

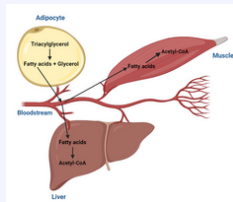
Lipid Metabolism

Fatty acid from stored diet triacylglycerols in adipocytes are degraded and then oxidized into acetyl-CoA by lipases

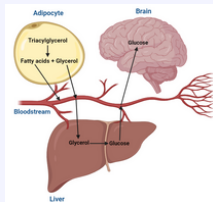
Release of Acetyl-CoA from Fatty Acid Storage

Triacylglycerol → glycerol + 3 fatty acids

- Glycerol = substrate for gluconeogenesis
 - Glycerol → glucose
 - Brain cells use for energy
- 3 fatty acids = enter blood, β -oxidation
 - Fatty acids → Acetyl-CoA**
 - Bind to albumin (transport protein)
 - Fuel source (liver, muscle) → β -oxidation → enter krebs cycle, make ATP
 - How liver obtains ATP when blood glucose is low
 - NOT** to brain cells
- Release is promoted by glucagon



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Fatty Acid Biosynthesis

- High glucose conditions
- Acetyl-CoA comes mostly from pyruvate → need to move it to cytosol
 - 2 e⁻ taken from NADH → to NAD⁺ and NADPH
- Stimulated by insulin

Overall Reaction:

Acetyl-CoA (matrix), 2 ATP, NADH, NADP⁺ → Acetyl-CoA (cytosol), 2 ADP + Pi, NAD⁺, NADPH

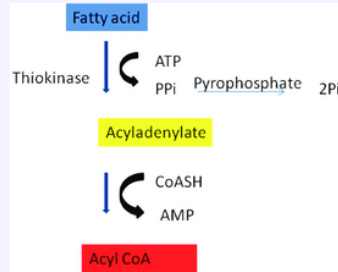
- Occurs via the citrate transport system
- Cytosolic acetyl-CoA uses NADPH to produce fatty acids
 - membrane lipids <- fatty acids <- triacylglycerols

β -Oxidation of Fatty Acids

For acyl-CoA with 2N carbons:

Acyl-CoA + N-1 Q + N-1 NAD⁺ + N-1 COA → N Acetyl-CoA (Citric acid cycle or converted to ketone bodies) + N-1 QH₂ (e⁻ transport chain) + N-1 NADH (e⁻ transport chain)

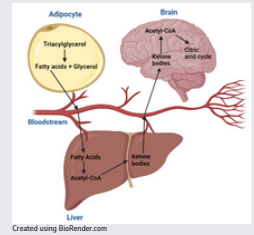
- Oxidative Process
 - Fatty Acids → Acetyl-CoA
 - NADH and QH₂ released
- Activation of fatty acids in cytosol is **required**
 - Not part of the process** of β -Oxidation
- Transporters move fatty acid from the bloodstream → cytosol → mitochondrial matrix
 - Driven by ATP → AMP + PPi
 - Matrix is preferred = direct use for krebs cycle
- Oxidized in 4 reactions → 4 e⁻ removed from carbon in each step
 - Each step removes 2 carbons
- Repeat until all carbons are completely oxidized to acetyl-CoA
- Produce 1 QH₂, 1 NADH, a fatty acyl-CoA chain that is 2 carbons shorter than the starting material
 - NADH and QH₂ molecules produced **2.5 and 1.5 ATP** molecules respectively
- Can use unsaturated fatty acids
 - Yield fewer QH₂ (already partially oxidized)
 - May require NADPH consumption
- We are assuming an equal number of carbons
- Fatty acids with odd number of carbons produce propionyl-CoA in last step
 - Convert to succinyl-CoA for the Krebs cycle



Sourced from https://www.researchgate.net/figure/Activation-of-fatty-acid-to-acyl-CoA-by-the-enzyme-thiokinase-Fig1_304738134

Ketone Bodies

- Low glucose conditions
- Liver's mitochondria diverts some acetyl-coA into ketone bodies
 - ketone bodies <-> acetyl-coA
 - acetone, acetoacetate, beta-hydroxybutyrate
- To the brain, muscle cells → convert back to acetyl-coA to make ATP



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Fatty Acid Synthesis in Cytosol

- NADPH required** for fatty acid synthesis
- Driven by ATP hydrolysis
- 2 carbon atoms added to a growing hydrocarbon chain, 4 e⁻ added for each turn of the cycle

Overall Reaction:

8 Acetyl-CoA + 14 NADPH + 7 ATP → Palmitate + 8 CoA + 14 NADP⁺ + 7 ADP + 7 Pi

- Palmitate (16C)** made after 7 cycles → can be stored in triacylglycerols are used to make membrane lipids
 - Humans can make lipids shorter or longer than 16 carbons
 - Cells have enzymes to add double bonds but not in every position
 - We need certain unsaturated fatty acids in our diet

LETTER TO THE STUDENT

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Created by students for other students, this resource aims to provide a comprehensive view of material taught within this course. Our goal is to help students develop, solidify, and refine their understanding of course content. Our resource is also open access meaning there are no financial or legal barriers to students who wish to access and use our resource.

To maximize the benefits of this resource, we recommend that you read carefully through the topics, focusing on *bolded terminology, compound structures, and diagrams*. Although this resource ideally will cover all testable content as of the 2024-2025 academic year, we cannot guarantee this and strongly encourage you to cross-reference with class material and notes.

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We appreciate you using our resource! Best of luck on your exams :)

-The WebStraw team

 Note to Instructors: If this resource has been created for your course and you would like to collaborate with us, please email us at team@webstraw.org

biochem 2280.

BROUGHT TO YOU
BY WEBSTRAW

a handmade guide

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Questions? Ask us at team@webstraw.org