

Chemistry 506: Allied Health Chemistry 2Chapter 21: Specific Catabolic PathwaysMolecular Destruction

Introduction to General, Organic & Biochemistry, 5th Edition by
Bettelheim and March: Chapter 21, Pages 665-690

Outline Notes by Dr. Allen D. Hunter, YSU Department of
Chemistry, ©2000.

Outline

1A SECTION(S) 21.1 GENERAL FLOW OF CATABOLIC PATHWAYS	2
1B SECTION(S) 21.2/3 GLYCOLYSIS	6
1C SECTION(S) 21.4/5/6 TRIGLYCERIDE METABOLISM.....	7

1A Section(s) 21.1 General Flow of Catabolic Pathways

- Overall Process
 - Start with complex mixtures of food molecules
 - Used to generate energy (as “fuel” molecules)
 - ATP
 - NADH and FADH₂
 - Acetyl CoA
 - Ultimate products are CO₂, H₂O, Urea (C(O)(NH₂)₂), etc.
 - Intermediate Breakdown products may be used in Anabolic pathways

➤ Carbohydrate Catabolism

- 1st stages can start in the digestive tract
- Final stage is called glycolysis and finishes within the mitochondrion

Polysaccharides



Oligosaccharides



Disaccharides



Monosaccharides



CO₂ + “fuel” molecules

➤ Lipid Catabolism

- Starts in **digestive system** and ends inside **mitochondria**
- **Lipases** break the **ester linkages** in the triglycerides

Triglycerides



Glycerol + Fatty Acids



CO₂ + “fuel” molecules

➤ Protein Catabolism

- Starts in digestive system and ends inside mitochondria

Proteins



Peptides



Amino Acids



CO₂ + “fuel” molecules + Urea

1B Section(s) 21.2/3 Glycolysis

- Monosaccharides ⇒ Energy
 - 1st stage adds energy to monosaccharide substrate
 - Activation by 2 ATP
 - This is typical of Catabolic reactions

- 2nd stage is oxidation which produces “fuel” molecules
 - ATP
 - NADH
 - FADH₂
 - Acetyl CoA

- Overall process shown on pages 668/669
 - It is very complex
 - Path differs under aerobic and anaerobic conditions
 - Lactic Acid byproduct
 - Net yield of Glucose is 36 ATP Molecules (i.e., 6/C)

1C Section(s) 21.4/5/6 Triglyceride Metabolism

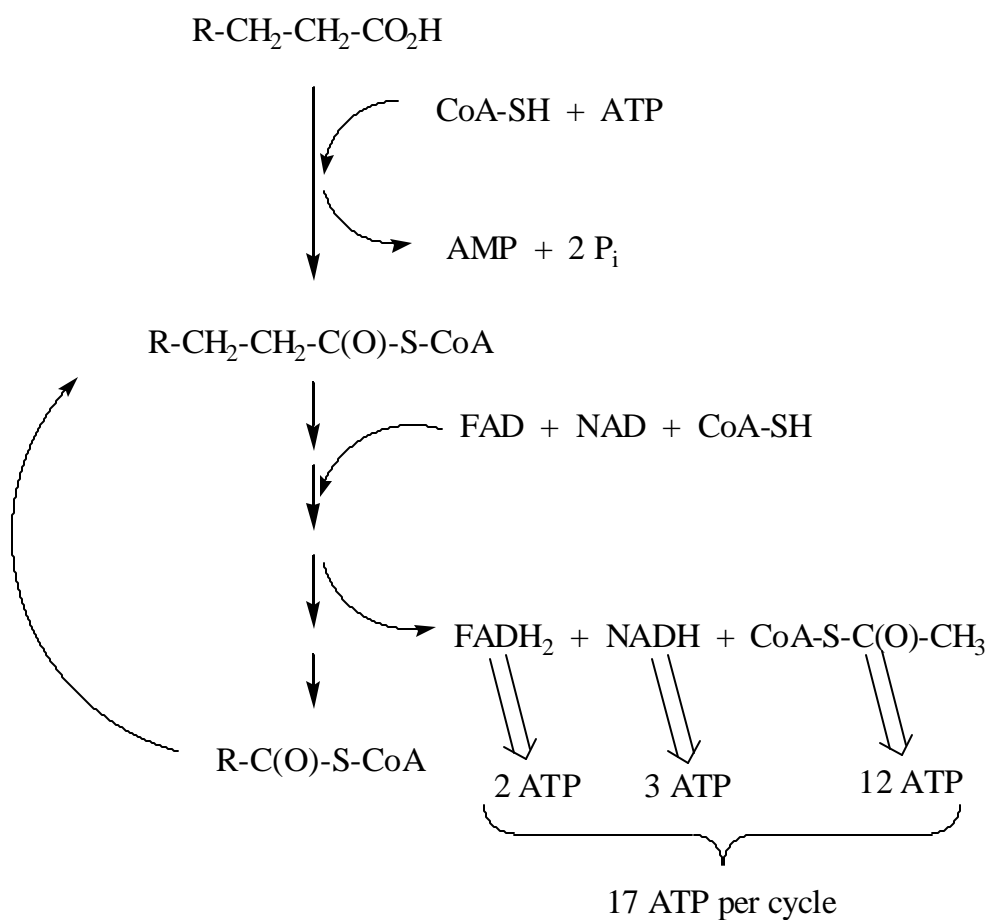
➤ Glycerol Metabolism

- Produces 20 ATP (i.e., 6.7/C)
- 1st step is ATP activation (i.e., phosphorylation)

➤ Fatty Acid Metabolism

- Typically produces 100-200 ATP
- Depends on Chain length and degree of unsaturation
- Steric Acid (C18, $\text{CH}_3\text{-(CH}_2\text{)}_{16}\text{-CO}_2\text{H}$)
 - Gives 146 ATP (8.1/C)
 - Higher ATP yield per carbon than carbohydrates because the molecule starts out less oxidized

- Reaction Pathway
- Cyclic Process
- C2 fragments removed each cycle
- Removed as Acetyl CoA



➤ For Steric Acid

➤ C18, $\text{CH}_3\text{-(CH}_2\text{)}_{16}\text{-CO}_2\text{H}$

ATP Activation \Rightarrow	-2 ATP
8 x one FADH_2 per cycle \Rightarrow	8 x 2 ATP
8 x one NADH per cycle \Rightarrow	8 x 3 ATP
<u>9 Acetyl CoA \Rightarrow</u>	<u>9 x 12 ATP</u>
Total ATP Production	146 ATP

Skip Sections 21.7/8/9/10

Problems: 21.1 to 21.28

Index of Topics and Vocabulary

A

Acetyl CoA	2, 6, 8, 9
activation	7
Activation by 2 ATP	6
aerobic	6
Amino Acids	5
Anabolic pathways	2
anaerobic	6
ATP	2, 6, 7, 9
ATP Activation	9
ATP yield per carbon	7

C

C(O)(NH ₂) ₂	2
C2 fragments	8
Carbohydrate Catabolism	3
Catabolic reactions	6
CH ₃ -(CH ₂) ₁₆ -CO ₂ H	9
Chain length	7
CO ₂	2, 3, 4, 5
complex	6
complex mixtures of food molecules	2
Cyclic Process	8

D

digestive system	4, 5
digestive tract	3
Disaccharides	3

E

Energy	6
ester linkages	4

F

FADH ₂	2, 6
Fatty Acid Metabolism	7
Fatty Acids	4
fuel molecule	6
fuel molecules	2, 3, 4, 5

G

General Flow of Catabolic Pathways	2
Glucose	6
Glycerol	4
Glycerol Metabolism	7
Glycolysis	6

H

H ₂ O	2
------------------------	---

I

Intermediate Breakdown products	2
---------------------------------------	---

L

Lactic Acid	6
Lipases	4
Lipid Catabolism	4

M

mitochondria	4, 5
mitochondrion	3
monosaccharide substrate	6
Monosaccharides	3, 6

N

NADH	2, 6, 9
------------	---------

O

Oligosaccharides	3
oxidation	6
oxidized	7

P

Peptides	5
phosphorylation	7
Polysaccharides	3
Problems	9
Protein Catabolism	5
Proteins	5

R

Reaction Pathway	8
------------------------	---

S

Skip	9
Steric Acid	9

T

Total ATP Production	9
Triglyceride Metabolism	7
Triglycerides	4

U

Ultimate products	2
unsaturation	7
Urea	2, 5