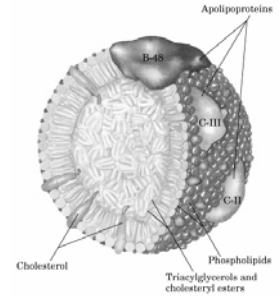


Lipid Metabolism

Lipoproteins are Responsible for Transport and Mobilization of Fat

Fig. 17-2 Lehninger POB 3rd Ed.

- Chylomicrons are formed from fat absorption
- VLDL secreted by liver have analogous (but not identical) structure
i.e. phospholipid shell with apolipoproteins (and varying amounts of cholesterol) and TAG core
- Function “differs” – chylomicrons from meals, VLDL between meals



Overview of Lipid Metabolism

Importance:

- Fat stores 9 Cal/g (no water)
- Carbohydrate stores 4 Cal/g (water associated)
- Protein stores 4 Cal/g (water associated)
- Alcohol (undergraduates' 4th major food group) stores 7 Cal/g (reason 63 not to drink)

Few free fatty acids: for human serum
total lipid averages 570 mg/dL (450-1,000)
FFA 12 mg/dL- (this bound to albumin)
dietary TAG's, PL's

Chylomicrons

vs. VLDL

- | | |
|--|--|
| <ul style="list-style-type: none"> • Made by intestine <ul style="list-style-type: none"> – 90-1000 nm diameter – Density <0.95 – 1-2% protein – 88% TAG – 8% PL – 3% CE – 1% C – trace FFA | <ul style="list-style-type: none"> • Made by liver <ul style="list-style-type: none"> – 30-90 nm diameter – Density 0.95-1.006 – 7-10% protein – 56% TAG – 20% PL – 15% CE – 8% C – 1% FFA |
|--|--|

Lipid Metabolism Occurs in “Three” Tissues

- Intestine (dietary fat absorption)
- Liver (fat synthesis and export between meals)
- Extrahepatic Tissues

CR and HDL

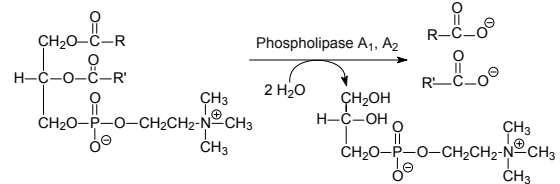
- Fat is low density, protein is high
- As these pass extrahepatic tissue, fat is extracted as needed
- Chylomicron remnants (CR, of chylomicrons) and HDL (remnants of VLDL)
- Some people get less of their VLDL to HDL (the ratio is what you would want looked at)



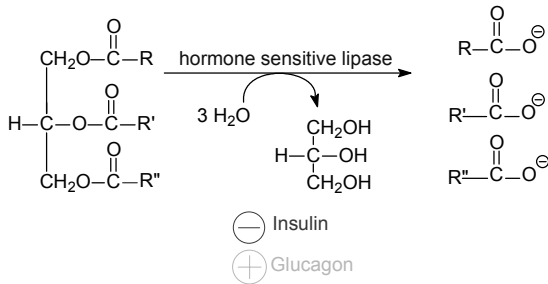
Some of the Apoproteins

Apoprotein	Lipoprotein	Size, kDa	Comments
Apo B-48	Chylomicrons and CRs	260	Synthesized in intestine
Apo B-100	VLDL, LDL, IDL, HDL	550	Synth in liver, ligand of LDL-R
Apo A-I	HDL, Chylo	28	Activator of LCAT Ligand of HDL-R
Apo A-II	HDL, Chylo	17	?Inhibitor of LCAT
Apo D	Subfraction of HDL	19.3	?lipid transfer protein
Apo C-II	VLDL, HDL, chylo	8.9	Activator of lipoprotein lipase

Phospholipases A₁ and A₂



Hormone Sensitive Lipase



β-Oxidation

Importance

Location

Activation: outer mitochondrial membrane

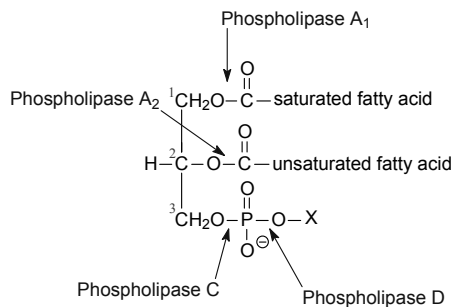
β-Oxidation: mitochondrial matrix

Reactions

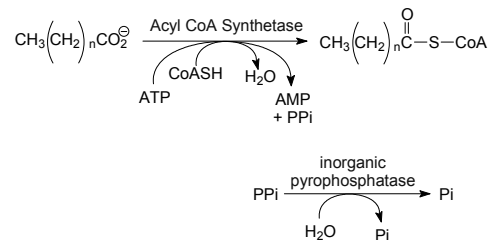
Energetics

Regulation

Phospholipase Specificity

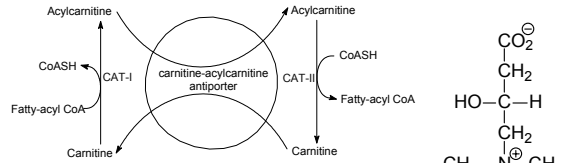


Activation of Fatty Acids

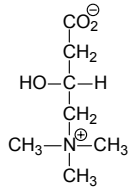


- Synthetase vs. synthase reminder
- Pyrophosphatase provides directionality

Transport of Activated Fatty Acids into the Mitochondria



- Carnitine palmitoyl transferase I
- Carnitine-acylcarnitine translocase
- Carnitine palmitoyl transferase II
- CAT-I inhibited by malonyl CoA



Coenzyme Table Continued

Vitamin	Coenzyme Form	Function
Biotin	Biocytin	CO ₂ fixation
Niacin	Nicotinamide	Hydride group transfer
Lipoic acid	Lipoate	Acyl group transfer
Pantothenic acid	Coenzyme A, aka CoASH	Acyl group transfer

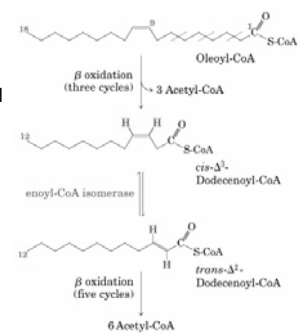
Reactions of β-Oxidation

Know name and structure of all metabolites
 Know name of all enzymes and coenzyme/cofactor requirements

β-Oxidation of Monounsaturated Fatty Acids

Fig. 17-9 Lehninger POB 3rd Ed.

Requires 1 additional enzyme
 lose 2 ATP per double bond



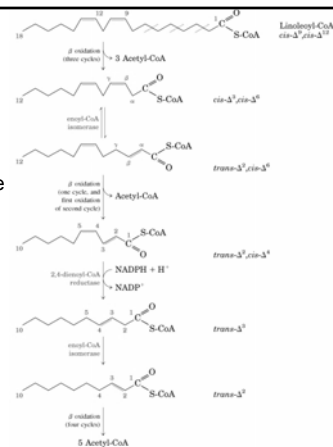
Coenzyme Table

Vitamin	Coenzyme Form	Function
Thiamin (B1)	Thiamine pyrophosphate (TPP)	Aldehyde group transfer
Riboflavin (B2)	FAD	Hydride group transfer
Pyridoxine (B6)	Pyridoxal phosphate (PLP)	Amino group transfer
B12	Coenzyme B12	Alkyl group transfers
Folic acid	Tetrahydrofolate (THF)	One-carbon transfers

β-Oxidation of Polyunsaturated Fatty Acids

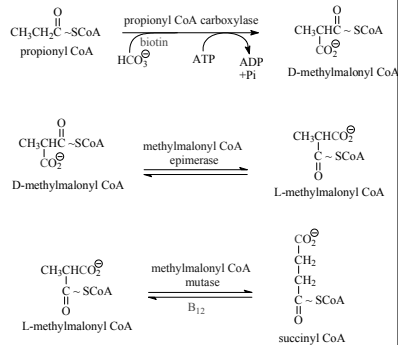
Fig. 17-10 Lehninger POB 3rd Ed.

Requires 1 additional enzyme (in addition to the additional enoyl CoA isomerase required for monounsaturated)
 lose 3 ATP per additional double bond

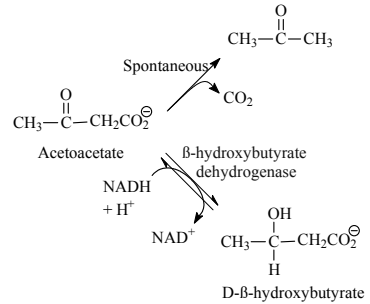


β-Oxidation of Odd-Chain Length Fatty Acids

Same as saturated but end with 3C converted to succinyl CoA



Ketone Body Synthesis I



Ketone Bodies

3: Acetone, acetoacetate and β-hydroxybutyrate normally low amounts amount increases in diabetes and starvation

Ketone Body Synthesis I

