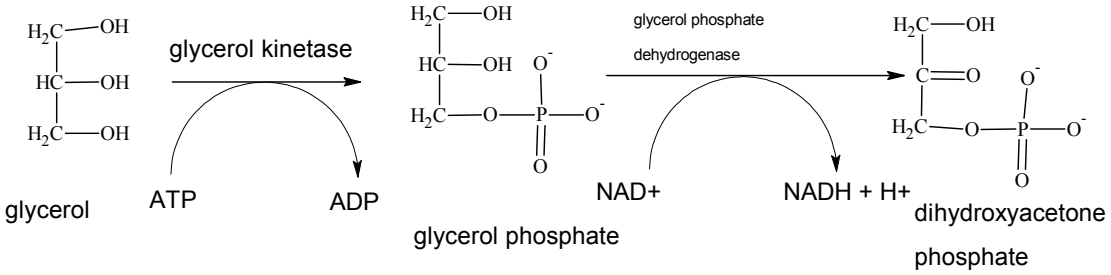
CHAPTER 26: Lipid Metabolism

- Richest energy source
- Carbs are for immediate energy, Lipids are for energy storage
- Light and compact a Fat Man weighing 250 pounds would weigh 514 pounds if all of his fat were suddenly converted into carbs
- Fat-free diets are fine provided:
    - -- You eat plenty of proteins and carbs
    - -- You eat Linoleic and linolenic fatty acids (essential fatty acids)
- Avg. Man is 16% fat and Avg. Woman is 25% fat

26.1 Storage and Mobilization of fats

- Your fat now is enough for you to starve for 30 – 40 days, if you have water
- Contrast to the amount of glycogen in your liver (stored carbs) can last only 1 day
- Adipose tissue – fat-storage cells (most of cytoplasm is fat globule)
    - -- swell or shrink depending on fat content
    - -- located just beneath skin or surrounding vital organs
    - -- aid in the insulation of the body against heat loss
- For stored fat to be mobilized, we must split it up into 3 fatty acids and 1 glycerol (done by lipases in adipose tissue)
- Regulated by hormones, activated by cAMP (from release of epinephrine)

- What happenes to a triglyceride after you eat it?
    - --transported via blood stream either to be stored or used up
    - -- fatty acids transported by serum albumin to be conv to acetyl CoA
    - -- glycerol backbone is transported to the liver where it is easily converted into dihydroxyacetone phosphate (enters glycolysis halfway in) → pyruvate → acetyl CoA



Total ATP from glycerol

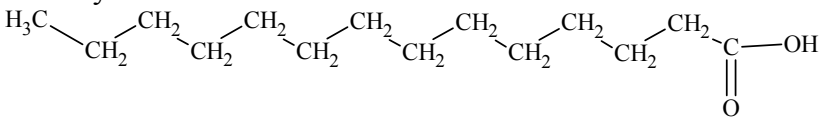
Conv. To DHAP	-1 ATP	Total:
	+1 NADH (cytoplasmic)	11 ATP
glycolysis	+1 NADH(cytoplasmic)	2 NADH (cytoplasmic)
(enters halfway)	+2 ATP	1 NADH
Pyruvate met.	+1 NADH	
Krebs, etc.	+ 10 ATP	

11 + (2 x 2.5 if liver, heart, kidney) + (1 x 2.5) = 18.5 ATP
11 + (2 x 1.5 if brain or muscle) + (1 x 2.5) = 16.5 ATP

Total ATP from glycerol backbone = 18.5 – 16.5 ATP

26.2 Fatty acid oxidation

What does a fatty acid look like

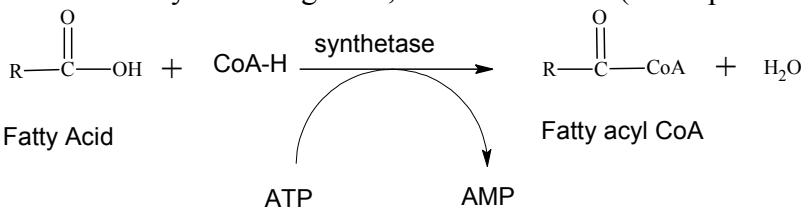


Has an even number of C's, can have C=C

Fatty acid oxidation takes place in the mitochondria near the Krebs cycle etc., makes it v. efficient

I. Step One

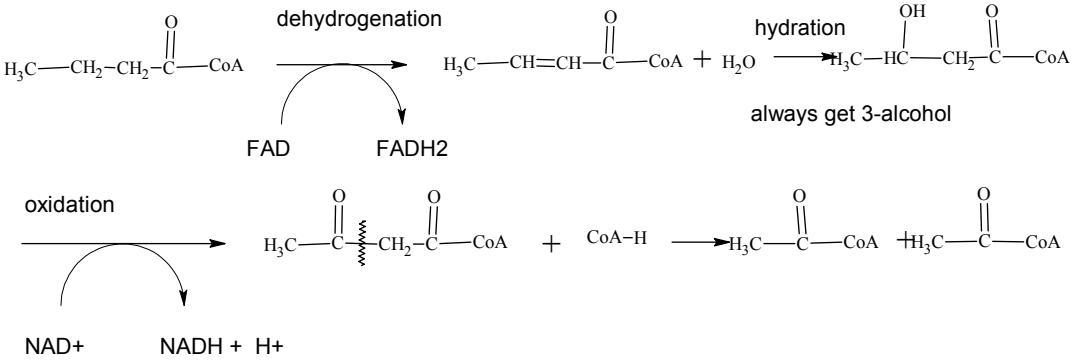
- Fatty acid must be activated, it is relatively inert
- Activated by removing –OH, subst. with CoA (uses up eff. 2 ATP)



- Fatty acyl CoA is transported into mitochondrial matrix via carrier mol.

II. Step Two – β oxidation

- fatty acyl CoA undergoes successive oxidations at the β carbon
- this removes 2C units at a time
- each oxidation produces 1 $FADH_2$ and 1 NADH



-So: If I have a fatty acid which is 16 carbons long, I will end up with 16/2 = 8 acetyl CoA molecules, 7 $FADH_2$'s and 7 NADH's

- The Fate of acetyl CoA is
    1) Enter Krebs cycle
    2) form a ketone body (next chapter)
    3) Used to reform fatty acids

** to answer questions, the book often just gives the name of the fatty acid, the structures are on pg 530 Table 20.1

Total ATP yield from Fatty Acid Oxidation (of 16 C fatty acid)

Step One -2 ATP

Step Two (β ox) (8 acetyl CoA x 10) = 80 ATP
(7 $FADH_2$ x 1.5) = 10.5 ATP
(7 NADH x 2.5) = 17.5 ATP
106 ATP

If this were a triglyceride (3 fatty acids and 1 glycerol)

3 fatty acids (3 x 106) = 318 ATP
glycerol 18.5 or 16.5 ATP
334.5 – 336.5 ATP

26.4 Ketosis

- we said acetyl CoA formed enters the Krebs cycle, or is used to form Ketone bodies
- ketaone bodies are formed from the buildup of acetyl coA in the body with depletion of oxaloacetate = krebs cycle can't start
- caused by diabetes or diet low in carbohydrates (fatty acid oxidation increases to provide more energy)
- kidneys usually excrete 20 mg of ketone bodies daily
- Ketosis – condition of having excess ketone bodies in the blood and urine (Atkins diet ppl must drink a lot of water to accommodate for the extra ketone bodies they are excreting)
- Acidosis – ketone bodies are acidic, buildup of acid in blood is acidosis. Interferes with hemoglobin oxygen transport; feeling of lethargy, irritability, loss of apetite
- Mammals can convert carbohydrates to lipids
- Mammals cannot convert lipids to carbohydrates

26.5 Fatty acid synthesis

- When we injest more carbohydrates than are needed for energy and for glycogen, the excess is converted into fatty acids via acetyl coA

8 Acetyl CoA + 7 ATP + 14 NADPH + $7H^+$ → 16C Fatty acid + 14 $NADP^+$ + 8CoA + 7 ADP + 7 Pi

26.6 Obesity, Exercise, and Diets

- large number of ppl are overweight
- being overweight leads to high blood pressure, diabetes, heart disease, stroke, gallbladder disease, and breast, prostate, and colon cancers.
- why do we get fat? We consume more energy than we use. Energy in Calories!!
- how do you lose weight? Difficult. Eat less caloric foods, move around more.
- For every 3,500 kcal in excess required for energy = 1 pound of fat,
  Therefore if you reduce your intake by 100 kcal / day and maintain activity level in 35 days you will lose 1 pound of fat
- This assumed body just burns fat. In reality it needs carbs. Your brain will make more carbs from proteins, leading to loss of muscle mass
- Most diet pills contain a diuretic, leading to loss of water weight (which you will always gain back)
- Others draw from stored glycogen (again will be replaced)

- Ideal diet is 1200 kcal/day

Problems with that

Bigmac = 541 kcal
Large Coke = 310 kcal
Fries = 453 kcal

Total : 1304 kcal = excess of daily allowance!!!

Even diet food can be tricky

Crispy chicken bacon ranch salad: 370 kcal

All data from www.nutritiondata.com