Topic: oxidation of fats
Class: B.Sc Part –III (Hons.)
Paper- V
Group – A

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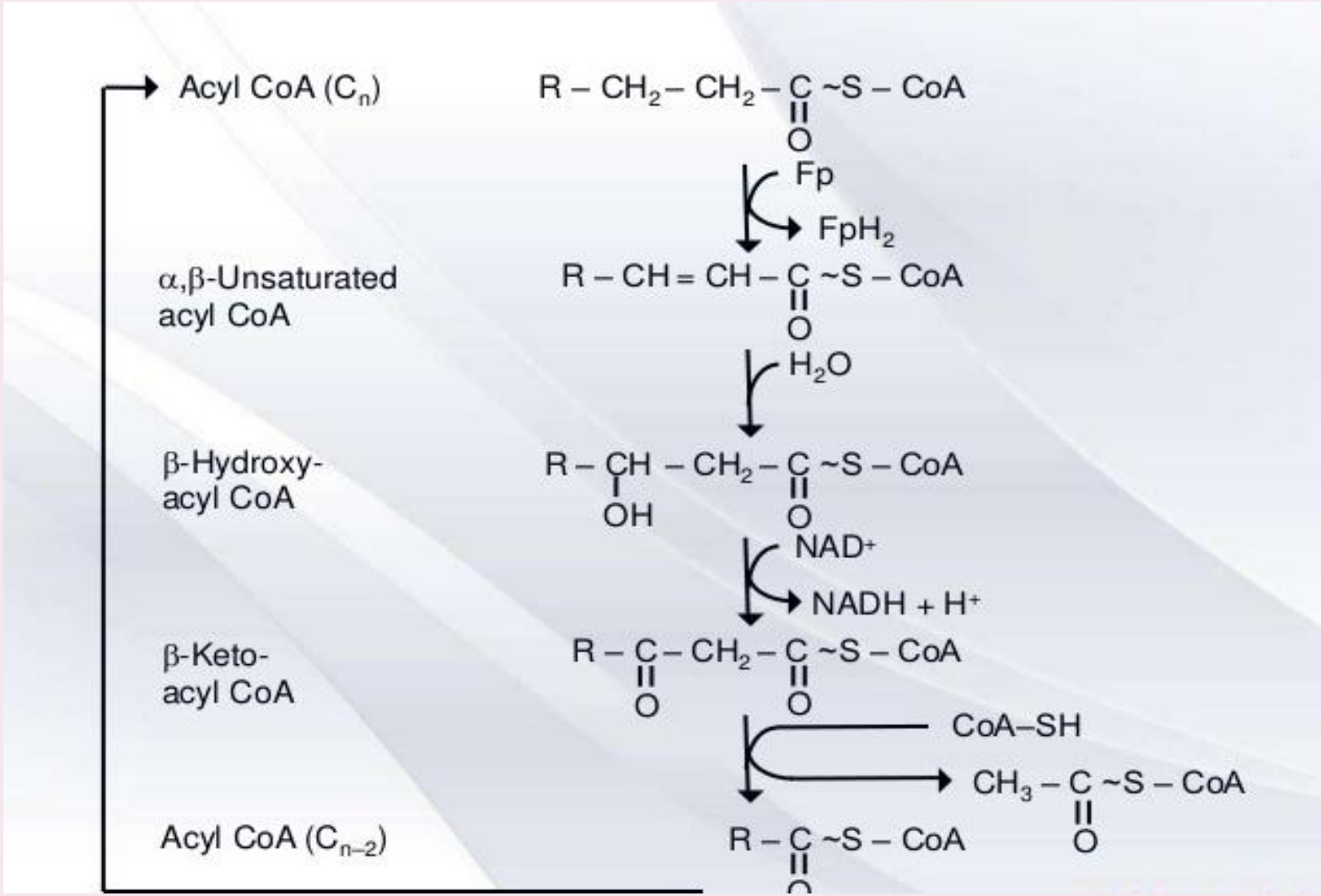
- Thus, during one cycle of beta-oxidation:
- Two carbon atoms are removed from the carboxyl end as acetyl CoA
- An acyl CoA having two carbon atoms less than the original acyl CoA is formed
- The new acyl CoA goes through the cycle again
- Two more carbon atoms are removed in the form of acetyl CoA
- This continues until only a two-carbon acyl CoA (acetyl CoA) is left


Acyl CoA (C_n)
R – CH_2 – CH_2 – C ~S – CoA
O
Fp
FpH_2
α,β-Unsaturated acyl CoA
R – CH = CH – C ~S – CoA
O
H_2O
β-Hydroxy-acyl CoA
R – CH – CH_2 – C ~S – CoA
OH
O
NAD^+
$NADH + H^+$
β-Keto-acyl CoA
R – C – CH_2 – C ~S – CoA
O
O
CoA–SH
CH_3 – C ~S – CoA
O
Acyl CoA (C_{n-2})
R – C ~S – CoA
O

Energetics

- In each cycle of b-oxidation:
- One FAD is reduced
- One NAD is reduced
- One acetyl CoA is formed
- If the fatty acid being oxidized is palmitic acid (C16):
- Seven cycles of b-oxidation will form seven molecules of acetyl CoA
- A two-carbon acyl CoA i.e. acetyl CoA will be left at the end of the last cycle
- Thus, eight molecules of acetyl CoA are formed
- When oxidized in the citric acid cycle, these will form 8 x 12 = 96 ATP equivalents
- Seven molecules of FAD are reduced in seven cycles
- When oxidized in the citric acid cycle, these will form 7x2 = 14 ATP equivalents

- Seven molecules of NAD are reduced in seven cycles
- When oxidized in the citric acid cycle, these will form 7x3 = 21 ATP equivalents
- Therefore, the total number of ATP equivalents formed is 96+14+21 = 131
- Two ATP equivalents are used in the initial activation reaction (ATP □ AMP + PPi)
- Hence, the net gain is 131–2 = 129 ATP equivalents per molecule of palmitic acid
- Hydrolysis of terminal phosphate group of ATP yields 7.3 kcal/mol of ATP
- Hence, oxidation of palmitic acid yields 129 x 7.3 = 942 kcal/mol of palmitic acid
- Molecular weight of palmitic acid is 256
- Hence, its potential energy is 256 x 9.1 = 2,330 kcal/mol

- If the fatty acid being oxidized is stearic acid (C18):
- Eight cycles of b-oxidation will form eight molecules of acetyl CoA
- A two-carbon acyl CoA i.e. acetyl CoA will be left at the end of the last cycle
- Thus, nine molecules of acetyl CoA are formed
- When oxidized in the citric acid cycle, these will form 9 x 12 = 108 ATP equivalents
- Eight molecules of FAD are reduced in eight cycles
- When oxidized in the citric acid cycle, these will form 8x2 = 16 ATP equivalents
- Eight molecules of NAD are reduced in eight cycles
- When oxidized in the citric acid cycle, these will form 8x3 = 24 ATP equivalents

- Therefore, the total number of ATP equivalents formed is 108+16+24 = 148
- Two ATP equivalents are used in the initial activation reaction (ATP -> AMP + PPi)
- Therefore, the net gain is 148–2 = 146 ATP equivalents per molecule of palmitic acid or 146x7.3 = 1,066 kcal/mol of palmitic acid

- Molecular weight of stearic acid is 284

- Its potential energy is 284 x 9.1 = 2,584 kcal/mol

- Fatty acids having an odd number of carbon atoms are also oxidized by b-oxidation
- After the last cycle of b-oxidation, a 3-carbon acyl CoA is left which is propionyl CoA
- This is converted by a series of reactions into succinyl CoA
- Succinyl CoA can enter the citric acid cycle