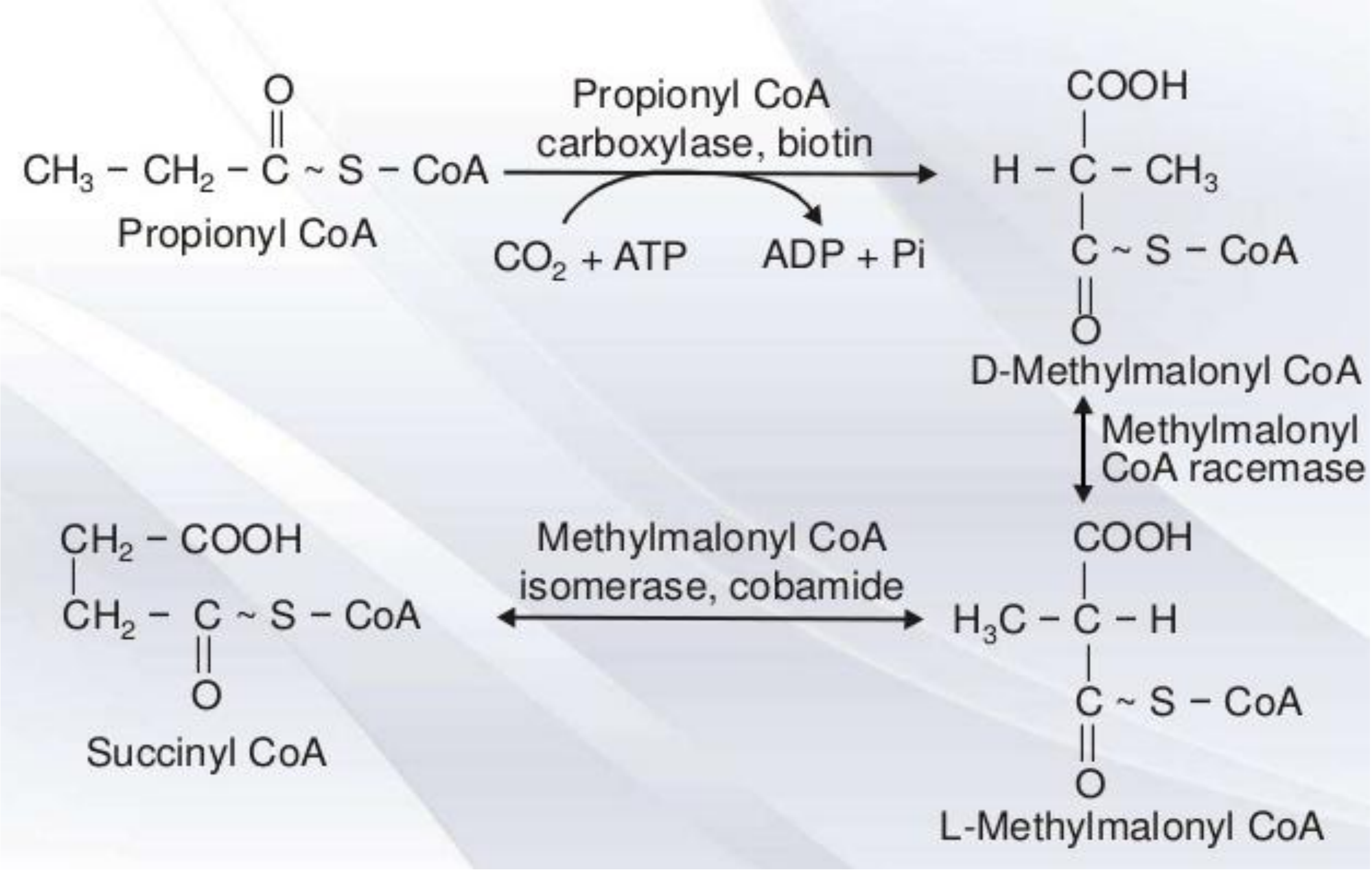
Topic: oxidation of fats
Class: B.Sc Part –III (Hons.)
Paper– V
Group – A

Faculty Name : Dr. Kumari Sushma Saroj
Department: Zoology
College: Dr. L. K. V. D College, Tajpur, Samastipur



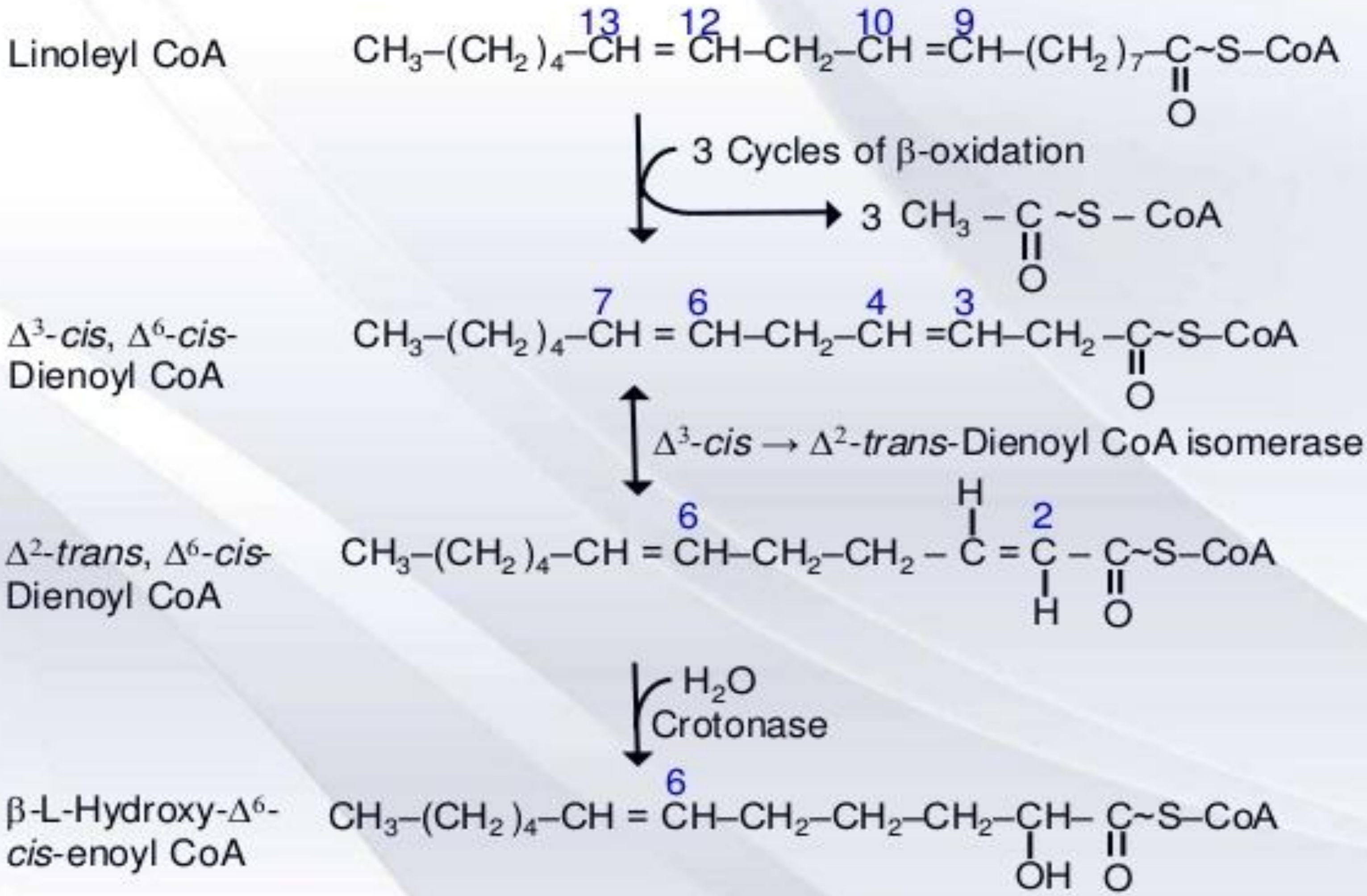
Propionyl CoA
carboxylase, biotin
Propionyl CoA
CO2 + ATP
ADP + Pi
COOH
H − C − CH3
C ~ S − CoA
O
D-Methylmalonyl CoA
Methylmalonyl
CoA racemase
COOH
H3C − C − H
C ~ S − CoA
O
L-Methylmalonyl CoA
Methylmalonyl CoA
isomerase, cobamide
CH2 − COOH
CH2 − C ~ S − CoA
O
Succinyl CoA

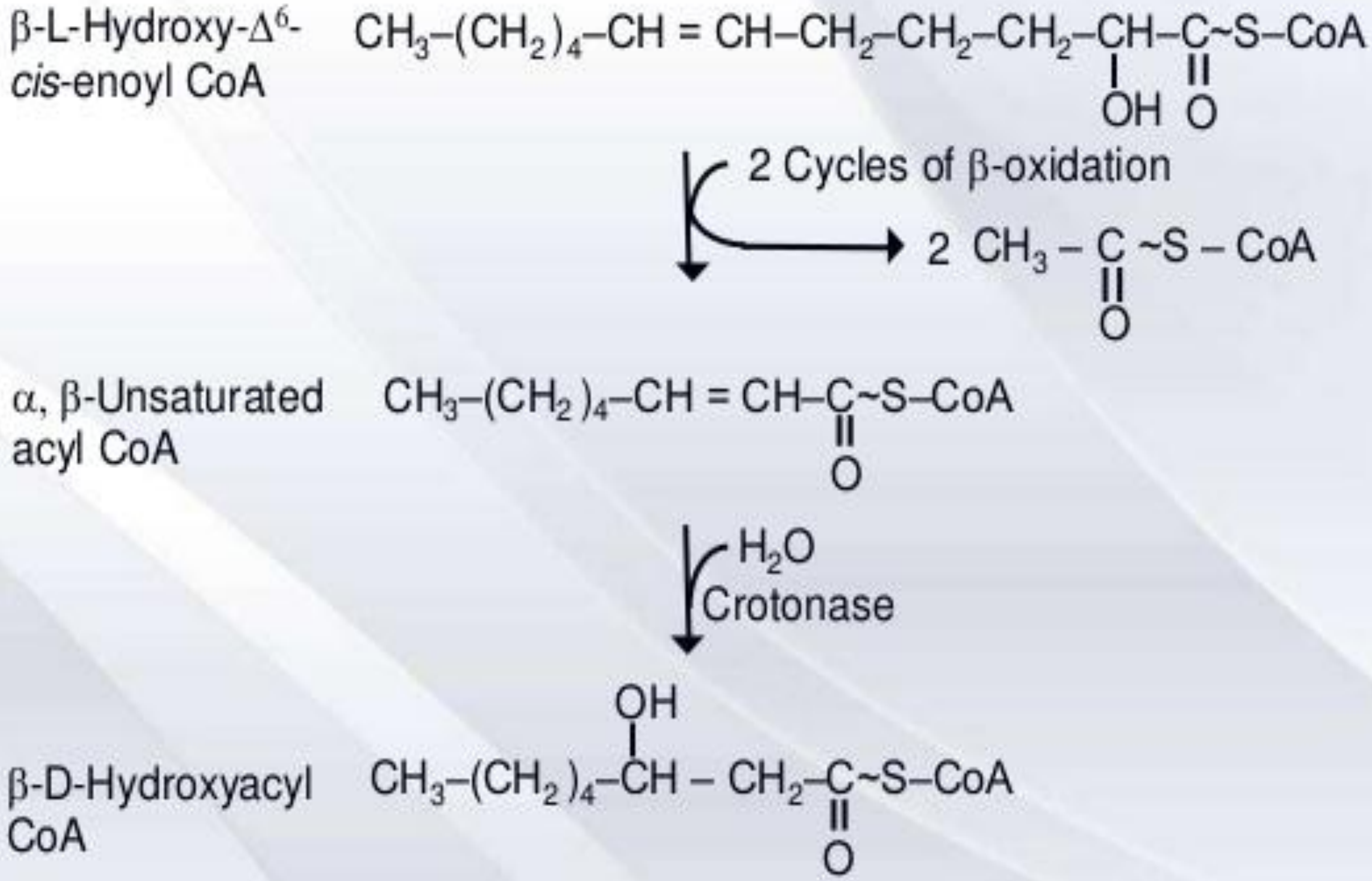
- Inborn errors of b-oxidation are uncommon
- Rarely, defects have been reported in:
- ▪ Acyl CoA dehydrogenase
- ▪ beta-Hydroxyacyl CoA dehydrogenase
- Clinical manifestation is unexplained hypo- glycaemia with or without ketosis Defects in b-oxidation
- Sometimes, transport of fatty acids into mitochondria is defective
- Carnitine-palmitoyl transferase I, carnitine- palmitoyl transferase II or carnitine-acyl- carnitine translocase may be defective
- Rarely, the defect may be due to carnitine deficiency
- Dietary carnitine deficiency has not been identified in healthy people
- Carnitine deficiency can occur in patients undergoing repeated haemodialysis
- This happens because haemodialysis removes carnitine from blood

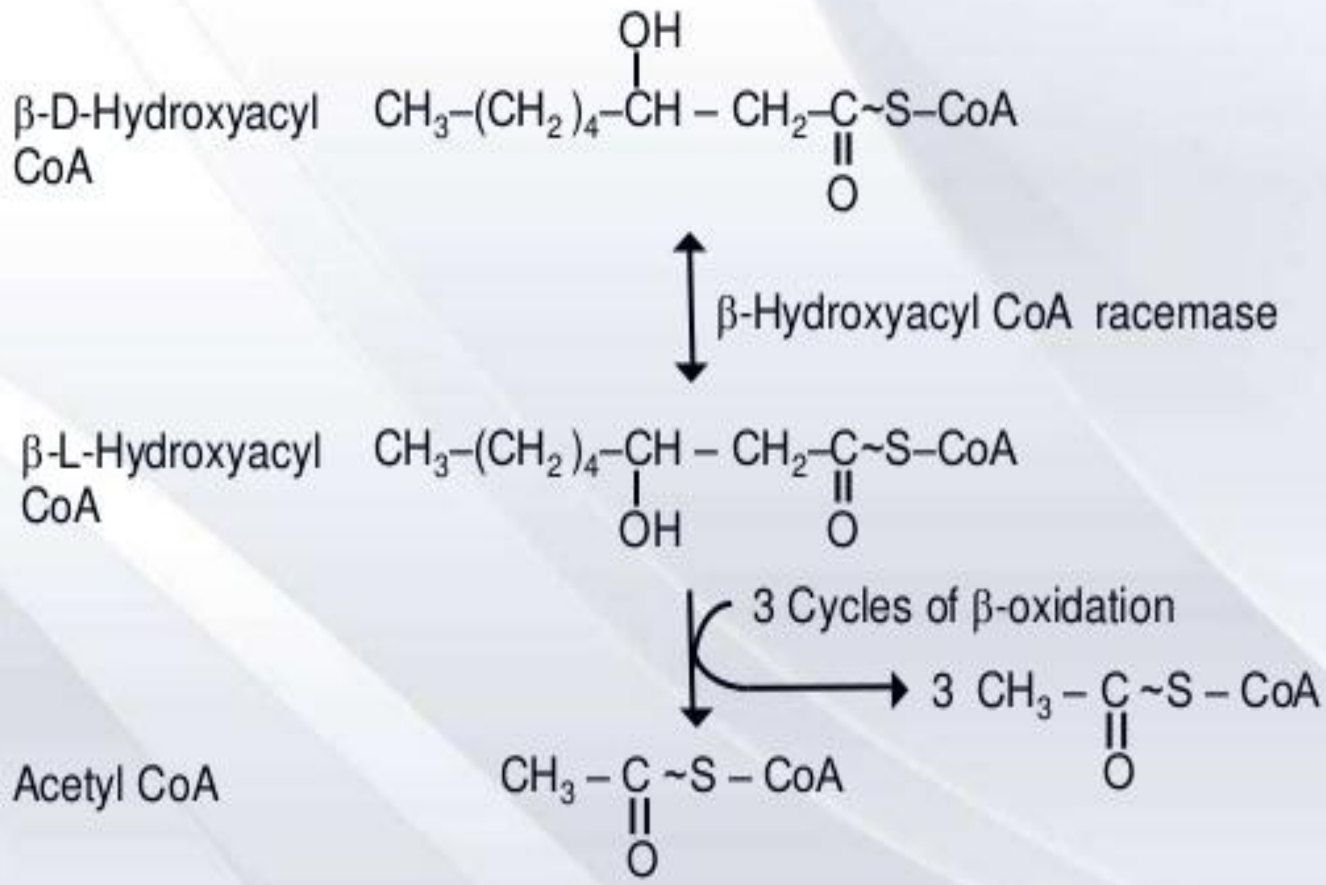
Regulation of fatty acid oxidation

- Fatty acid metabolism is regulated according to the availability of energy When energy is needed, oxidation of fatty acids in increased and their synthesis is decreased The reverse occurs when energy is abundant
- Rate of fatty acid oxidation depends on the availability of substrates i.e. fatty acids Fatty acids are released from fat depots by lipolysis When lipolysis increases, so does the oxidation of fatty acids When lipolysis decreases, oxidation of fatty acids also decreases
- When energy is scarce, secretion of glucagon and epinephrine increases These two activate hormone-sensitive lipase through cAMP Lipolysis increases; fatty acids are released from stored triglycerides Increased availability of fatty acids increases their oxidation

- NADH inhibits beta-hydroxyacyl CoA dehydrogenase Acetyl CoA inhibits thiolase This decreases the oxidation of fatty acids
- Unsaturated fatty acids are also oxidized by beta-oxidation Two additional enzymes are needed to deal with the double bonds Double bonds in naturally occurring fatty acids have a cis conformation(Oxidation of unsaturated fatty acids)
- On hydration, cis double bonds form the D-isomers of hydroxyacyl CoA beta-Hydroxyacyl CoA dehydrogenase can act only on beta-L-hydroxyacyl CoA Therefore, the D-isomers have to be racemised to L-isomers
- When a double bond occurs between beta- and gamma-carbon, acyl CoA dehydrogenase cannot act on it The reason is that the single hydrogen atom attached to beta-carbon atom cannot be removed
- Hence, the double bond is shifted between the alpha- and beta-carbon atoms by an isomerase This isomerase also converts the cis double bond into a trans double bond These reactions are illustrated by oxidation of linoleic acid


Linoleyl CoA
13
12
10
9
CH3–(CH2)4–CH = CH–CH2–CH =CH–(CH2)7–C~S–CoA
O
3 Cycles of β-oxidation
3 CH3 – C ~S – CoA
O
Δ3-cis, Δ6-cis-
Dienoyl CoA
7
6
4
3
CH3–(CH2)4–CH = CH–CH2–CH =CH–CH2 –C~S–CoA
O
Δ3-cis → Δ2-trans-Dienoyl CoA isomerase
Δ2-trans, Δ6-cis-
Dienoyl CoA
6
2
H
CH3–(CH2)4–CH = CH–CH2–CH2 – C = C – C~S–CoA
H
O
H2O
Crotonase
β-L-Hydroxy-Δ6-
cis-enoyl CoA
6
CH3–(CH2)4–CH = CH–CH2–CH2–CH2–CH– C~S–CoA
OH
O


β-L-Hydroxy-Δ6-cis-enoyl CoA
$CH_3-(CH_2)_4-CH=CH-CH_2-CH_2-CH_2-CH(OH)-C(=O)\sim S-CoA$
2 Cycles of β-oxidation
$2\ CH_3-C(=O)\sim S-CoA$
α, β-Unsaturated acyl CoA
$CH_3-(CH_2)_4-CH=CH-C(=O)\sim S-CoA$
H_2O
Crotonase
β-D-Hydroxyacyl CoA
$CH_3-(CH_2)_4-CH(OH)-CH_2-C(=O)\sim S-CoA$


β-D-Hydroxyacyl CoA
CH3–(CH2)4–CH(OH) – CH2–C(=O)~S–CoA
β-Hydroxyacyl CoA racemase
β-L-Hydroxyacyl CoA
CH3–(CH2)4–CH(OH) – CH2–C(=O)~S–CoA
3 Cycles of β-oxidation
3 CH3 – C(=O) ~S – CoA
Acetyl CoA
CH3 – C(=O) ~S – CoA