COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

FATTY ACID SYNTHESIS

BY

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ZOOLOGY: SEM- III, PAPER- C7T: FUNDAMENTALS OF BIOCHEMISTRY, UNIT 1: CARBOHYDRATES

Fatty Acid Synthesis:

- Lipogenesis, the synthesis of fatty acids and their esterification to glycerol to form triacylglycerols, which occurs mainly in the liver in humans, with dietary carbohydrate as the major source of carbon.

- While the de novo synthesis of fatty acids from acetyl-CoA occurs in the cytosol on the fatty acid synthase complex.

- Fatty acid synthesis is the creation of fatty acids from acetyl-CoA and NADPH through the action of enzymes called fatty acid synthases.

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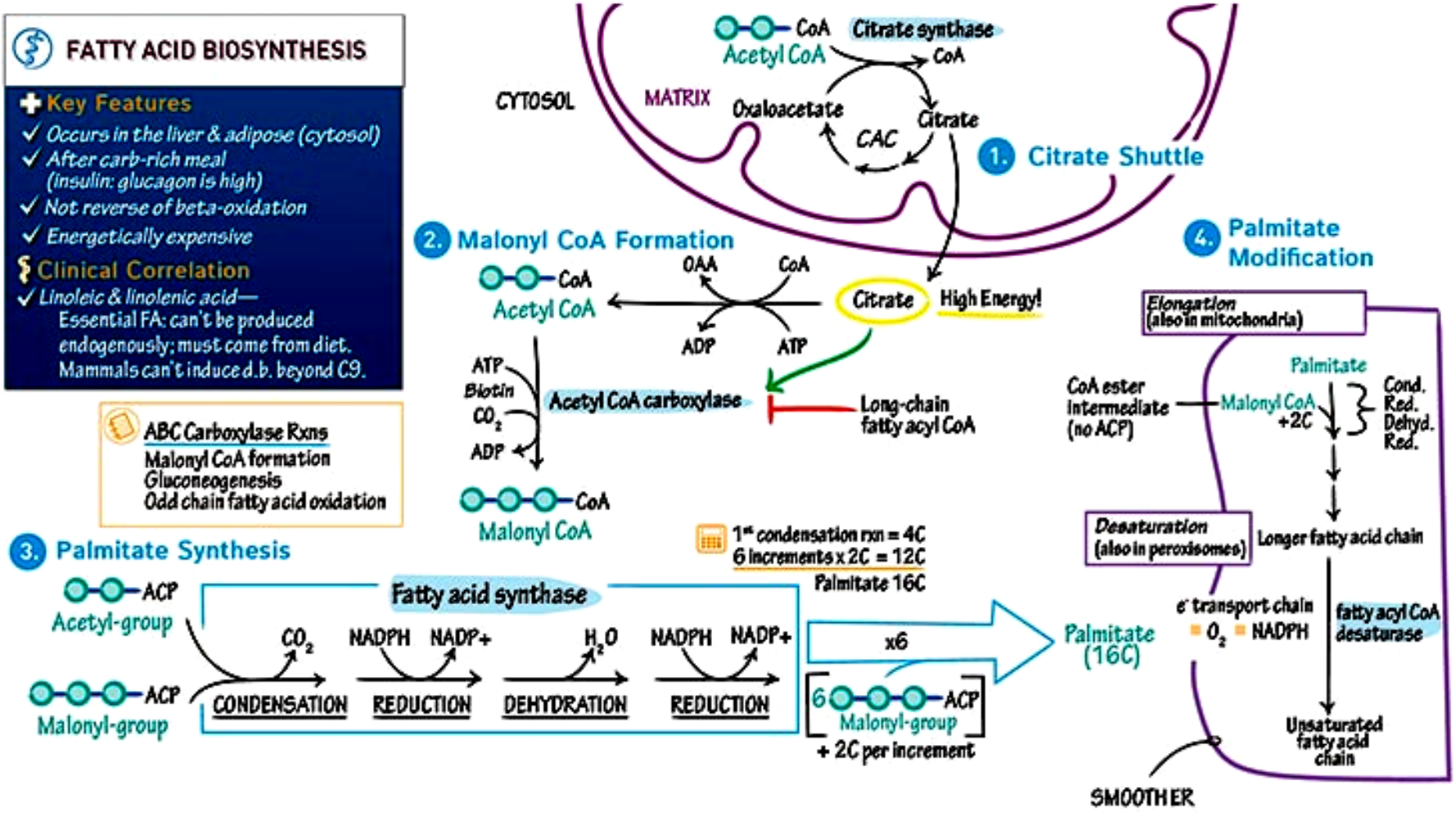

Location of Fatty acids:

Fatty acid synthesis takes place in the cytosol and is carried out by a multienzyme complex called FAS (fatty acid synthase complex).

Substrates (to make one palmitate):

- 8 acetyl CoA
- 14 NADPH
- 7 ATP

Products:

- 1 molecule of palmitate (16-carbon fatty acid)

- 7 H_2O

Fatty acids Synthesis Pathway:

- Acetyl CoA is converted to malonyl CoA by acetyl CoA carboxylase.
- Malonyl CoA is transferred to FAS.
- Through a series of condensation, reduction, and dehydration reactions, the two carbons of malonyl CoA are added to the growing fatty acyl moiety on FAS.

- FAS are then recharged with another malonyl moiety, and the cycle continues.
- Each turn of the cycle results in the addition of a two-carbon group to the fatty acid moiety as well as the use of one ATP, one acetyl CoA, and two NADPH.

When the cycle has completed seven turns, the 16-carbon fatty acid (palmitate) is released from FAS.

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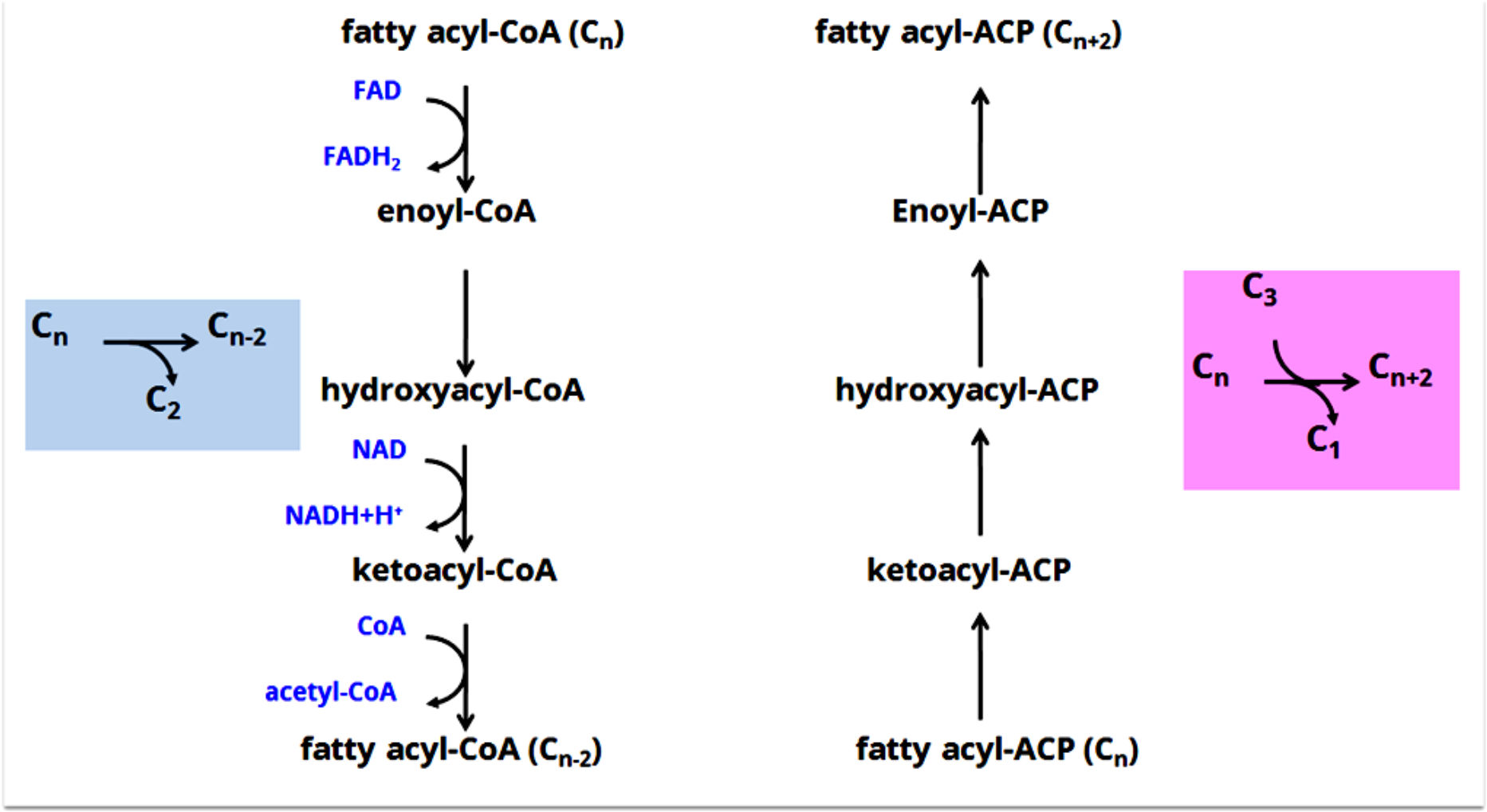

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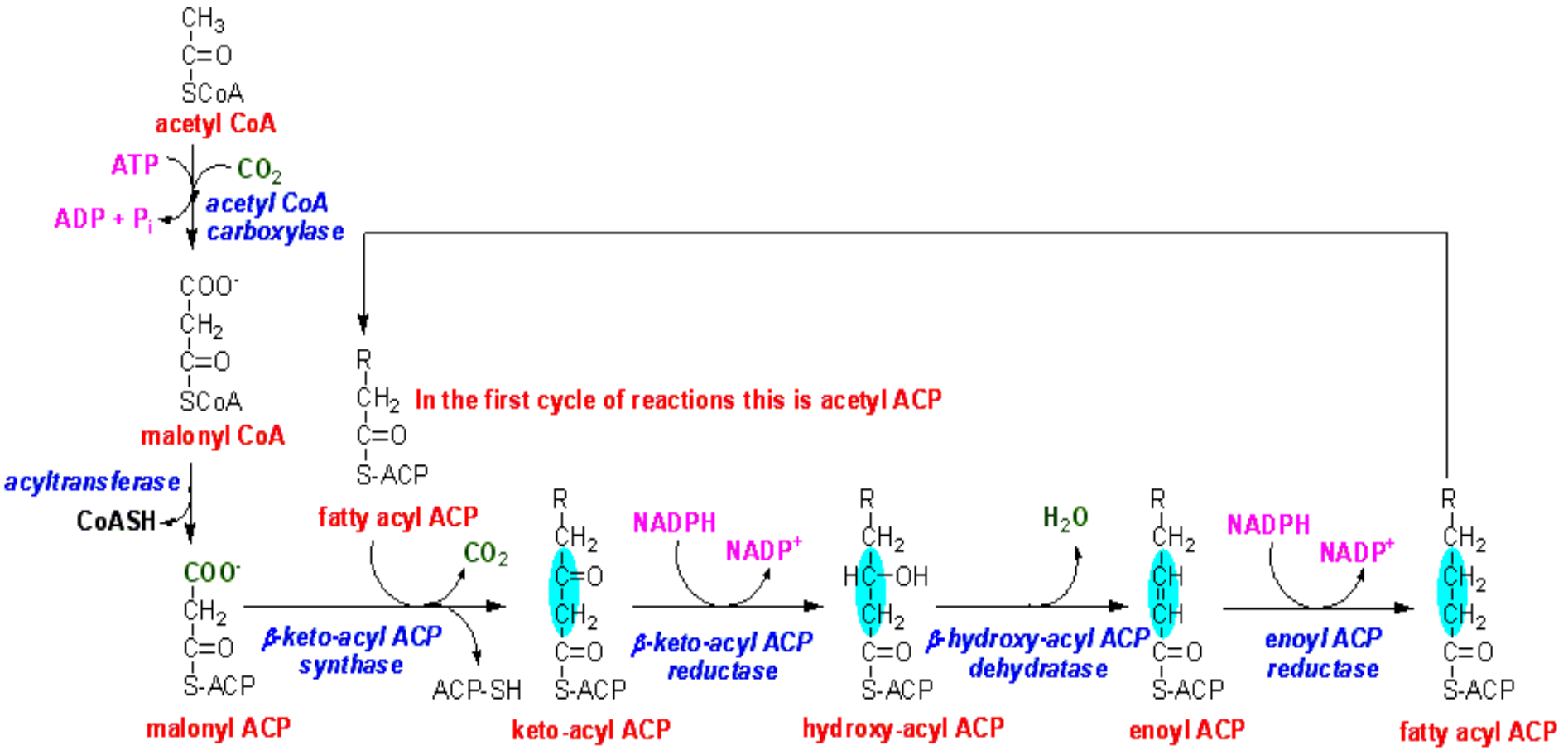

Important enzymes:

- **Acetyl CoA carboxylase:** Transforms acetyl CoA to malonyl CoA with the use of biotin and bicarbonate as cofactors. Requires one ATP.

- **Malonyl CoA transferase:** Transfers the malonyl CoA molecule to FAS.

- **FAS:** This collection of enzymes transfers the two carbons of malonyl CoA to the carboxyl end of the growing chain of the fatty acyl moiety. Requires two NADPH.

Activators:

- Insulin stimulates fatty acid synthesis by dephosphorylating and, therefore, activating acetyl CoA carboxylase.

Inhibitors:

- Glucagon and epinephrine inhibit fatty acid synthesis by inactivation of acetyl CoA carboxylase.

Significance:

- Fatty acid synthesis is a critical anabolic pathway in most organisms.

- In addition to being the major component of membranes, fatty acids are important energy storage molecules, and fatty acyl derivatives possess a variety of physiological functions, including post-translational modification of numerous proteins.

- Fatty acid biosynthesis is important for cell growth, differentiation, and homoeostasis.

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THANK YOU

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