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M1 - GI Sequence

Pancreas

John Williams, M.D., Ph.D.

Winter, 2009
PANCREAS

Gray’s Anatomy, wikimedia commons
The pancreas is made up of three functional components:

Endocrine – Islets 2%

Exocrine – Acinar 80%
  Digestive Enzymes

Exocrine - Ducts 8%
  Bicarbonate Rich Fluid

Innervation
  Vagal – Acini  Ach main transmitter
  Ducts
  Islets
  Sympathetic – Islets  NE main transmitter
  Blood Vessels
REGULATION OF PANCREATIC SECRETION
Stimulation of Pancreatic Secretion during the Intestinal Phase

Presence of acid in duodenum cause release of **Secretin**
Presence of Fats in duodenum cause release of **Cholecystokinin**

Vagal Stimulation cause release of pancreatic enzymes

Secretin causes release of Bicarbonate secretions
CCK causes secretion of Enzymes

Control of Pancreatic Secretions

Frank Boumphrey M.D. 2009

[Image credit: Frank Boumphrey, M.D., wikimedia commons]
Stimulation of Pancreatic Secretion during the Intestinal Phase

Paracrine stimulation
Within the mucosa

Endocrine stimulation
Concentration of Ions in Pancreatic Juice as a Function of Flow

Pancreatic Bicarbonate output increases in response to low Duodenal pH

Fig. 9-5 Johnson, L. *Gastrointestinal Physiology*, 6th ed. Mosby Elsevier, St. Louis, MO; 2001: 102.
Mechanism of Pancreatic Bicarbonate Secretion

New Fig 16.3

- Duct Cell
- ATPase
- K+
- CO₂
- Na⁺
- H₂CO₃
- HCO₃⁻ + H⁺
- Na⁺
- H⁺
- Na⁺
- ATPase
- H⁺
- Na⁺
- cAMP
- Secretin
- Na⁺, K⁺
- Tight junction
- CFTR
INTRACELLULAR TRANSPORT OF PANCREATIC SECRETORY PROTEINS
Stimulus-secretion Coupling of Pancreatic Enzyme Secretion
## Human pancreatic exocrine enzymes

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Molecular weight (daltons)</th>
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<tbody>
<tr>
<td><strong>Proteases</strong></td>
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</tr>
<tr>
<td>Trypsinogen 1</td>
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<tr>
<td>Trypsinogen 2</td>
<td>25,000</td>
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<tr>
<td>Trypsinogen 3</td>
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<tr>
<td>Chymotrypsinogen</td>
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<td>Colipase</td>
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<td>Carboxyl ester hydrolase</td>
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<tr>
<td>Phospholipase A2</td>
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<td><strong>Nucleases</strong></td>
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<td>DNase I</td>
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<tr>
<td>RNase</td>
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</tbody>
</table>
Activation of Pancreatic Proenzymes in the Intestine involves Enterokinase and activated Trypsin
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Slide 16 – Source Undetermined
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