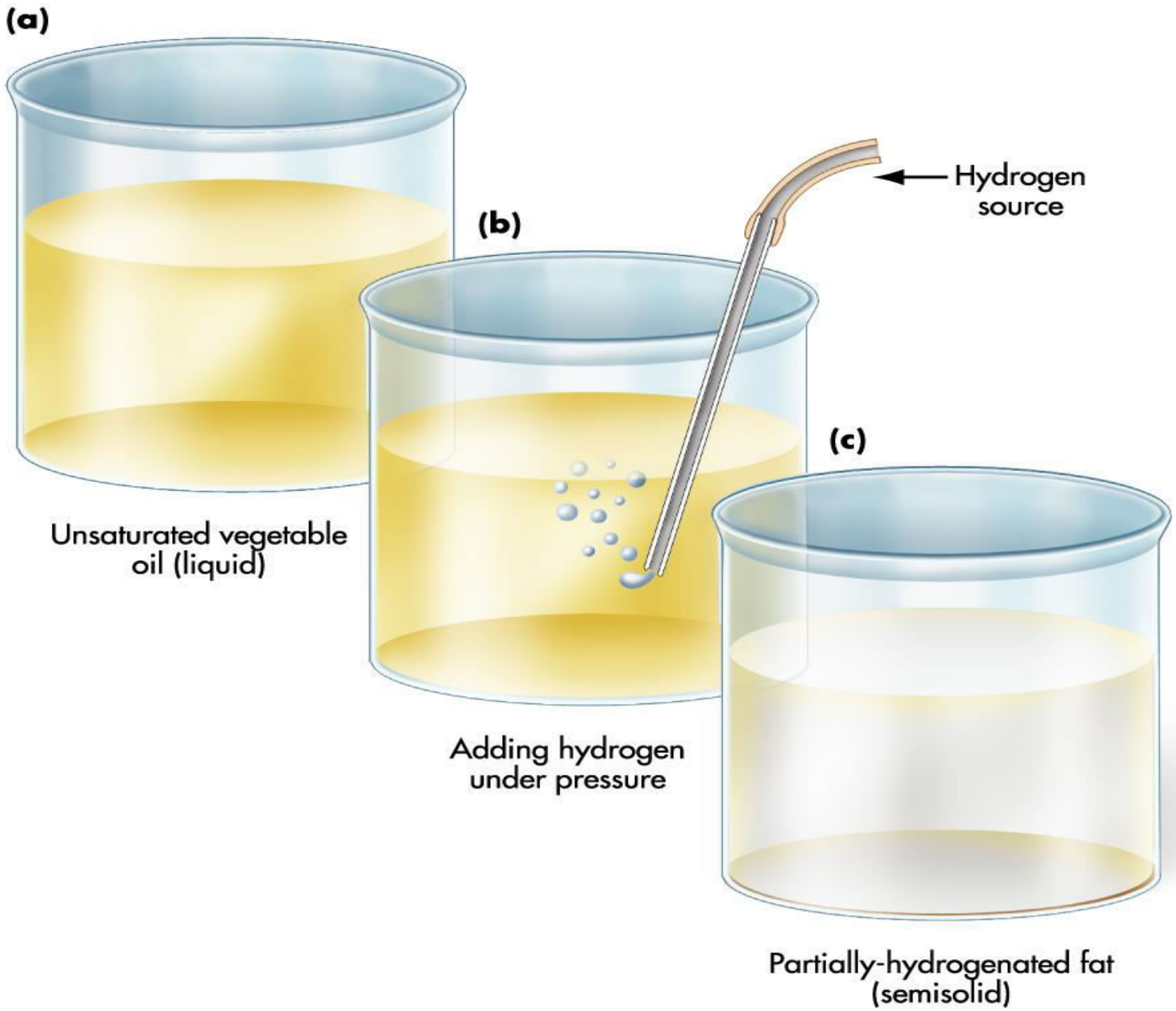
Cis

Unsaturated → Saturated (or trans)

Trans



Hydrogenation



Hydrogenation

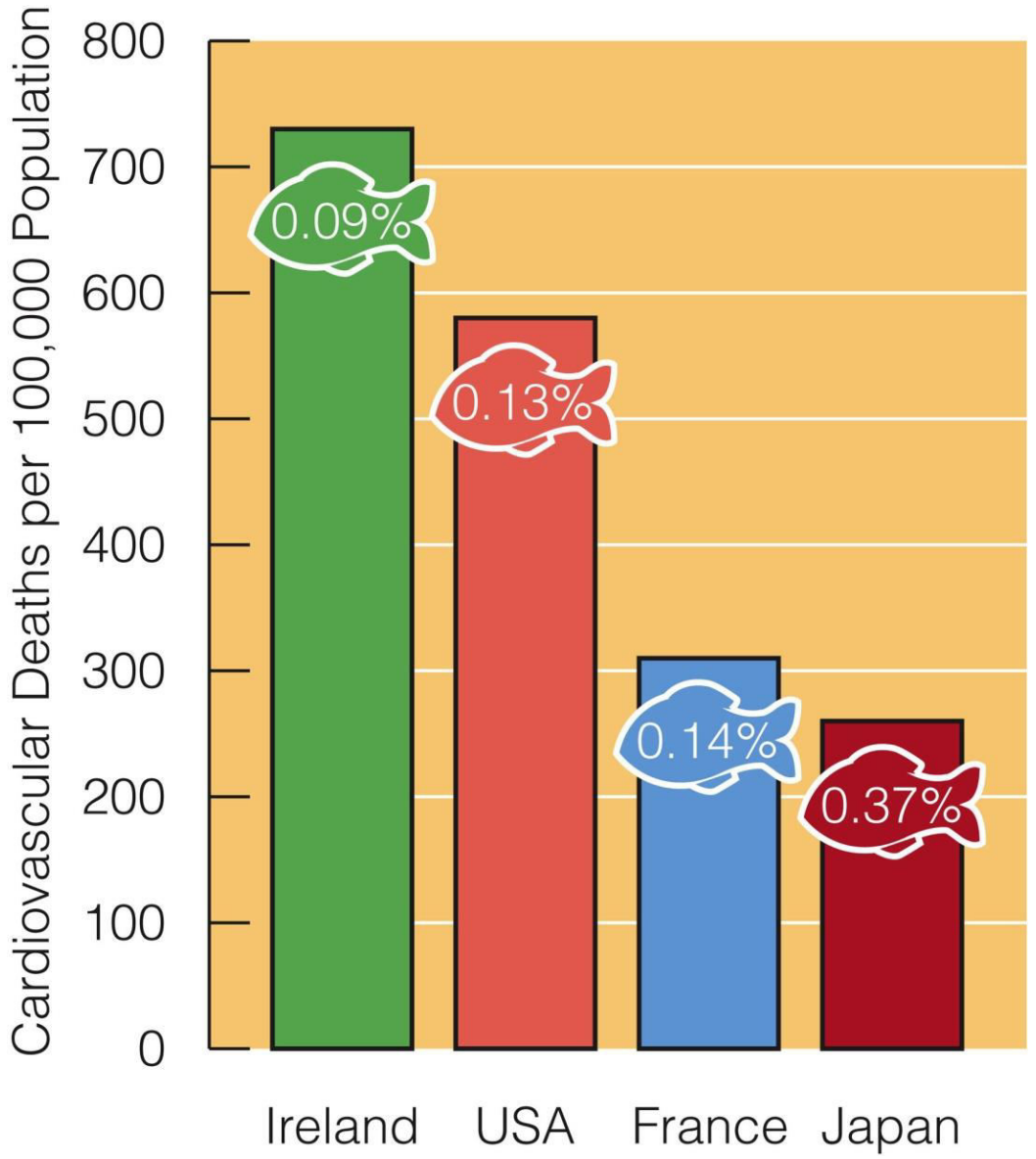
Advantages

- Renders the oil more stable and resistant to oxidation, hence a longer shelf life
- Alters the texture of foods (spreadable: margarine)

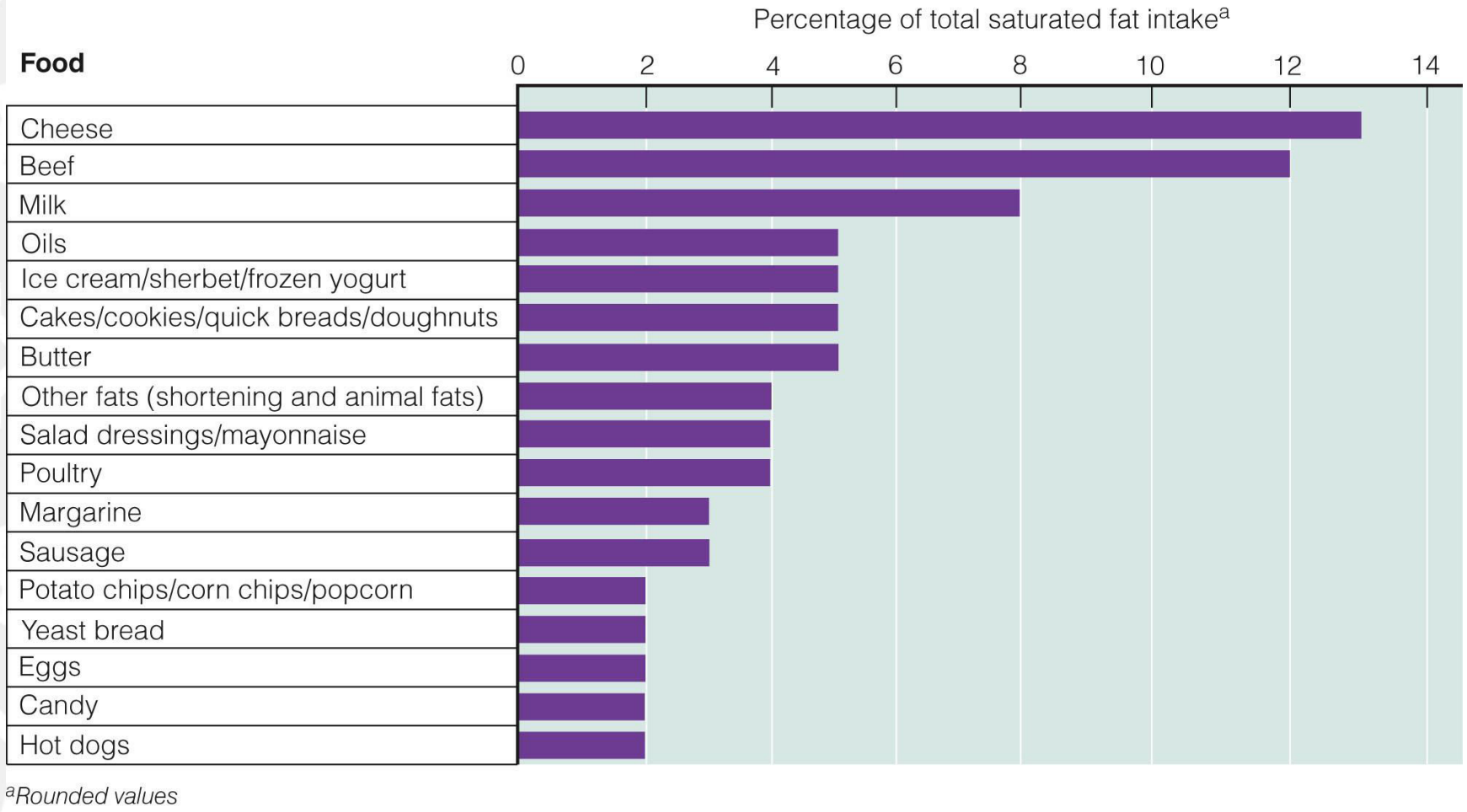
Disadvantages

- Makes polyunsaturated fats more saturated, consequently less healthy
- Produces *trans*-fatty acids that behave more like saturated fats than unsaturated (thus LDL)

Fish oil intakes and cardiovascular death rates



Top contributors of saturated fats in diet



[a]*Rounded values*

Lipids in milk, yogurt, and cheese

جامعة الشارقة
UNIVERSITY OF SHARJAH

Fat-free, skim, zero-fat, no-fat, or nonfat milk, 8 oz (<0.5% fat by weight)

Calories 80	Calories from Fat 0
	% Daily Value*
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Cholesterol 5mg	**2%**

Low-fat milk, 8 oz (1% fat by weight)

Calories 105	Calories from Fat 20
	% Daily Value*
Total Fat 2g	**3%**
Saturated Fat 1.5g	**8%**
Cholesterol 10mg	**3%**

Low-fat cheddar cheese, 1.5 oz

Calories 70	Calories from Fat 30
	% Daily Value*
Total Fat 3g	**5%**
Saturated Fat 2g	**10%**
Cholesterol 10mg	**3%**

Nutrition Facts
Amount Per Serving

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Strawberry yogurt, 8 oz

Calories 250	Calories from Fat 45
	% Daily Value*
Total Fat 5g	**8%**
Saturated Fat 3g	**15%**
Cholesterol 15mg	**5%**

Whole milk, 8 oz (3.3% fat by weight)

Calories 150	Calories from Fat 70
	% Daily Value*
Total Fat 8g	**12%**
Saturated Fat 5g	**25%**
Cholesterol 24mg	**8%**

Reduced-fat, less-fat milk, 8 oz (2% fat by weight)

Calories 120	Calories from Fat 45
	% Daily Value*
Total Fat 5g	**8%**
Saturated Fat 2g	**10%**
Cholesterol 20mg	**7%**

Cheddar cheese, 1.5 oz

Calories 165	Calories from Fat 130
	% Daily Value*
Total Fat 14g	**22%**
Saturated Fat 9g	**45%**
Cholesterol 40mg	**13%**

Low-fat strawberry yogurt, 8 oz

Calories 240	Calories from Fat 20
	% Daily Value*
Total Fat 2.5g	**4%**
Saturated Fat 2g	**10%**
Cholesterol 15mg	**5%**

Lipids in bread, cereal, rice and pasta

Nutrition Facts

Amount Per Serving

Low-fat granola, 1/2 c	
Calories 195	Calories from Fat 35
	% Daily Value*
Total Fat 3g	**5%**
Saturated Fat 1g	**5%**
Cholesterol 0mg	**0%**

Crispy oat bran, 1/2 c	
Calories 150	Calories from Fat 45
	% Daily Value*
Total Fat 5g	**8%**
Saturated Fat 1.5g	**8%**
Cholesterol 0mg	**0%**

Buttery crackers, 5 crackers	
Calories 80	Calories from Fat 35
	% Daily Value*
Total Fat 4g	**6%**
Saturated Fat 1g	**5%**
Cholesterol 0mg	**0%**

Fried rice, 1/2 c[a]	
Calories 140	Calories from Fat 65
	% Daily Value*
Total Fat 7g	**11%**
Saturated Fat 1g	**5%**
Cholesterol 20mg	**7%**

A homemade waffle	
Calories 220	Calories from Fat 100
	% Daily Value*
Total Fat 11g	**17%**
Saturated Fat 2g	**10%**
Cholesterol 50mg	**17%**

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A dinner roll	
Calories 80	Calories from Fat 20
	% Daily Value*
Total Fat 2g	**3%**
Saturated Fat 0g	**0%**
Cholesterol 0mg	**0%**

Fettuccine alfredo, 1/2 c	
Calories 250	Calories from Fat 130
	% Daily Value*
Total Fat 14g	**22%**
Saturated Fat 8g	**40%**
Cholesterol 60mg	**20%**

A breakfast bar	
Calories 150	Calories from Fat 55
	% Daily Value*
Total Fat 6g	**9%**
Saturated Fat 2.5g	**13%**
Cholesterol 0mg	**0%**

A muffin	
Calories 160	Calories from Fat 54
	% Daily Value*
Total Fat 6g	**9%**
Saturated Fat 1g	**5%**
Cholesterol 20mg	**7%**

A large biscuit	
Calories 260	Calories from Fat 80
	% Daily Value*
Total Fat 11g	**17%**
Saturated Fat 2.5g	**13%**
Cholesterol 0mg	**0%**

A large croissant	
Calories 270	Calories from Fat 130
	% Daily Value*
Total Fat 14g	**22%**
Saturated Fat 8g	**40%**
Cholesterol 45mg	**15%**