BI 358 Lecture 4

I. **Announcements** Updates on Outlines & Quiz 1? Quiz Key posted in the glass box near 112 HUE. Next T *Nutritional Analyses*; Record ≥ 1 day of your diet on p 4-8 of DLN.

II. **Addiction Medicine Follow-up** CB1 & CB2 receptors, immunity? ETOH dependence & endocannabinoids? Anxiety?


IV. **Metabolic Lab Research cf: Dietary Intake Estimation**

V. **Gastrointestinal Physiology** G&H ch 62, 63, 64, 65 + LS2

A. Digestion overview + alimentary tract fig 62-1 p 753-4
B. Gut cross section, histology + plexi fig 62-2 pp 754-9
C. Secretions+phases tab 64-1, fig 64-1,64-2,64-7 pp 775-87
D. **Hydrolysis**: Central theme of digestion ch 65 p 789-93
   1. Carbohydrate fig 65-1 p 790
   2. Fat fig 65-3 p 791, fig 65-4 p 792
   3. Protein fig 65-2 p 791

We're almost 1/5 finished! Learn & enjoy every moment!!...
WOW!  SUPER 🌟
~ TOP 5 - 10.

EXCELLENT!!  🎉
~ TOP 15.

GREAT EFFORT
~ TOP 20 - 25.
**Endocannabinoid Receptors**

**CB-1**
- Brain Structures
- Controlling Energy Intake
  - (e.g., Hypothalamic Hunger-Satiety Center)

**CB-2**
- Leukocytes/WBCs
- Immune & Inflammatory Reactions
  - (e.g., Lymphocytes & Macrophages)

Endocannabinoid hyperactivity

**Metabolic & Eating Disorders**
- 1. Abdominal Obesity
- 2. Dyslipidemia
- 3. Hyperglycemia

http://www.jimmunol.org/content/165/1/373.full?ijkey=YriEsKcvAs2z
ETOH Dependence + Link to Endocannabinoids?

**Suspect Genes?**
Dopaminergic Receptor DA D2
ETOH Dehydrogenase
Aldehyde Dehydrogenase
Fatty Acid Amide Hydrolase (FAAH)
G- vs A-allele μ-Opioid Receptor (OPRM 1)
Cation Transport & Synaptic Transmission

*Metabolizes Anandamide + Δ9-THC*
*Anandamide Deficient → Anxiety*

**e.g., Delete Gene for FAAH or Block FAAH Action by URB597**

1. ↑ Preference for ETOH
2. ↑ Sensitivity to ETOH Sedation
3. ↑ Recovery from ETOH Motor Incoordination

**e.g., G- vs A-Allele for OPRM 1**

1. ↑ Feelings of Intoxication/Sedation
2. ↑ Happiness/Euphoria
3. Naltrexone more effective in patients with G-allele?

Ask people what they ate yesterday or even today, and the odds are that they’ll underestimate the amount. This discrepancy is called the eye-mouth gap.

One study found that some obese people actually ate twice as much as they reported. Research has shown that perhaps 80% of us – even lean and athletic people – underestimate our food intake.
Adults underestimate, on average, their daily intakes by 800 calories. > 1 ½ lb per wk!!

They overestimate intakes of fruit & dairy products, but underestimate amounts of sweets, refined grains, oils, and other fats they eat.

Misreporting is seldom a deliberate deception – it’s likely an unconscious response perhaps to social & family pressure, combined with wishful thinking.

People don’t know how much food they put on their plates.
If you’re trying to lose weight or improve your diet, don’t trust your eyes.

Weigh or measure the food you eat to get a good sense of how much you’re really eating.

**Lombo editorial comments:**

1. *Train yourself to make good guesses/estimates rather than weigh everything.*

2. *Train yourself…that is… Exercise! Exercise!! Exercise!!!*
Figure 4-9. Changes in body weight, body fat, and lean body weight for diet, exercise, and combination groups. (From Ziti W. B., and Golding, L. A.: Comparing diet and exercise as weight reduction tools. Phys. Sportsmed. 4:49–53, 1976.)

NB: Each group 500 kcal deficit/day, 16 weeks
Compared to dieting, exercise is superior in inducing % body fat reduction & preserving lean body mass!
Dietary Composition & Physical Endurance

- High-fat diet: ~ 1/3 endurance!
- Normal mixed diet: 57 min
- High-carbohydrate diet: 114 min
- ~ 1/3 endurance!

eg, Atkins!
Tedium of Metabolic Lab & Dietary Research
Discussion 4: Nutritional Analyses via 2 Programs

ChooseMyPlate.gov

- The Most Extensive Database Ever provides over 20,000 easy-to-find foods, including most common foods, popular brands, regional favorites, international foods, and vegetarian options.
- “How Big Is a Serving” Tips, based on the MyPyramid recommendations, are linked on the screen where students need help.
- Trans fats include the most up-to-date information available, and are displayed in all reports.
- MyPyramid values include the latest USDA updates, and show actual intake in all categories, including Discretionary calories.
- The 3-Day Average Wizard lets you print the most common assignment in one step.
Digestion Steps

1. Ingestion
2. Mechanical Digestion
3. Chemical Digestion
4. Peristalsis
5. Absorption
6. Storage
7. Defecation

GI-Doughnut Analogy

GI Lumen

Body

Me?
GI Regulation

1. Local/Intrinsic
   - rapid

2. Nervous
   - Slower, but longer lasting!

3. Hormonal

   autoregulation

   extrinsic
Muscularis Externa

Glands

Lumen

Epithelium

Submucosa

Lamina Propria

Serosa

cf: G&H fig 62-2

Meissner’s sensory & secretory plexus!

Myenteric motor plexus!

LOCAL

H Howard 1990
Parasympathetic Branch Activates the Gut!
Cholecystokinin \(\rightarrow\) Gallbladder contraction + Pancreatic enzymes

\[ \downarrow \] Motility

Gastrin \(\rightarrow\) HCl, Pepsinogen by stomach

Motilin \(\rightarrow\) \(\uparrow\) Motility

Secretin \(\rightarrow\) HCO\(_3\), H\(_2\)O by pancreas

Cholecystokinin \(\rightarrow\) Gallbladder contraction + Pancreatic enzymes

\[ \uparrow \] NaCl + H\(_2\)O in feces

\[ \uparrow \] Cl-

GUANYLIN

Motility \(\leftarrow\) GIP

\[ \downarrow \] Insulin

Motility \(\leftarrow\) GLP-1

\[ \uparrow \] Insulin

Ghrelin (stomach fundus, pancreas, …)

Leptin (adipocytes)

What about feedback for hunger-satiety?

Suspense – until next time!
**FIGURE 15-6**

**Peristalsis in the esophagus.** As the wave of peristaltic contraction sweeps down the esophagus, it pushes the bolus ahead of it toward the stomach.

For an animation of this figure, click the Gastrointestinal Motility tab in the Gastrointestinal Physiology tutorial on the CD-ROM.
### Gut Secretions

<table>
<thead>
<tr>
<th>Secretion</th>
<th>Release Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mucus</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>2. Enzymes</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>3. H$_2$O, acids, bases$^+$</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>4. Hormones</td>
<td>into Blood</td>
</tr>
</tbody>
</table>
Table 64-1 Daily Secretion of Intestinal Juices

<table>
<thead>
<tr>
<th>Secretion Type</th>
<th>Daily Volume (ml)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saliva</td>
<td>1000</td>
<td>6.0-7.0</td>
</tr>
<tr>
<td>Gastric secretion</td>
<td>1500</td>
<td>1.0-3.5</td>
</tr>
<tr>
<td>Pancreatic secretion</td>
<td>1000</td>
<td>8.0-8.3</td>
</tr>
<tr>
<td>Bile</td>
<td>1000</td>
<td>7.8</td>
</tr>
<tr>
<td>Small intestine secretion</td>
<td>1800</td>
<td>7.5-8.0</td>
</tr>
<tr>
<td>Brunner’s gland secretion</td>
<td>200</td>
<td>8.0-8.9</td>
</tr>
<tr>
<td>Large intestinal secretion</td>
<td>200</td>
<td>7.5-8.0</td>
</tr>
<tr>
<td>Total</td>
<td>6700</td>
<td></td>
</tr>
</tbody>
</table>
**Figure 64-1** Typical function of a glandular cell for formation and secretion of enzymes and other secretory substances.
Figure 64-2 Formation and secretion of saliva by a submandibular salivary gland.
Figure 64-7 Phases of gastric secretion & their regulation. G&H 2011 p 780.
Hi gang!!
You need me for digestion!!

**Hydrolysis of Energy Nutrients**

...Central-linking theme!!

Hi gang!!
You need me for digestion!!

H₂O + Enzyme

The ENZYME data bank
Polymer to Monomer
(Many to One)

Carbohydrate

Protein + Fat

Glucose

Amino Acids

Fatty Acids + Glycerol

...Central-linking theme, again!!
Disaccharide + Water → Monosaccharides

Peptide (portion of protein molecule) + Water → Amino acid + Amino acid

Fat + Water → Fatty acids + Glycerol
Carbohydrate Digestion = $1^0$ Energy Nutrient

Starches
- Ptyalin (saliva)–20–40%
- Pancreatic amylase–50–80%

Maltose and 3 to 9 glucose polymers
- Maltase and $\alpha$-dextrinase (intestine)

Glucose

Lactose
- Lactase (intestine)

Galactose

Sucrose
- Sucrase (intestine)

Fructose
Why Do Some People Have Trouble Digesting Milk?

- Ability to digest milk carbohydrates varies
  - Lactase
    - Made by small intestine
  - Symptoms of intolerance
    - Gas, diarrhea, pain, nausea?
- Milk allergy?
- Nutritional consequences
- Milk tolerance and strategies
HIGH FAT FOODS

An LDL to HDL ratio greater than 5 to 1 in men or 4.5 to 1 in women

Increased risk of heart disease
Fat Digestion = $2^0$ Energy Nutrient

- **Fat** is emulsified by **Bile + Agitation** to form **Emulsified fat**.
- **Pancreatic lipase** catalyzes the conversion of **Emulsified fat** into **Fatty acids and 2-monoglycerides**.
HIGH PROTEIN (FAT?) FOODS?
Where does enzymatic digestion of protein begin?
Zymogen = inactive precursor
Protein Digestion = $3^0$ Energy Nutrient
What is the major function of the small intestine? Absorption!!
G&H 2011 fig 65-6

A

- Central lacteal
- Blood capillaries
- Vein
- Artery

B

- Brush border
- Basement membrane
- Venules
- Arteriole
- Central lacteal
- Capillaries
Why is the pancreas so unique?
Enzymes specific for all 3 energy nutrients!
Poor motility causes greater absorption, and hard feces in transverse colon causes constipation.

Excess motility causes less absorption and diarrhea or loose feces.
Questions
Discussion?