BI 358 Lecture 4

I. **Announcements** Dr. Bovee feedback due < 5 pm today. Outline + Quiz 1 update? Quiz Key posted near lab. Next T *Nutritional Analyses*. Record diet ≥ 1 d DLN p 4-8. [https://www.supertracker.usda.gov/](https://www.supertracker.usda.gov/) [https://cronometer.com/]

II. **Addiction Medicine Follow-up** Vaping linked to host of new health risks. ETOH dependence-endocannabinoid link?


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

Heck yeah! Nutrition Lab on Tuesday! Move more, eat smart, weigh less!
WOW!  SUPER  😊
~ TOP 5-10 ~

EXCELLENT!!  ~ TOP 15 ~

GREAT EFFORT  ~ TOP 20-25 ~
Vaping Linked to Host of New Health Risks

https://www.sciencenews.org/article/vaping-linked-host-new-health-risks
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

e.g., Delete Gene for FAAH or Block
FAAH Action by URB597 (KDS4103)

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

Metabolizes Anandamide + Δ 9-THC
Anandamide Deficient → Anxiety

Membrane-bound enzyme

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?

http://www.ncbi.nlm.nih.gov/pubmed/26756798
Ask people what they ate yesterday or even today, and the odds are that they’ll underestimate the amount. This discrepancy is called the \textit{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!!!**
4 oz $\rightarrow$ 3 oz

Deck of Cards

1 oz

raw $\rightarrow$ cooked

1/3 c

1/4 c

1.5 oz

$\equiv$ 1 oz

$\equiv$ 1/3 c

$\equiv$ 1/4 c

$\equiv$ 1.5 oz

NB: Each group 500 kcal deficit/day, 16 weeks
Exercise is better than dieting in lowering body fat & preserving muscles!
Dietary Composition & Physical Endurance

eg, Atkins!

High-fat diet

Normal mixed diet

High-carbohydrate diet

Maximum endurance time:

57 min

114 min

167 min

~ 1/3 endurance!
Tedium of Metabolic Lab & Dietary Research
Discussion/Lab 4: Nutritional Analyses via 2 Programs

https://www.supertracker.usda.gov/

https://cronometer.com/
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

2. Nervous

3. Hormonal

- autoregulation
- extrinsic

rapid

Slower, but longer lasting!
Muscularis Externa
Glands

Serosa
Epithelium
Submucosa
Lumen
Lamina Propria

Muscularis Externa
Glands

Myenteric motor plexus!
Meissner’s sensory & secretory plexus!

H Howard 1990

LOCAL

G&H fig 62-2
Parasympathetic Branch Activates the Gut!

Ciliary ganglion
Ciliary muscles of eye
Pupillary sphincter
Sphenopalatine ganglion
Lacrimal glands
Nasal glands
Submandibular ganglion
Submandibular gland
Otic ganglion
Parotid gland
Heart
Stomach
Pylorus
Colon
Small intestine
Ileocecal valve
Anal sphincter
Bladder
Detrusor
Trigone
Sacral
What about feedback for hunger-satiety?

Ghrelin (stomach fundus, pancreas, …)
Leptin (adipocytes)

Suspense – until next time!
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>
<tr>
<td></td>
<td>Daily Volume (ml)</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Saliva</td>
<td>1000</td>
</tr>
<tr>
<td>Gastric secretion</td>
<td>1500</td>
</tr>
<tr>
<td>Pancreatic secretion</td>
<td>1000</td>
</tr>
<tr>
<td>Bile</td>
<td>1000</td>
</tr>
<tr>
<td>Small intestine secretion</td>
<td>1800</td>
</tr>
<tr>
<td>Brunner’s gland secretion</td>
<td>200</td>
</tr>
<tr>
<td>Large intestinal secretion</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6700</strong></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.
Hydrolysis of Energy Nutrients

...Central-linking theme!!

Hi gang!!
You need me for digestion!!

\[ H_2O + \text{Enzyme} \]
Polymer to Monomer
(Many to One)

Carbohydrate
+ Glucose

Protein
+ Fat

Amino Acids
Fatty Acids
+ Glycerol

...Central-linking theme, again!!
Disaccharide

Maltose + Water → Glucose + Glucose

Monosaccharides

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

Fat + Water → Fatty acids + Glycerol

Carbohydrate-digesting enzymes

Protein-digesting enzyme

Triglyceride-digesting enzyme
Carbohydrate Digestion = 1° Energy Nutrient

- Starches
  - Ptyalin (saliva) – 20–40%
  - Pancreatic amylase – 50–80%
- Maltose and 3 to 9 glucose polymers
  - Maltase and α-dextrinase (intestine)
- Glucose
- Lactose
  - Lactase (intestine)
- Galactose
- Fructose
- Sucrose
  - Sucrase (intestine)
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
Fat Digestion = 2\(^0\) Energy Nutrient

Fat → (Bile + Agitation) → Emulsified fat

Emulsified fat → Pancreatic lipase → Fatty acids and 2-monoglycerides

G&H 2011 fig 65-4 p 792
HIGH PROTEIN (FAT?) FOODS?
Where does enzymatic digestion of protein begin?
Zymogen = inactive precursor
Protein Digestion = 3° Energy Nutrient

Proteins \rightarrow Pepsin \rightarrow \begin{align*} & \text{Proteases} \\ & \text{Peptones} \\ & \text{Polypeptides} \end{align*} 

\begin{align*} \text{Trypsin, chymotrypsin, carboxypolypeptidase, proelastase} \\ \begin{bmatrix} \text{Polypeptides} \\ + \\ \text{Amino acids} \end{bmatrix} \rightarrow & \text{Peptidases} \\
\rightarrow & \text{Amino acids} \end{align*}
What is the **major** function of the **small intestine**? **Absorption!!**
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