BioChem 330 - Course Outline

• Metabolism and Bioenergetics (II)
  – ENZYME CATALYSIS:
    • kinetic constants \(k_{\text{cat}}\), \(K_m\)
    • Catalytic strategies, the serine proteases
  – CATABOLISM (breakdown)
    • Carbohydrates
      – Glycolysis
      – Tricarboxylic Acid Cycle
      – Electron Transport
      – Chemiosmosis and ATPase
    • Fatty acids and amino acids
Oxidation of Fats Provide Metabolic Energy

• Lipids are a large class of glycerol derivatives

• Triacylglycerols comprise 90% of our dietary fats

• C_{18} monounsaturated fatty acid is oleic acid
Digestion of Fats Starts with Peristalsis.....

• Dilemma: dietary fat is not very soluble, but must be digested by soluble enzymes

• Enzymes access the lipids at water/lipid interfaces that are favored by the actions of peristalsis
Absorption of Fat Occurs in small Intestines

Bile Acids:

are derived from cholesterol

are secreted into small intestines from liver through bile duct

Help free fatty acids to be absorbed by intestinal mucosa
Absorption of Fat Occurs in small intestines

Intestinal fatty acid binding protein (I-FABP)

FA fills the strand gap in the top beta sheet

Binding motif called a beta clam structure
Interfacial Enzymatic hydrolysis of TAG ester bond

Strategy 1: Pancreatic Lipase

hydrolysis of TAG

Specific to positions 1,3

Access to binding site (oxyanion hole) regulated by co-lipase

catalytic triad at active site
Interfacial Enzymatic hydrolysis of TAG ester bond

Strategy 2: Phospholipase A2

Enzyme binds to micelle, opening up a channel through which it can bind to hydrolyze a phospholipid
Transportation of fats in lymph and blood.....

- Exogenous pathways for dietary fats and cholesterol

- Endogenous pathways for fats, cholesterol moving internally from one place to another
TAGs are transported within lipoprotein vessicles

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Chylomicrons</th>
<th>VLDL</th>
<th>IDL</th>
<th>LDL</th>
<th>HDL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (g · cm⁻³)</td>
<td>&lt;0.95</td>
<td>&lt;1.006</td>
<td>1.006–1.019</td>
<td>1.019–1.063</td>
<td>1.063–1.210</td>
</tr>
<tr>
<td>Particle diameter (Å)</td>
<td>750–12,000</td>
<td>300–800</td>
<td>250–350</td>
<td>180–250</td>
<td>50–120</td>
</tr>
<tr>
<td>Particle mass (kD)</td>
<td>400,000</td>
<td>10,000–80,000</td>
<td>5000–10,000</td>
<td>2300</td>
<td>175–360</td>
</tr>
<tr>
<td>% Protein⁵</td>
<td>1.5–2.5</td>
<td>5–10</td>
<td>15–20</td>
<td>20–25</td>
<td>40–55</td>
</tr>
<tr>
<td>% Phospholipids⁵</td>
<td>7–9</td>
<td>15–20</td>
<td>22</td>
<td>15–20</td>
<td>20–35</td>
</tr>
<tr>
<td>% Free cholesterol⁵</td>
<td>1–3</td>
<td>5–10</td>
<td>8</td>
<td>7–10</td>
<td>3–4</td>
</tr>
<tr>
<td>% Triacylglycerols⁶</td>
<td>84–89</td>
<td>50–65</td>
<td>22</td>
<td>7–10</td>
<td>3–5</td>
</tr>
<tr>
<td>% Cholesteryl esters⁶</td>
<td>3–5</td>
<td>10–15</td>
<td>30</td>
<td>35–40</td>
<td>12</td>
</tr>
<tr>
<td>Major apolipoproteins</td>
<td>A-I, A-II, B-48, C-I, C-II, C-III, E</td>
<td>B-100, C-I, C-II, C-III, E</td>
<td>B-100, C-I, C-II, C-III, E</td>
<td>B-100</td>
<td>A-I, A-II, C-I, C-II, C-III, D, E</td>
</tr>
</tbody>
</table>

⁵Surface components
⁶Core lipids.

© 2008 John Wiley & Sons, Inc. All rights reserved.
Transportation of fats in lymph and blood.....

Lipoproteins are micellar assemblies

LDL: Nonpolar core; TAG, cholesterol esters

Amphiphillic surface: protein (i.e. apolipoprotein B-100), phospholipid, cholesterol

As size ↑ the density ↓
Transportation of fats in lymph and blood.....

Apolipoprotein A1

Occurs in chylomicrons/ HDL

Protein is loosely associated with the micelle

243 amino acid 29 kD peptide

Assembles as homotetramer

Amphipathic nature of helix

Figure 20-6a,b
Uptake of LDL by Endocytosis.....