OBJECTIVES OF THE LECTURE

• By the end of this lecture, student can:
  ▶ Define what is lipid
  ▶ Explain the structure, roles and metabolism of Lipid
  ▶ Explain the impact of deficiency and excessive intake of lipid
FAT

► The important nutrient for source of calories.
► One gram fat supplies 9 calories.
► Also needed to carry and store essential fat-soluble vitamins, i.e: vitamin A and D.
► Two basic types of fat
  ▶ Saturated Fat
  ▶ Unsaturated Fat
► Used differently in our bodies and has a different effect on our health.
CHARACTERISTICS

• Lipids: hydrophobic – insoluble in water
  ► Animal lipids are solids
    • Bacon fat, lard, butter
    • Use for long term energy storage, protection of organs & insulation
    • 3 x higher than carbohydrate
    • Padding around organs
    • Resists heat transfer

• Vegetables fats are liquids
  ► Oils – olive oil, corn oil, coconut oil
1. Fat and oils
   - Composed of 2 molecules: glycerol and fatty acid
     - Glycerol: 3 C with alcohol
     - Fatty acids: long chains of hydrocarbon with acid carbocsil (COOH)
       - Can be 12 to 20 carbon long
       - Two kinds of fatty acid
         - Saturated fatty acid
         - Unsaturated fatty acid
   - Triglyceride: Storage form of fat
• Are found in meats and whole dairy products.
• Some also found in plant foods like tropical oils.
• Single bond.
• The fat solid at room temperature.
• Eat too much saturated fat, it increases chances of getting heart disease, coronary artery disease and fats build up in the lining of arteries.
• Butiric acid (4), Miristic acid (14), Palmitic acid (16), Stearic (18)
**UNSATURATED FATS**

- Usually liquid at room temperature.
- Double bond.
  - Mono unsaturated fatty acid (MUFA) (1 double bond)
    - Oleic acid (18C)
  - Poly unsaturated fatty acid (FUFA) (2 and more double bond)
    - Linoleic acid (2 double bond) (18C)
    - Linolenic acid (3 double bond) (18C)
    - Aracidonic acid (5 double bond) (20C)
    - Called as essential fatty acid
- They are found in most vegetable products and oils.
- Using foods containing polyunsaturated and monounsaturated fats does not increase our risk of heart disease.
- Eating too much may also make us gain weight.
2. **Phospholipids**
   - Cell membrane components
   - Similar to fats – glycerol backbone with fatty acids BUT one fatty acid is replaced by PHOSPHATE
   - Make a molecule hydrophobic one part and hydrophilic other part
   - It cause lipid bilayer
   - Example: Lecithin (in market)
   - But body can produce by liver.
FUNCTIONS OF PHOSPHOLIPIDS

► Act as building blocks of the biological cell membranes in virtually all organisms.
► Participate in the transduction of biological signals across the membrane.
► Act as efficient store of energy as with triglycerides.
► Play an important role in the transport of fat between gut and liver in mammalian digestion.
► An important source of acetylcholine - neurotransmitter substance in mammals.
3. Lipoprotein

- Contain in the blood composed with protein, phospholipids and cholesterol.
- Functions: to carry lipid into the body.
- Three types of lipoprotein:
  - High Density Lipoprotein (HDL): 55% protein + 45% lipids – good
  - Low Density of lipoprotein (LDL): 25% protein + 57% Lipids – bad
  - Very Low Density of lipoprotein (VLDL): < 10% protein
4. Steroids
   - Cholesterol, Ergesterol, 7-dehydrocholesterol
   - Totally different structure – Four C Rings
   - Used in Membrane – provides stability
   - Used to make hormones
     • Sec hormones – testosterone, progesterone, estrogen
     • Can be drugs of abuse
Cholesterol

- Needed by our bodies for our cells, nerves and brain.
- Important in forming hormones and enzymes.
- Human can make all the cholesterol their need in the livers.
- Also can get from the food that we eat.
- Eat too much cholesterol or eat too many foods that contain cholesterol or saturated fat, the level of blood cholesterol increases. Higher chances of developing heart disease.
- Cutting the amount of cholesterol we eat may only have a small effect on blood cholesterol.
LIPID DIGESTION

• The goal of fat digestion
  – To dismantle triglycerides into small molecules that the body can absorbs
  • Monoglycerides, fatty acids and glycerol.

• In the Mouth
  – Start off slowly, some fats beginning to melt when reach body temperature
  – Salivary gland releases an enzyme (lingual lipase)
  – Plays a small role in fat digestion in adults and active role in infants
  – In Infants, this enzyme digests the short and medium chains fatty acids in milk
• In the stomach
  - Muscle contractions of the stomach mix the stomach contents
  - This helps to expose the fat attach by the gastric lipase enzyme – works primarily on short-chain fatty acids.
  - Only little fat digestion takes place in the stomach.
- In the small intestine

- Most digestion occurs

- Fat triggers the release of the hormone cholecystokinin (CCK) – signals the gallbladder to release its store bile

- Bile acid are side chains of amino acids attract to water, other side is sterol that attract to fat.

- This structure allows bile to act as emulsifier.

- Fats are fully digested as they encounter lipase enzymes from the pancreas and small intestine.
FUNCTION OF FAT

• Providing and storing energy.
• Supplying essential fatty acids.
  – Linoleic fatty acids.
  – Linolenic fatty acids.
• Insulating the body.
  – Helping to maintain the body’s temperature.
• Carrying fat soluble vitamin.
• Contributing flavor and aroma.
• Increasing fullness value of food.
• Aiding formation of cell membranes and prostaglandins (hormone that stimulate specific process in the body)
HEALTH EFFECTS OF LIPIDS

• Heart disease
  – Elevated blood cholesterol is a major risk factor for cardiovascular disease.
  – Cholesterol accumulates in the arteries cause restricting blood flow and raising blood pressure.

• Risks from Saturated fats
  – Increase LDL cholesterol – heart disease

• Risks from Trans-fats
  – Raise LDL and lower HDL cholesterol, heart disease, cancer (need research)
HYDROGENATION PROCESS

• A chemical process by which hydrogens are added to monounsaturated or polyunsaturated fats.

• The process of hydrogenation adds hydrogen atoms to cis-unsaturated fats, eliminating double bonds and making them into partially or completely saturated fats.
  - To reduce the number of double bonds
  - Making fats more saturated (solid)
  - More resistant to oxidation

• Hydrogenation produces trans-fatty acids
CIS- AND TRANS- FATTY ACIDS

Trans-Fatty Acid

Cis-Fatty Acid
• Benefits from Monounsaturated Fats
  – Decrease risks of heart disease
  – In Mediterranean region – lower rates of heart disease due to high intake of olive oil, canola oil.

• Benefits from Omega-3 Polyunsaturated Fats
  – Lowering blood cholesterol and preventing heart disease.

• Cancer
  – There is a association between total fat and some type of cancers
  – Dietary fats seems to promote cancer
• Obesity
  – Fat contributes twice as many kcalories compared to carbohydrate or protein
  – Eat high-fat diets regularly may exceed their energy needs and gain weight
THANKS....