LECTURE OUTLINE Chapter 5 The Lipids: Fats, Oils, Phospholipids and Sterols

I The THREE types of LIPIDS

A. Triglycerides (fats & oils)- the MAJOR type of lipid in food and humans.

1. 2 parts of triglycerides-
   a) one glycerol molecule which is a ______ carbon backbone to the triglyceride molecule
   b) three fatty acid molecules (4-22 carbons) in each triglyceride

DRAW A TRIGLYCERIDE:

2. How Fatty Acids Differ
   a) Chain ________ (chains 4 to 22 carbons long, always an even # of carbons)

   b) Degree of SATURATION

Saturated Fatty Acids, SAFAs
   Carbons have all the hydrogen they can hold so no double bonds between the carbons.
   __________ at room temperature
   Can __________ risk of heart disease
   Food Sources: __________________________________________

   What impact do SAFAs acids have on blood cholesterol levels?

Monounsaturated Fatty Acids, MUFAs
   One point of unsaturation (one double bond)
   __________ at room temperature
   Can __________ risk of heart disease
   Food Sources: __________________________________________

   What impact do MUFAs have on blood cholesterol levels?

Polyunsaturated Fatty Acids, PUFAs
   Two or more points of unsaturation (2 or more double bonds)
   __________ at room temperature
   Can __________ risk of heart disease
Can go rancid- oxygen attacks the _____________ and produces fatty acid fragments that smell bad and are hard to digest
Whether a PUFA is an Omega 3 or Omega 6 depends on the position of the _____________
Food Sources: ___________________________________________

What impact do PUFAs have on blood cholesterol levels?

_Essential Fatty Acids, ______(type of polyunsaturated fatty acid)_
Linoleic acid (omega 6)   Food Sources:
Linolenic acid, ALA (omega 3)   Food Sources:
Do you find ALA in fish?

_Other Omega 3 PUFA s that are not _______
EPA & DHA   Food Sources: ___________________________

_Trans Fatty Acids_
Bi-product of _________________
Actually a monounsaturated fatty acid _have one double bond_, but act
MORE like a _____________ fatty acid, due to the different
configuration of hydrogen around the double bond.
Can _________________ risk of heart disease.
What impact to trans fats have on blood cholesterol levels?

_Food Labels and Trans Fat:_
A product can have zero trans fat, but still be high in _____________
fat.
To determine if a product has trans fat you need to look at the
_______________ list.

_More about Hydrogenated Fats:_
The fatty acids of a polyunsaturated oil are exposed to hydrogen gas
at high temperatures and pressure, resulting in both _____________
and _____________fatty acids.
_Purpose:_ to make fats _____________(i.e. margarine and
_______________) and to _______________shelf life of baked
goods.
B. **Phospholipids** (one example- lecithin)
   1. 3 parts of lecithin (one kind of phospholipid)
      a) one glycerol molecule
      b) two fatty acid molecules
      c) phosphorus group

   2. What is the difference between the structure of a triglyceride and the structure of a phospholipid like lecithin?

C. **Sterols (waxes).** One kind is ____________
   1. How is the structure of cholesterol different than either of the other types of lipids?
   2. Cholesterol can be made in the **liver** from ______________ fatty acids.
   3. Only ______________ make cholesterol.

**II Where do lipids come from?**

A. **Plants** make triglycerides and phospholipids from fragments of __________
   Plants make sterols, but do NOT make cholesterol. Why?

B. **Animals** make triglycerides from fragments of carbohydrates, __________ or __________. Animals can make ______________ from saturated fatty acids, and carbohydrates. Humans make all of the fatty acids they need except 2 called the **EFAs.** Can you remember which fatty acids are essential?

**III Lipoproteins**

A. What do they do?
   Transport vehicles for __________ in __________ and __________

B. What are they made of?
   Made by the body, composed of ______________. ______________.
   ______________. ______________

A. Types:
   1. **Chylomicrons**
      Made in ______________
      Mostly composed of ______________ which they carry from intestinal cells to cells in the body.
2. **Low Density Lipoproteins (LDLs)**
   Made in ________________
   Mostly composed of ________________
   Carry triglycerides and cholesterol from ____________ to ____________
   Can become oxidized and damage arterial walls which can lead to plaque buildup
   What effect do they have on heart disease risk?

3. **High Density Lipoproteins (HDLs)**
   Made in ________________
   Mostly composed of ________________
   Carry cholesterol from ____________ to ____________ for disposal
   Can remove cholesterol from plaque in arterial walls
   What effect do they have on heart disease risk?

Why are LDLs referred to as “bad” cholesterol and HDLs referred to as “good” cholesterol?

Do LDL and HDL carry different kinds of cholesterol?

Do you find LDL and HDL in foods?

Is there good and bad cholesterol in foods?

Can foods impact levels of LDL and HDL in the body?

**IV Recommendations** regarding lipids & heart health

1. Enjoy your food.
2. Eat plenty of whole grains, fruits & vegetables.
3. Dietary Guidelines 2010 Summary:
   *Keep total fat intake between ______ percent of Calories, mostly from WHOLE foods that provide unsaturated fats such as: ____________________________

   *Keep saturated less than _____ of Calories, trans fat as _____ as possible and cholesterol less than ______ per day

   _____ of seafood per week.

4. **Nutritional Disadvantages** of a low fat diet:
   a. hard to get enough __FA
   b. hard to get enough vitamin __
   c. may increase __DL and lower __DL
Which of the above foods would be most likely to raise your risk of heart disease? Why?

V Digestion and Absorption of

After eating foods with triglycerides, what needs to happen?

A. Separation & Isolation in the stomach

B. Addition of the emulsifier BILE into small intestine
   1. Bile is an emulsifier made by the ______ and stored in the ____________
   2. Where does bile function as an emulsifier? ________________ (an emulsifier helps oil & water stay mixed together)
   3. Does bile function in the stomach? ______

C. Enzymatic digestion in the small intestine
   1. Enzymes for lipids (lipases) made only by the pancreas and they function in the small intestine.
   2. In the cream that’s used to make butter, the main lipid that needs to be enzymatically digested is ______
   3. After enzymatic digestion of the carbohydrates and lipids in whole milk, what is absorbed (after enzymatic digestion) into the cells lining SI? The carbohydrate in the milk is ________ & it is enzymatically digested down to __________ and __________. The lipid in the whole milk that needs to be enzymatically digested is __________ and it is is enzymatically digested down to __________ & ________

So, what is absorbed into the cells lining SI after enzymatic digestion of the carbohydrates and lipids in whole milk?
D. ABSORPTION & TRANSPORT in the lymph to blood & then to cells all around the body.

TGs can NOT travel all by themselves in the watery blood. Why?

In the layer of cells of the villi lining the wall of the small intestine, fatty acids and glycerol join together to make ________________, which are made into a package that can travel in the watery lymph (then blood) because it has emulsifiers and protein. The package is a combination of:

a. TGs from food,
b. Protein,
c. Sterols and
d. one more type of lipid to be the emulsifier. What is this type of lipid called that is an emulsifier? ________________

The name of the package of protein and the 3 types of lipids (with the main one being TGs from food) is a ________________

E. What happens once triglycerides have been delivered to the cells?

1. ________________

2. ________________

3. If the triglycerides contain EFAs, the EFAs are used to make:

a. ________________

b. ________________ (eico is Greek for _____)
VI Usefulness of Fats

A. Value of Fats in the Body
   1. FUNCTION of triglycerides and fatty acids in human body
      a. cushion
      b. insulation layer
      c. energy reserve (Body's own oil well.)

   (Why don't you need fat in the diet for these first 3 functions (cushion, insulation, energy) of fat in the body?)

   d. specific FAs, like
      Omega 6 EFA (linoleic) - used in production of ______
            ____________, including skin, nerve & brain cell membranes

      Omega 3 EFA (linolenic) - used to make ________________
            compounds (called eicosanoids) that regulate blood pressure, blood clots, immune response

            other important FAs like DHA & AA (NOT EFAs) - involved in visual acuity & brain development in infants.
            DHA (docosahexaenoic acid) and AA (arachidonic acid)

   Similac Advance Baby formula: Nonfat milk, lactose, high-oleic safflower oil, soy oil, coconut oil, whey protein concentrate plus small amounts of C. cohnii oil, M. alpina oil and about 30 added vitamins and minerals

   Why does this formula have so many different kinds of oil?

   2. FUNCTION of cholesterol in human body
      a. used to make ______ - an emulsifier
         Definition of an emulsifier - a substance that allows fat droplets to stay dispersed in water.
      b. used to make vitamin D
      c. used to make reproductive hormones, like _________________
Why don't you need **cholesterol** in the **diet** for these 3 functions?

3. FUNCTION of **phospholipids** in human body. Phospholipids are part of the **lipoproteins**. They are EMULSIFIERS in **cell membranes** as well as in the **blood**
   What are the **3 places** in the body where we've talked about emulsification taking place:
   a. __________________________
   b. __________________________
   c. __________________________
   Why don't you need **phospholipids** in the **diet** for these functions?
   ___________________________________________

B. Value of Fats in the **Diet**
   1. fats & oils satisfy **appetite** (the **desire** to eat). Why?

   2. fats & oils satisfy **hunger** (the **need** to eat). Why?

   3. fats & oils carry the fat soluble vitamins: __________________________