Energy Yield from FA Oxidation

$CH_3\text{-}(CH_2)_{14}\text{-}CO\text{-}CoA$

↓

6 $FADH_2$
6 NADH
6 Acetyl CoA

$CH_3\text{-}CH_2CH_2\text{-}CO\text{-}CoA$

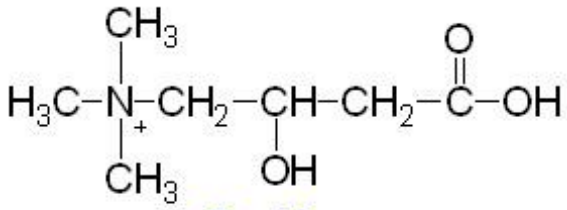
↓

$CH_3\text{-}CO\text{-}CoA$ + $CH_3\text{-}CO\text{-}CoA$ + $FADH_2$ + NADH

Energy Yield from FA Oxidation (cont.)

- Oxidation of C 16 FATTY ACID
  - 7 $FADH_2$ ➔ 14 ATP
  - 7 NADH ➔ 21 ATP
  - 8 Acetyl CoA ➔ 96 ATP
- Activation of the Acid consumes 2 ATP
- Net 129 ATP mole per mole of C16 Fatty Acid

Carnitine



Carnitine

* Other functions:
  - Export of branched chain acyl groups from mitochondria
  - Excretion of acyl groups that cannot be metabolized in the body

Carnitine Deficiencies

- Secondary deficiencies:
  Liver disease, malnutrition, ↑requirements
- Congenital Deficiencies:
  ↓ Enzyme, ↓ uptake, ↓ tubular reabsorption
- ↓ Ability to use FA as a fuel
- Accumulation of F.A and branched Acyl groups in cells

Oxidation of unsaturated F.A: Oleic Acid

$CH3 – (CH_2)_7\text{-}CH = CH\ (CH_2)_7\text{-}CO\sim CoA$

18:cis Δ^9

3 rounds of β oxidation

3 Acetyl CoA

$CH3 – (CH_2)_7\text{-}CH = CH\ CH_2\text{-}CO\sim CoA$

12:cis Δ^3

isomerase

$CH3\ (CH_2)_7\ CH_2\text{-}CH{=}CH\text{-}CO\sim CoA$

12:trans Δ^2

Oxidation of Unsaturated F.A: Linoleic Acid

18:$\Delta^{9,12}$

3 Cycles of β oxidation

3 Acetyl CoA

12:$\Delta^{3.6}$

Isomerase

12:$\Delta^{2.6}$

Acetyl CoA

$CH_3\text{-}(CH_2)_4\text{-}CH{=}CH\text{-}CH_2\text{-}CH_2\text{-}CO\text{-}CoA$ (10:Δ^4)

Dehydrogenase

$CH_3\text{-}(CH_2)_4\text{-}CH{=}CH\text{-}CH{=}CH\text{-}CO\text{-}CoA$

Reductase

$CH_3\text{-}(CH_2)_4\text{-}CH\text{-}CH{=}CH\text{-}CH\text{-}CO\text{-}CoA$

Oxidation of FA with odd number of carbons

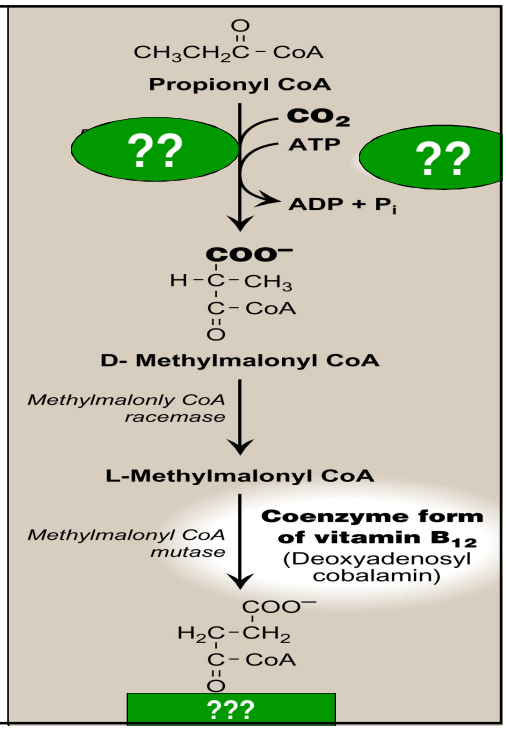
$CH_3\text{-}(CH_2)_{13}\text{-}CO\sim CoA$

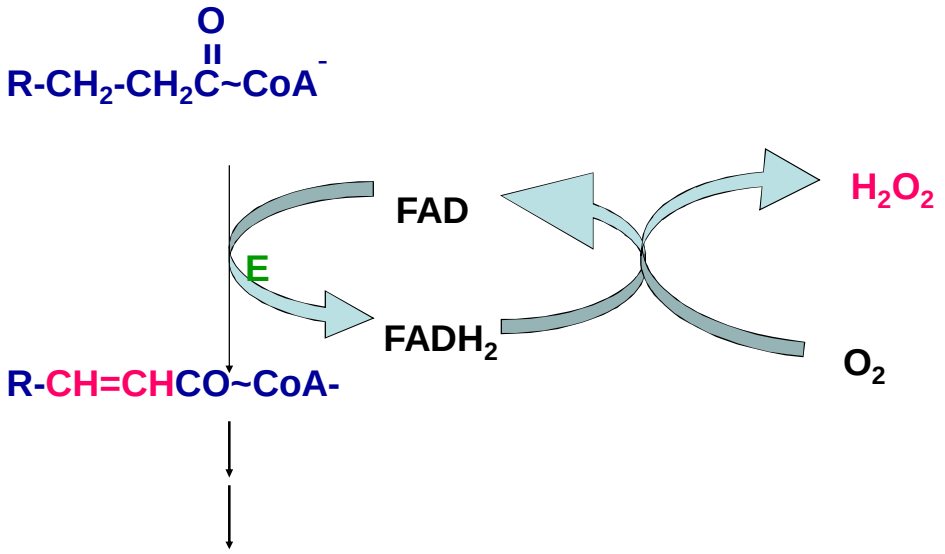
Six Cycles of β oxidation ↓

↓

$CH_3\text{-}CH_2\text{-}\overset{\overset{\displaystyle O}{\|}}{C}\sim CoA$ + 6 Acetyl CoA

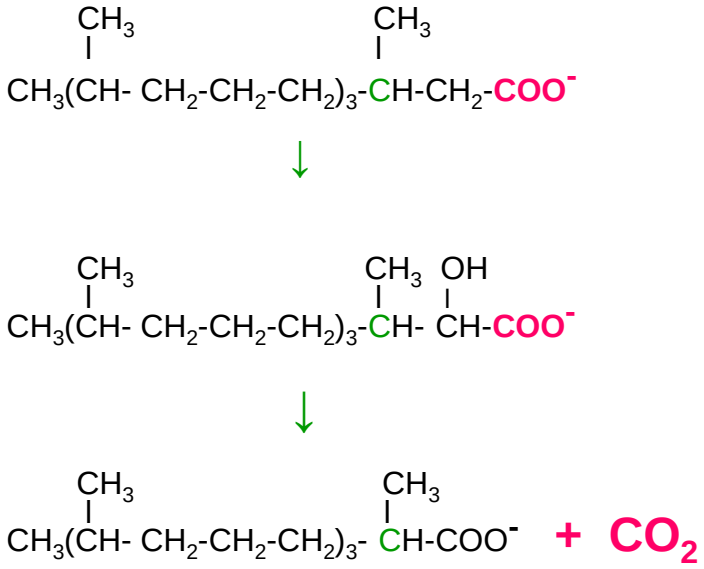
Propionyl CoA



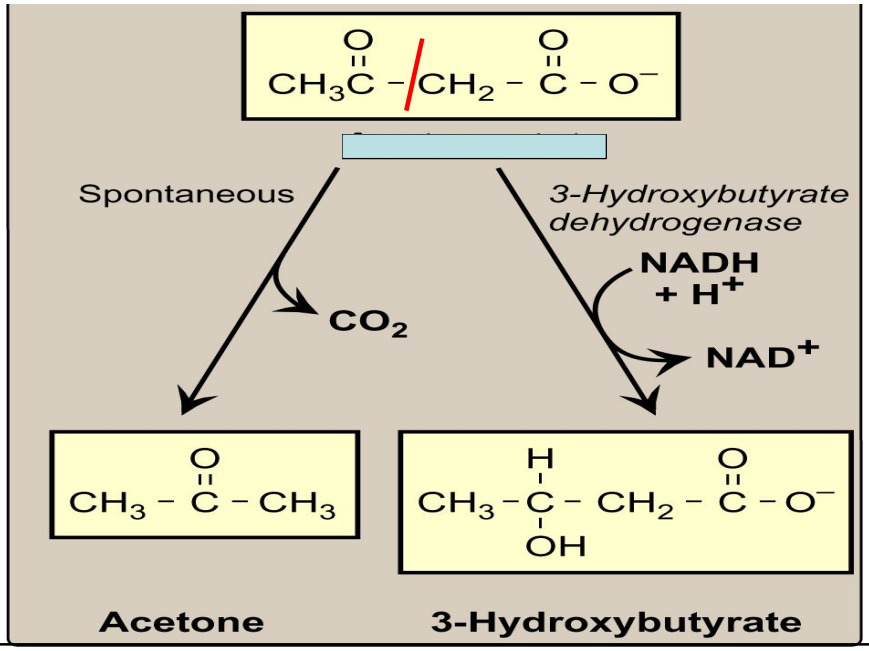


Oxidation of Very Long Chain Fatty Acid in Peroxisomes:
E: FAD Containing Oxidase

α Oxidation of Fatty Acids

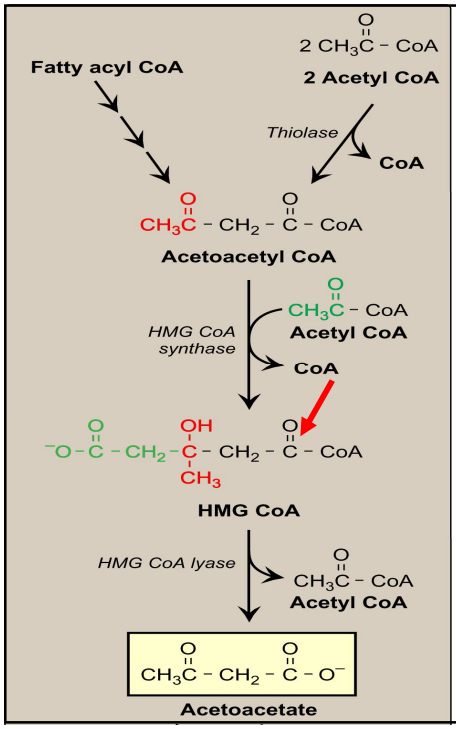


Ketone Bodies



Ketone Bodies

- Synthesis:
  In Liver
- Precursor:
  Acetyl CoA
- At high rate during:
  -Fasting
  - Uncontrolled Diabetes Mellitus



Net Reaction ??

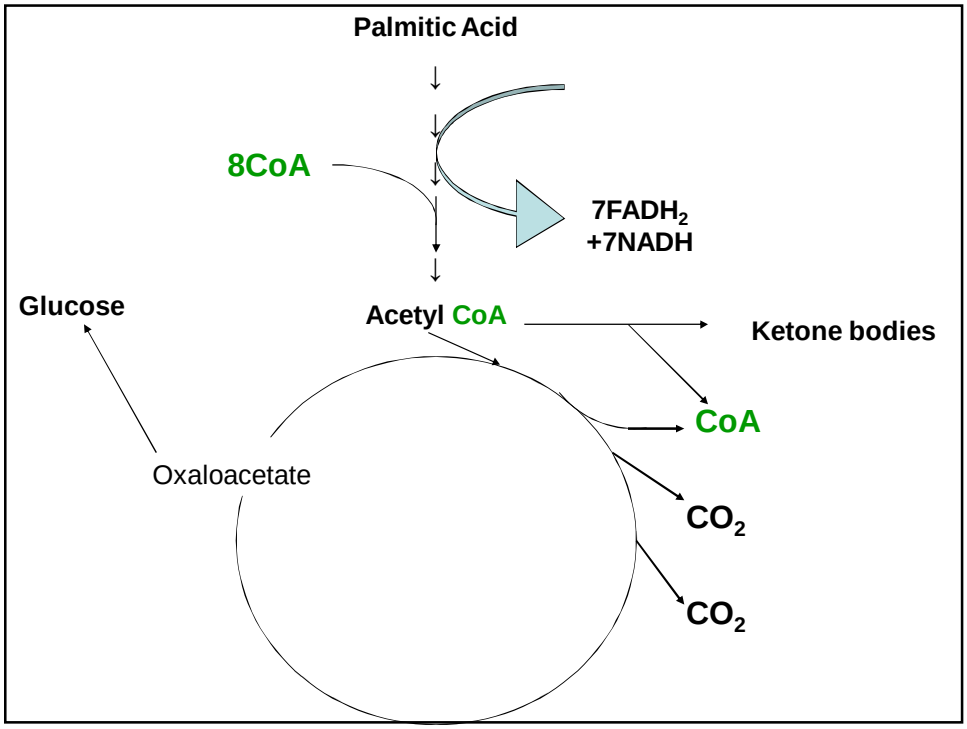
2 Acetyl CoA → Acetoacetate + 2 CoA

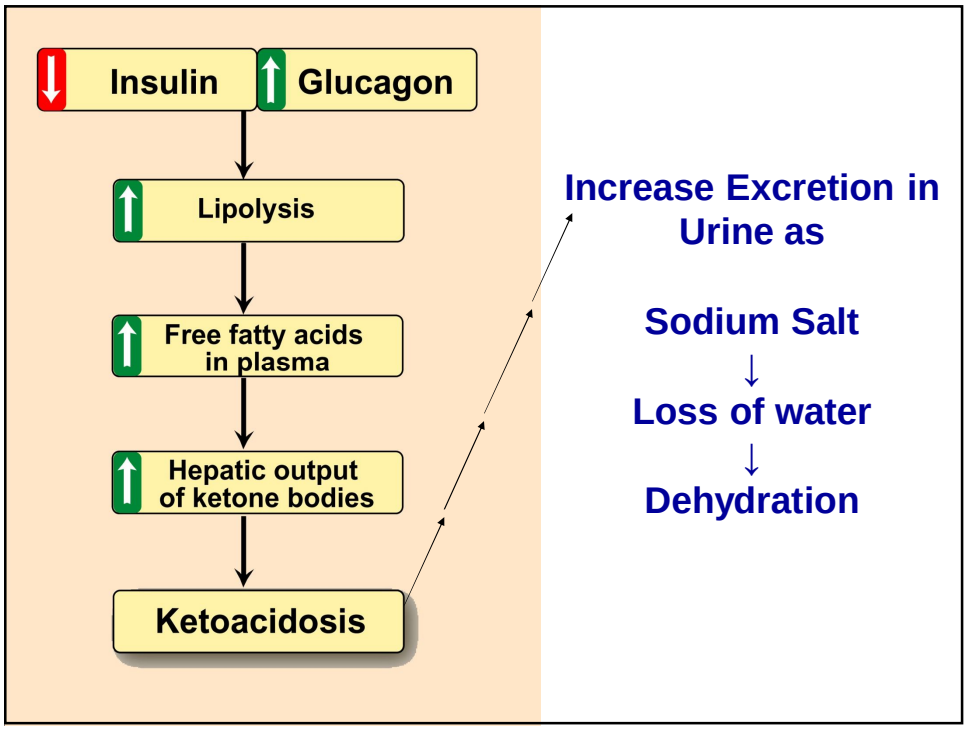
Net Reaction

2 Acetyl CoA → Acetoacetate + 2 CoA

Advantage (Purpose) ?

- For the liver
- For the tissues


Palmitic Acid
8CoA
7FADH2
+7NADH
Glucose
Acetyl CoA
Ketone bodies
CoA
Oxaloacetate
CO2
CO2


Insulin
Glucagon
Lipolysis
Free fatty acids in plasma
Hepatic output of ketone bodies
Ketoacidosis
Increase Excretion in Urine as
Sodium Salt
↓
Loss of water
↓
Dehydration