Heck yeah! Nutrition Lab next Tuesday! Move more, eat smart, weigh less!

BI 358 Lecture 4

I. **Announcements**  Dr. Bovee feedback due < 5 pm today. Outline + Quiz 1 update? Quiz Key posted near lab. **NB**: Group member feedback. Next T Lab *Nutritional Analyses*. Record diet ≥ 2 d to analyze w/*DietController*!

II. **Addiction Medicine Follow-up**  Opioid overdose + Narcan story/ies! Vaping linked to host of new health risks.

III. **Nutritional Physiology**  Zuti & Golding, Diet vs. Exercise historical research! Estimating food & liquid quantities.

IV. **Gastrointestinal Physiology**  G&H ch 63, 64, 65, 66 + LS2

   A. Digestion overview + alimentary tract fig 63-1
   B. Gut cross section, histology + plexi fig 63-2
   C. Secretions + phases tab 65-1, fig 65-7
   D. **Hydrolysis**: Central theme of digestion ch 66 p 833-42
      1. Carbohydrate fig 66-1
      2. Fat fig 66-3, fig 66-4
      3. Protein fig 66-2
WOW!  SUPER  😊
~ TOP 5-10 ~

EXCELLENT!!
~ TOP 15 ~

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

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5493817/
https://www.sciencenewsforstudents.org/article/vaping-may-threaten-brain-immunity-and-more
4 oz $\rightarrow$ 3 oz

or

$\equiv$ 1 c

raw $\rightarrow$ cooked

$\equiv$ 1/3 c

$\equiv$ 1 oz

$\equiv$ 1/4 c

$\equiv$ 1.5 oz

Deck of Cards

≡

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

eg, Atkins!

High-fat diet

Normal mixed diet

High-carbohydrate diet

~ 1/3 endurance!

Maximum endurance time:

57 min
114 min
167 min
Tedium of Metabolic Lab & Dietary Research
Discussion/Lab 4: Nutritional Analyses

Record diet for ≥ 2 d!
No need to purchase software, as we have on computers in lab!
http://www.dietcontroller.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!
**Myenteric motor plexus!**

*Meissner’s sensory & secretory plexus!*

*LOCAL*

(cf: G&H 2011 fig 62-2, G&H 2016 fig 63-2)

H Howard 1990
Parasympathetic Branch Activates the Gut!

G&H 2011 fig 60-3 p 731
G&H 2016 fig 61-3 p 775
**HORMONAL**

**What about feedback for hunger-satiety?**

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

**Suspense – until next time!**

- Gastrin → HCl, Pepsinogen by stomach
- Motilin → ↑ Motility
- Secretin → HCO$_3^-$, H$_2$O by pancreas
- Cholecystokinin → Gallbladder contraction + Pancreatic enzymes

↓ Motility ← GIP
↑ Insulin

↓ Motility ← GLP-1
↑ Insulin

↑ Cl$^-$ ← Guanylin
↑ NaCl + H$_2$O in feces

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G&H 2011 tab 62-1 p 758
G&H 2016 tab 63-1 p 802
**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.

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Ringlike peristaltic contraction sweeping down the esophagus

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LS2 2006; cf: G&H 2011 fig 62-5, G&H fig 2016 fig 63-5
# 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. H₂O, 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>Total</td>
<td>6700</td>
</tr>
</tbody>
</table>

G&H 2011 tab 64-1 p 775, G&H 2016 tab 65-1 p 819
Figure 64-7 Phases of gastric secretion & their regulation. G&H 2011 fig 64-7 p 780, G&H 2016 fig 65-7 p 824.
Hi gang!!
You need me for digestion!!

H_2O + Enzyme →...Central-linking theme!!

The ENZYME data bank

Help! Me too!
Polymer to Monomer (Many to One)

...Central-linking theme, again!!

Carbohydrate

Protein + Fat

Glucose

Amino Acids

Fatty Acids + Glycerol
Disaccharide + Water → Glucose + Glucose

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

Fat + Water → Fatty acids + Glycerol

cf: G&H 2011 pp 789-93, G&H 2016 p 833-7
Carbohydrates in foods

Sizer & Whitney 2011 p 136
Carbohydrate Digestion = 1\(^0\) 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

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 $\xrightarrow{(Bile + Agitation)}$ Emulsified fat

Emulsified fat $\xrightarrow{Pancreatic lipase}$ Fatty acids and 2-monoglycerides

G&H 2011 fig 65-4 p 792
G&H 2016 fig 66-4 p 836
HIGH PROTEIN (FAT?) FOODS?
Where does enzymatic digestion of protein begin?
Zymogen = inactive precursor

LS2 2006
G&H 2011
fig 64-4
G&H 2016
fig 65-4
Protein Digestion = $3^0$ Energy Nutrient

Proteins → *Pepsin* → [Proteos, Peptones, Polypeptides]

- Trypsin, chymotrypsin, carboxypolypeptidase, peptidases
  - [Polypeptides + Amino acids] → Peptidases → Amino acids

G&H 2011 fig 65-2 p 791
What is the **major** function of the small intestine?

*Absorption!!*
Brush border

Pinocytic vesicles

Endoplasmic reticulum

Mitochondria
Why is the pancreas so unique?
Enzymes specific for all 3 energy nutrients!

The glandular portions of the pancreas are grossly exaggerated.
Poor motility causes greater absorption, and hard feces in transverse colon causes constipation.

Excess motility causes less absorption and diarrhea or loose feces.

cf: G&H 2011 fig 63-5, G&H fig 64-5
Questions + Discussion