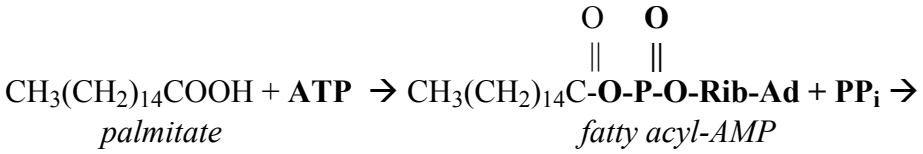
ANSC (NUTR) 618
LIPIDS & LIPID METABOLISM

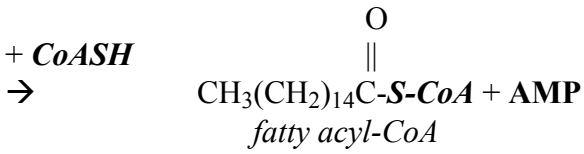
Fatty Acid Oxidation

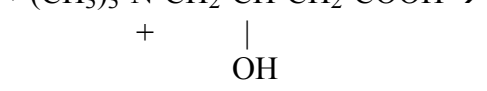
I. Enzymatic degradation of fatty acids in eukaryotic cells

A. Activation and transport

1. Activation: fatty acyl CoA synthetase
2. Carnitine palmitoyl transferase I (CPT-I; *carnitine acyltransferase*)
   a. Exchanges carnitine for CoASH in cytosol
   b. *Inhibited by malonyl-CoA*
3. Carnitine palmitoyl transferase II
   a. Exchanges CoASH for carnitine
   b. Carnitine is transported back to cytosol.







(*carnitine*)

→ $(CH_3)_3$-N-CH_2-CH-CH_2-COOH + ***CoASH***

+ |

O

|

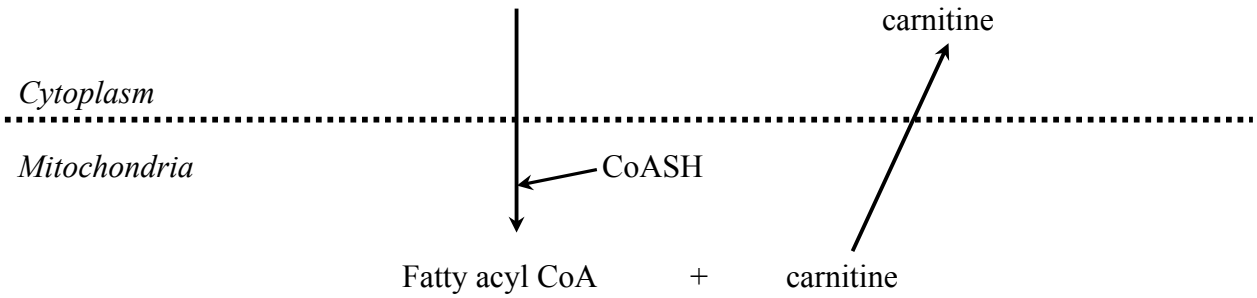
C=O

| *acyl carnitine*

$(CH_2)_{14}$

|

CH_3



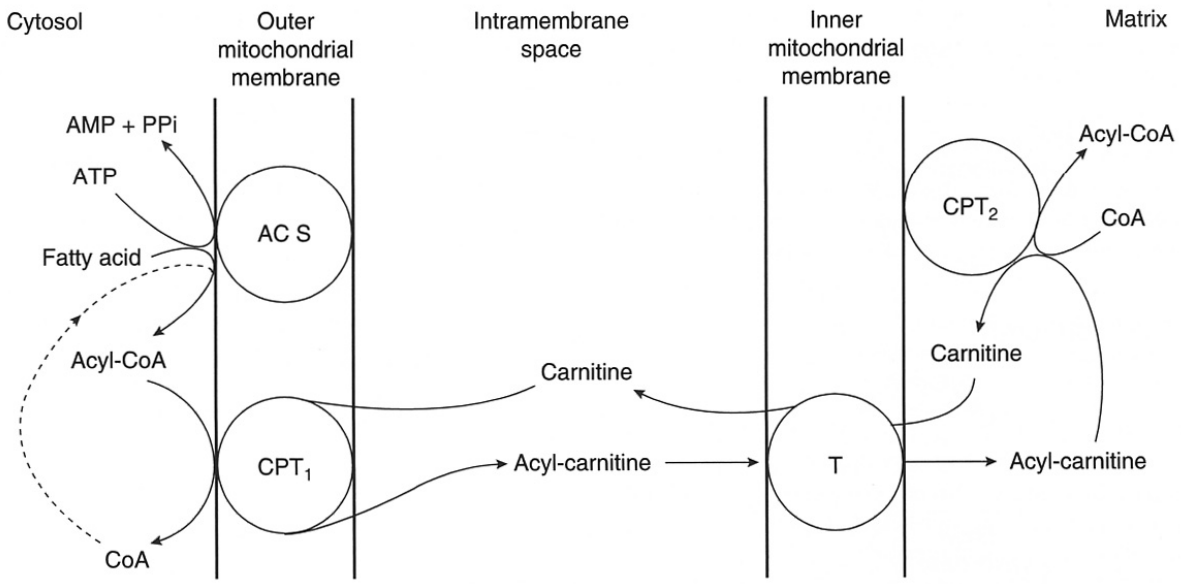


Fig. 2.27 Movement of acyl residues into mitochondria via carnitine. ACS = acyl-CoA synthetase; T = translocase; CPT = carnitine:palmitoyltransferase.

B. ß-Oxidation

1. Oxidation of the α-carbon (by FAD) produces a *trans*-double bond.
2. The *trans*-double bond is hydrated, producing a hydroxy-fatty acyl-CoA.
3. The hydroxyl group is oxidized (by NAD^+) to produce a keto-fatty acyl-CoA.
4. The first two carbons are displaced to produce acetyl-CoA.

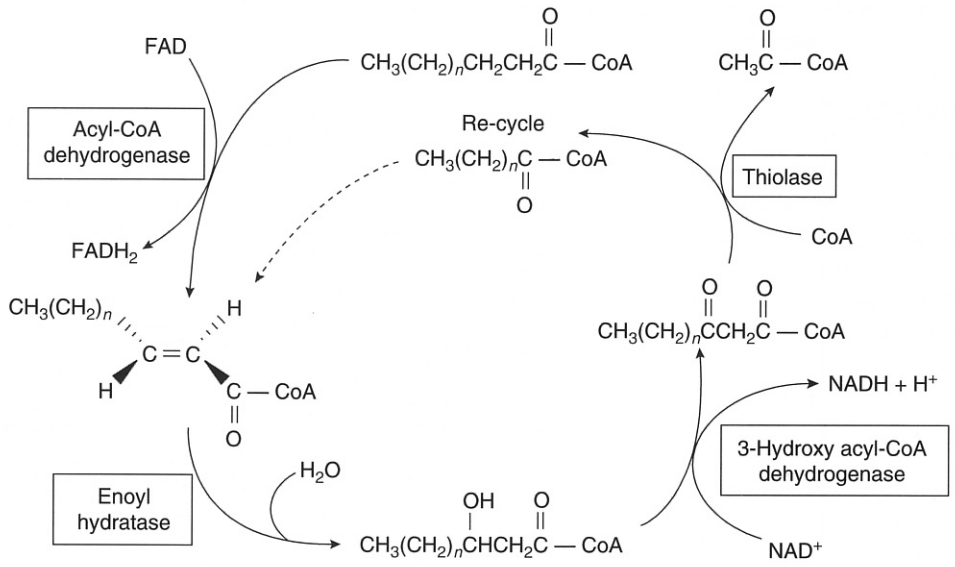
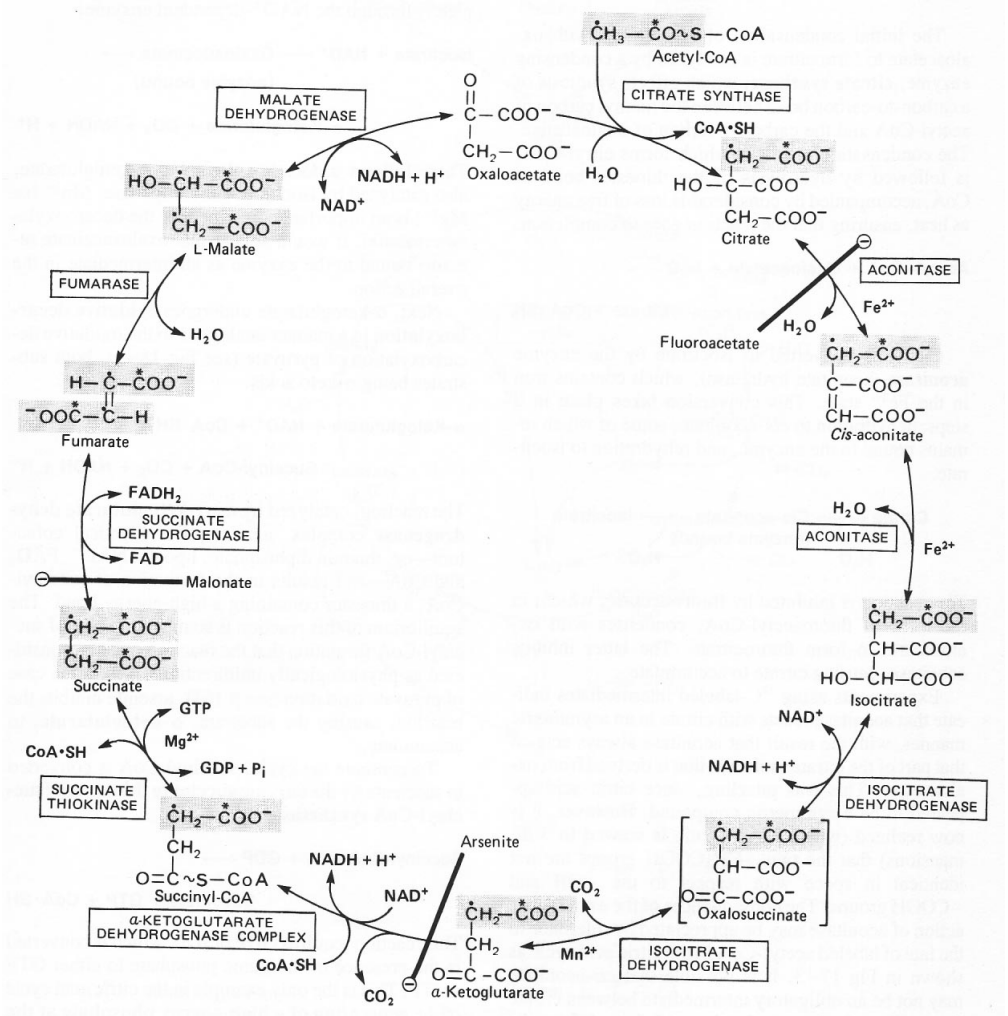


Fig. 2.28 The fatty acid β-oxidation cycle.

5. Entry of acetyl-CoA into the TCA cycle



6. ***Comparison to fatty acid synthesis***

a. Oxidation requires FAD, NAD^+, synthesis requires NADPH.

b. Oxidation requires CoASH derivatives, synthesis requires ACPs.

c. Oxidation is multienzyme, synthesis requires just one enzyme complex.

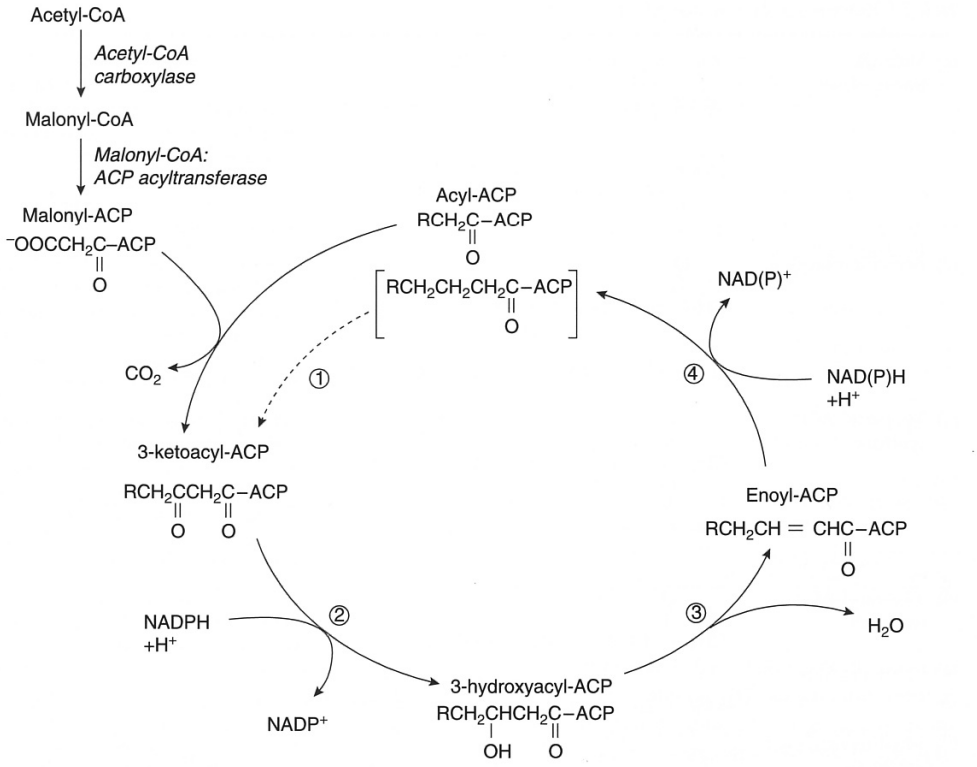


Fig. 2.7 The repeat cycle of reactions for the addition of two carbons by fatty acid synthase. Reactions of the cycle: (1) condensation (3-ketoacyl-ACP synthase); (2) reduction (3-ketoacyl-ACP reductase); (3) dehydration (3-hydroxyacyl-ACP dehydrase); (4) reduction (enoyl-ACP reductase).