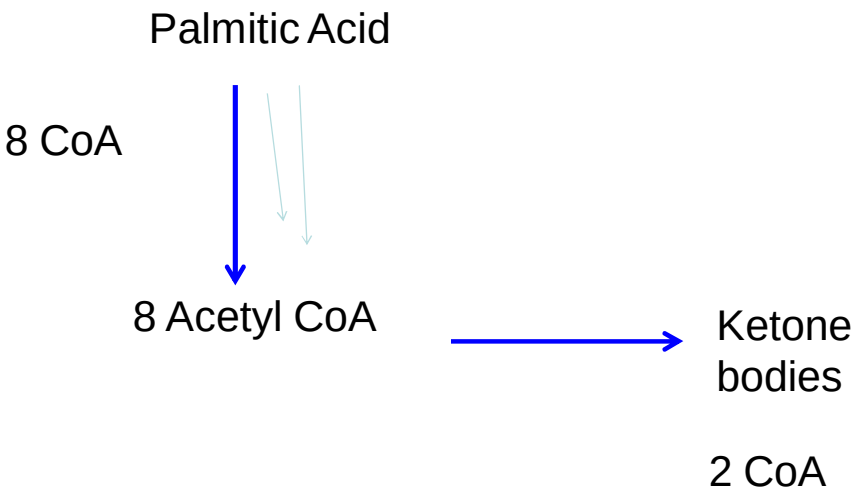
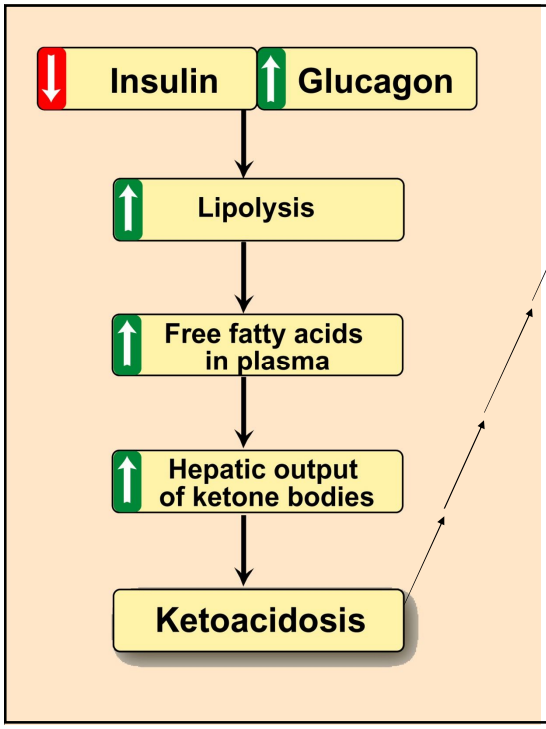
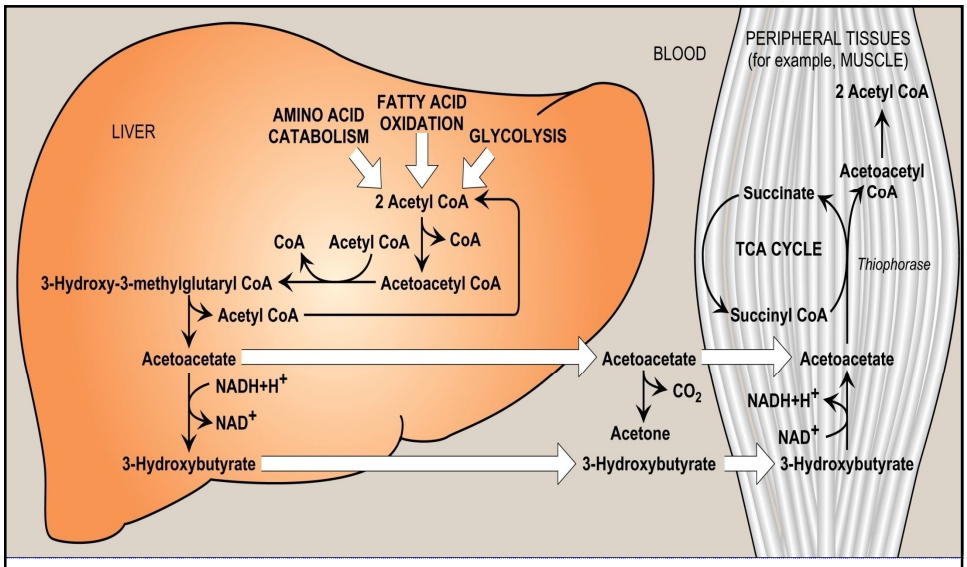
Synthesis of Fatty Acids and Triacylglycerol



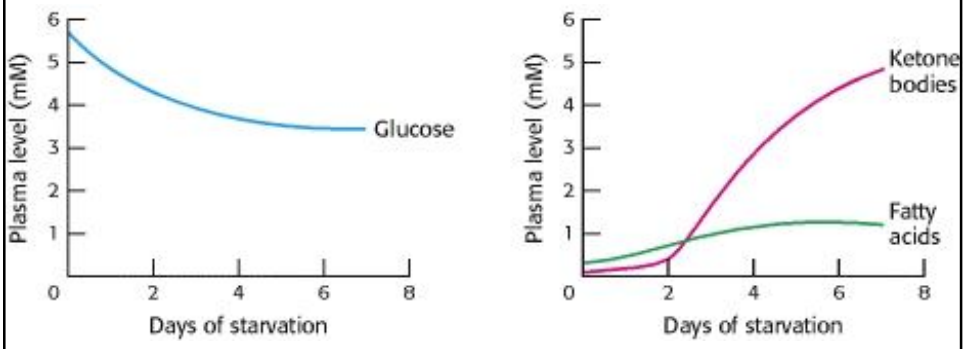


Increase Excretion in Urine as

Sodium Salt
↓
Loss of water
↓
Dehydration



Use of Ketone Bodies by Peripheral Tissues: Skeletal Muscle, Cardiac Muscle and In Brain During Prolonged Fasting (Starvation)



Fuel metabolism in starvation

	Amount formed or consumed in 24 hours (grams)	
Fuel exchanges and consumption	**3rd day**	**40th day**
Fuel use by the brain		
Glucose	100	40
Ketone bodies	50	100
All other use of glucose	50	40
Fuel mobilization		
Adipose-tissue lipolysis	180	180
Muscle-protein degradation	75	20
Fuel output of the liver		
Glucose	150	80
Ketone bodies	150	150

Fatty Acid Synthesis

- Requires
  - Carbon Source: Acetyl CoA
  - Reducing Power: NADPH
  - Energy Input: ATP

Why Energy ?

Fatty Acid	Acetyl CoA
↓	↓
↓	↓
↓	↓
↓	↓
Acetyl CoA	Fatty Acid
ΔG^o : -ve	ΔG^o : +ve

Why Energy ?

Fatty Acid
↓
↓
↓
↓
Acetyl CoA

ΔG^o : -ve

Acetyl CoA + n(ATP)
↓
↓
↓
↓
Fatty Acid + n(ADP)

ΔG^o : -ve

FA Degradation and Synthesis

Acyl CoA $_{(n)}$

↓ **Oxidation**

↓ **Hydration**

↓ **Oxidation**

↓ **Thyolysis**

Acyl CoA $_{(n-2)}$ + Acetyl CoA

Acyl CoA $_{(n+2)}$

↑ **reduction**

↑ **dehydration**

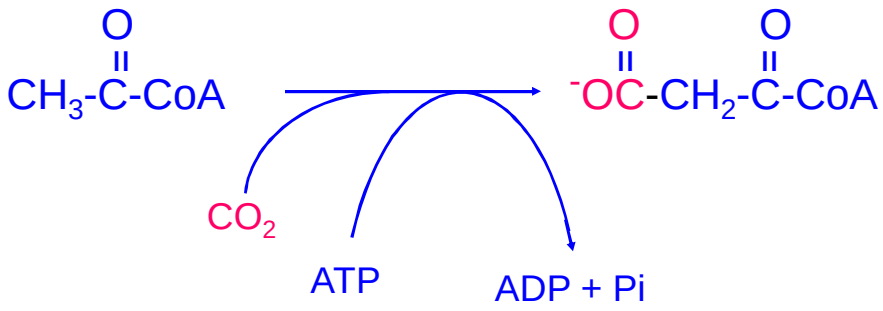
↑ **reduction**

↑ **condensation**

Acyl CoA$_{(n)}$ + Malonyl CoA

Acetyl CoA

Carboxylation of Acetyl CoA Produces Malonyl CoA

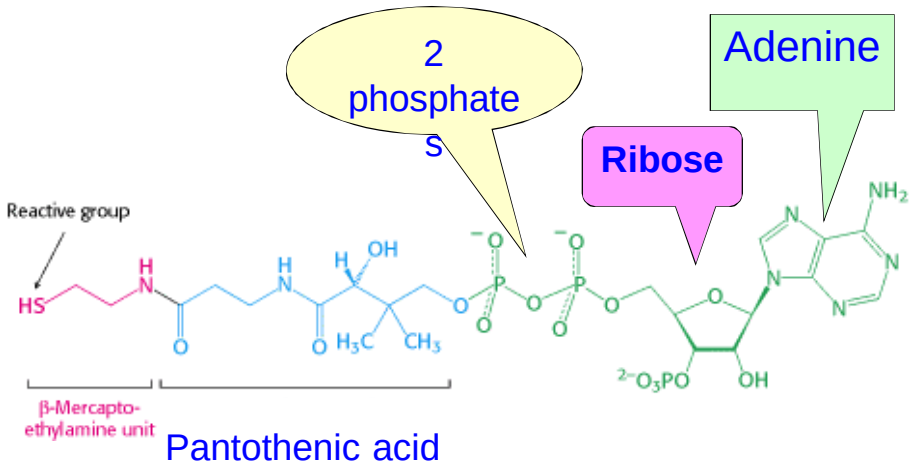


Acetyl CoA Carboxylase

Biotin-Containing Enzyme

Fatty Acid Synthase Catalyzes the remaining steps

- **Multifunctional Enzyme Complex**
- **Dimer of two Identical Chains**
- **Each has Seven Catalytic Activities**
  - One activity is Condensing Enzyme with –SH
- **One Domain is Linked to Phosphopantetheine**
  - With Reactive -SH



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- **Multifunctional Enzyme Complex**
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- **Each has Seven Catalytic Activities**
  - One activity is Condensing Enzyme with –SH
- **One Domain is Linked to Phosphopantetheine**
  - With Reactive -SH
  - Carries Intermediates during Catalysis
  - (Acyl, Acetyl and Malonyl Groups)
  - Known as Acyl Carrier Protein (ACP)

Fatty Acid Synthesis (Overview)

Acetyl-CE (Acyl-CE) + Malonyl ACP
(n) (3)

CO_2

Ketoacyl ACP
(n+2)

↓

↓

↓

Acyl ACP

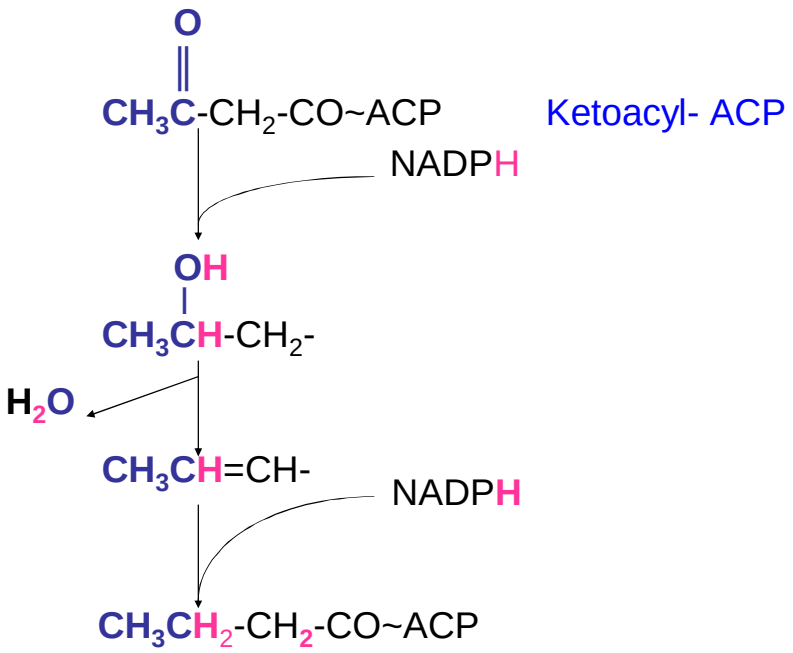
CH_3CO~S-CE + OOC-CH_2-CO~ACP
Acetyl Malonyl-ACP
(Acyl)

CO_2
HS-CE

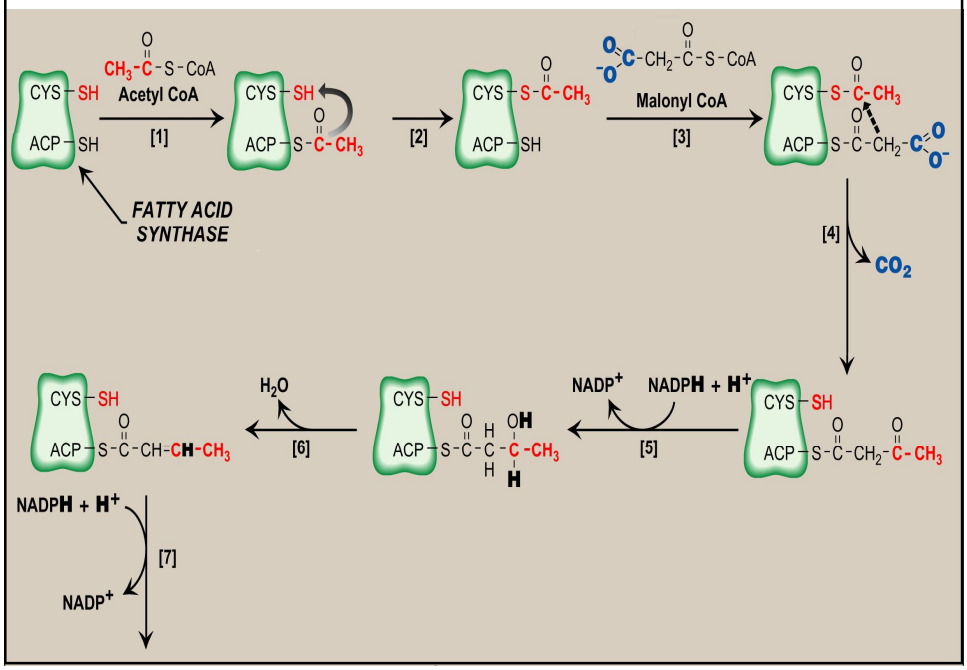
$CH_3C(=O)$-CH_2-CO~ACP

Ketoacyl- ACP

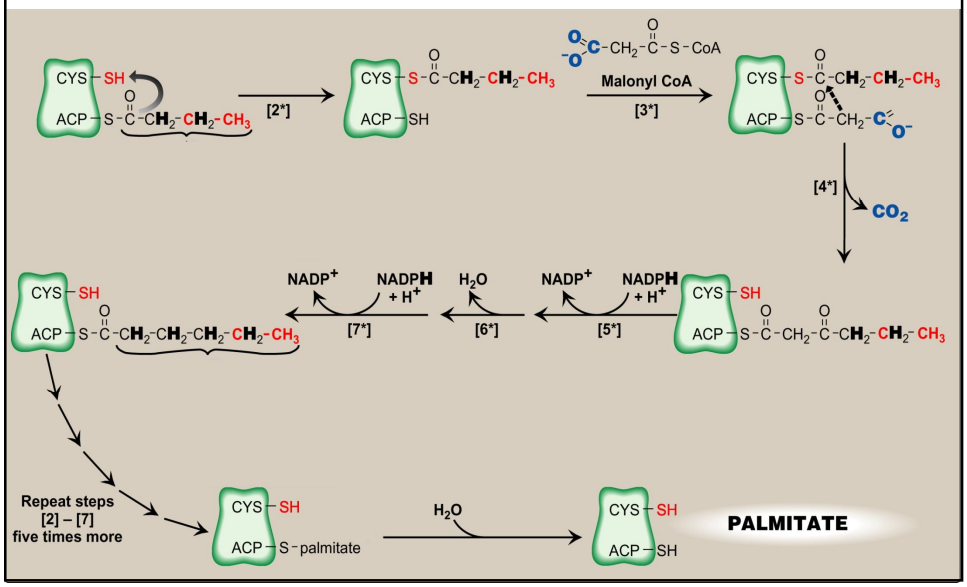
Reduction of the Ketoacyl Group



Synthesis of Palmitate by Fatty Acid Synthase



Synthesis of Palmitate by Fatty Acid Synthase (Cont.)



Synthesis of Palmitate (net reaction)

How many cycles of synthesis (Condensation)?

* 7

How many Malonyl CoA?

* 7

How many Acetyl CoA?

* 1

How Many NADPH?

* 14