Fluid input into digestive system

- 2.0 L food and drink
- 1.5 L saliva (salivary glands)
- 0.5 L bile (liver)
- 2.0 L gastric secretions
- 1.5 L pancreatic secretions
- 1.5 L intestinal secretions

9.0 L Total input into lumen

Fluid removed from digestive system

- Absorption: 7.5 L from small intestine
- 1.4 L from large intestine
- Excretion: 0.1 L in feces

9.0 L removed from lumen
<table>
<thead>
<tr>
<th>Source</th>
<th>Substance Secreted</th>
<th>Stimulus for Release</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mucous neck cell</td>
<td>Mucus</td>
<td>Tonic secretion; with irritation of mucosa</td>
<td>Physical barrier between lumen and epithelium</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td></td>
<td>Secreted with mucus</td>
<td>Buffers gastric acid to prevent damage to epithelium</td>
</tr>
<tr>
<td>Parietal cells</td>
<td>Gastric acid (HCl)</td>
<td>Acetylcholine, gastrin, histamine</td>
<td>Activates pepsin; kills bacteria</td>
</tr>
<tr>
<td>Intrinsic factor</td>
<td></td>
<td></td>
<td>Complexes with vitamin B&lt;sub&gt;12&lt;/sub&gt; to permit absorption</td>
</tr>
<tr>
<td>Enterochromaffin-like cell</td>
<td>Histamine</td>
<td>Acetylcholine, gastrin</td>
<td>Stimulates gastric acid secretion</td>
</tr>
<tr>
<td>Chief cells</td>
<td>Pepsin(ogen)</td>
<td>Acetylcholine; acid, secretin</td>
<td>Digests proteins</td>
</tr>
<tr>
<td></td>
<td>Gastric lipase</td>
<td></td>
<td>Digests fats</td>
</tr>
<tr>
<td>D cells</td>
<td>Somatostatin</td>
<td>Acid in the stomach</td>
<td>Inhibits gastric acid secretion</td>
</tr>
<tr>
<td>G cells</td>
<td>Gastrin</td>
<td>Acetylcholine, peptides and amino acids</td>
<td>Stimulates gastric acid secretion</td>
</tr>
</tbody>
</table>
(e) Intestinal surface area is enhanced by finger-like villi.
Jejunum, villi H&E B=brush border, C=connective tissue, Arrows=flask cells
Proteins 

Peptides 

Di- and tripeptides cotransport with H⁺. 
Amino acids cotransport with Na⁺. 
Small peptides are carried intact across the cell by transcytosis.

Peptidases 

Blood → To the liver
Lumen of small intestine

Pancreatic secretions include inactive enzymes.

Trypsinogen

Enteropeptidase activates trypsin.

Trypsin activates other proenzymes.

Chymotrypsinogen → Chymotrypsin
Procarboxypeptidase → Carboxypeptidase
Procolipase → Colipase
Prophospholipase → Phospholipase
Glucose is absorbed by indirect active transport coupled to facilitated diffusion on a GLUT2 transporter. Fructose uses GLUT5.
Pancreas

- Unit of this exocrine gland is the acinus
- Zymogen refers to precursor of enzyme.
- "pro..." as in "procarboxypeptidase and "...ogen" as in "chymotrypsinogen" -- a peptide fragment is cut off
- examples - prohormones -> peptide hormones.
- bicarbonate (alkaline)
- Optimum pH for trypsin is 8.
continued

• Pancreas and common bile duct (from liver and gall bladder) dumping into duodenum

• When I took organic chemistry lab (1966-7) we used gall stones for a cholesterol extraction.

• Note: Islets of Langerhans (endocrine tissue) in pancreas where alpha cells make glucagon and beta cells make insulin.
Liver function

- Portal (also hypothalamus -> pituitary and kidney cortex to medulla).
- "microsomal fraction" (how smooth endoplasmic reticulum) detoxify.
- Enzymes, barbiturates (inducible).
- Alcohol -(alcohol dehydrogenase (ADH) )-> aldehyde - (aldehyde dehydrogenase)-> acetic acid.
- With AcetylCoA to fatty acid
- cirrhosis.
continued

• Erythrocyte iron recycling,
• bile pigment (bilirubin) \( \rightarrow \) urobilinogen turns feces dark.
• Also colors urine.
• Hepatitis (disorder which spills bile into blood) - turns skin yellow (jaundice) (feces are not as dark, urine is darker)
1. Bile salts from liver coat fat droplets.

2. Bile salts recycle

3. Cholesterol is transported.

4. Absorbed fats combine with cholesterol and proteins in the intestinal cells to form chylomicrons.

5. Chylomicrons are released into the lymphatic system.
Fat digestion

- Liver contributes to fat digestion via bile salts, salts of cholesterol, that emulsify fats.
- Triglycerides are broken to monoglycerides and free fatty acids.
- Despite this breakdown, fats are reassembled, put in droplets with proteins and carried in lymph duct called lacteal.
Hormones

• Local hormones control digestion - Many found later in other places
• from stomach: food stimulates gastrin which, in turn, stimulates gastric juice until there is a low (acidic) pH
• from duodenum:
  • Cholecystokinin (CCK) - liver and pancreas
  • Secretin for bicarbonate release
  • Enterogastrones to slow gastric emptying