

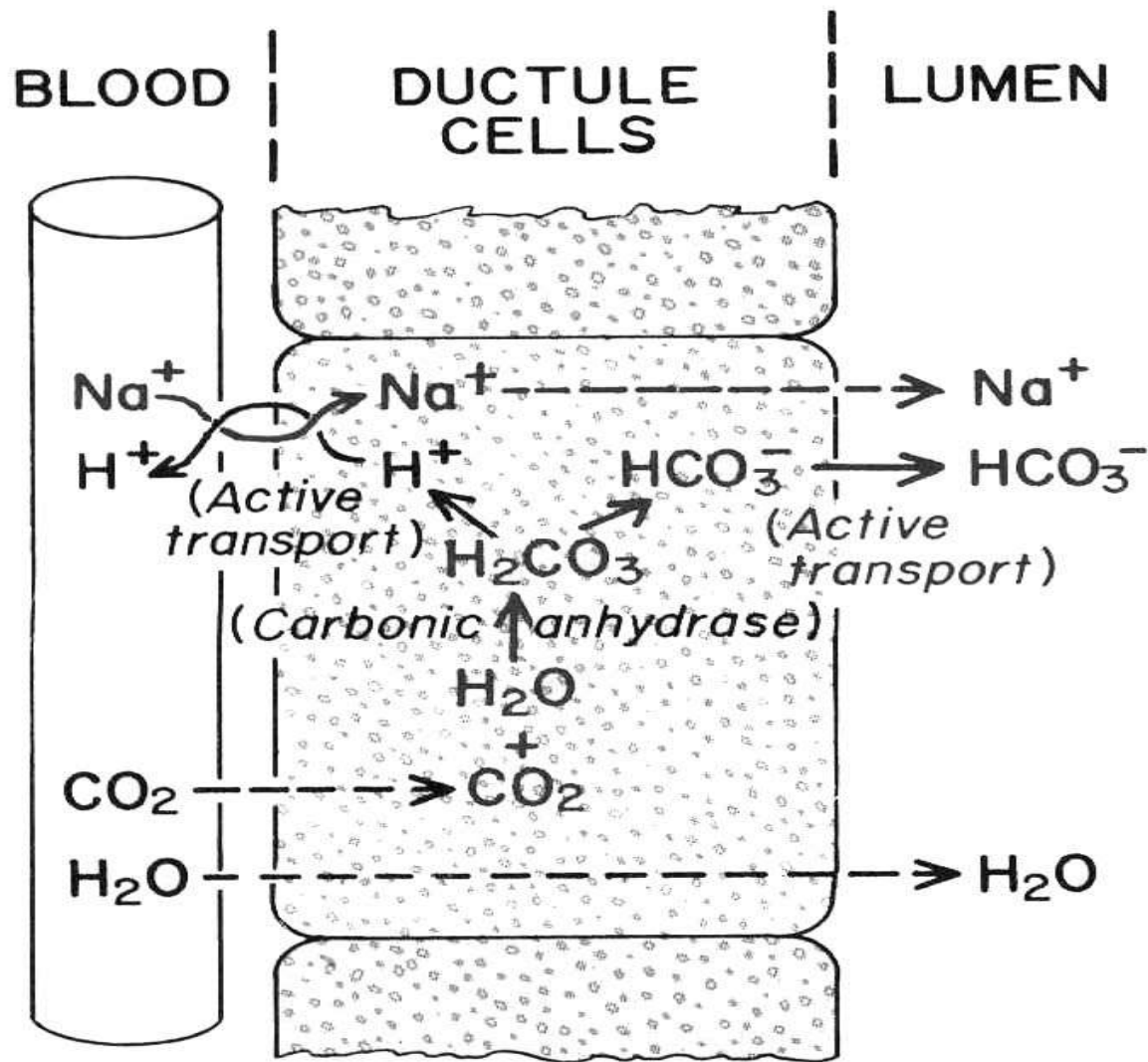
**Lecture 29. Digestion in the
duodenum. The role of
pancreatic juice and bile in
digestive processes.**

STAGES OF DIGESTION

- I. **Cavity digestion – takes place in the chyme**
- II. **Membrane contact - in glycocalyx**
- III. **Membrane, connected with absorption – on the membrane of enterocyte microvilli**

DUODENUM CONTENT

- I. Chyme (pH – acid) from the stomach
- II. Pancreatic juice (pH – alkaline)
- III. Bile – (pH – alkaline)
- IV. Enteral juice – secreted by the enterocytes & brunner & luberkine glands (pH – alkaline)



Secretion of iso-osmotic sodium bicarbonate solution by the pancreatic ductules.

Pancreatic juice content

1,5-2,0 l per day

pH – 7,8-8,4.

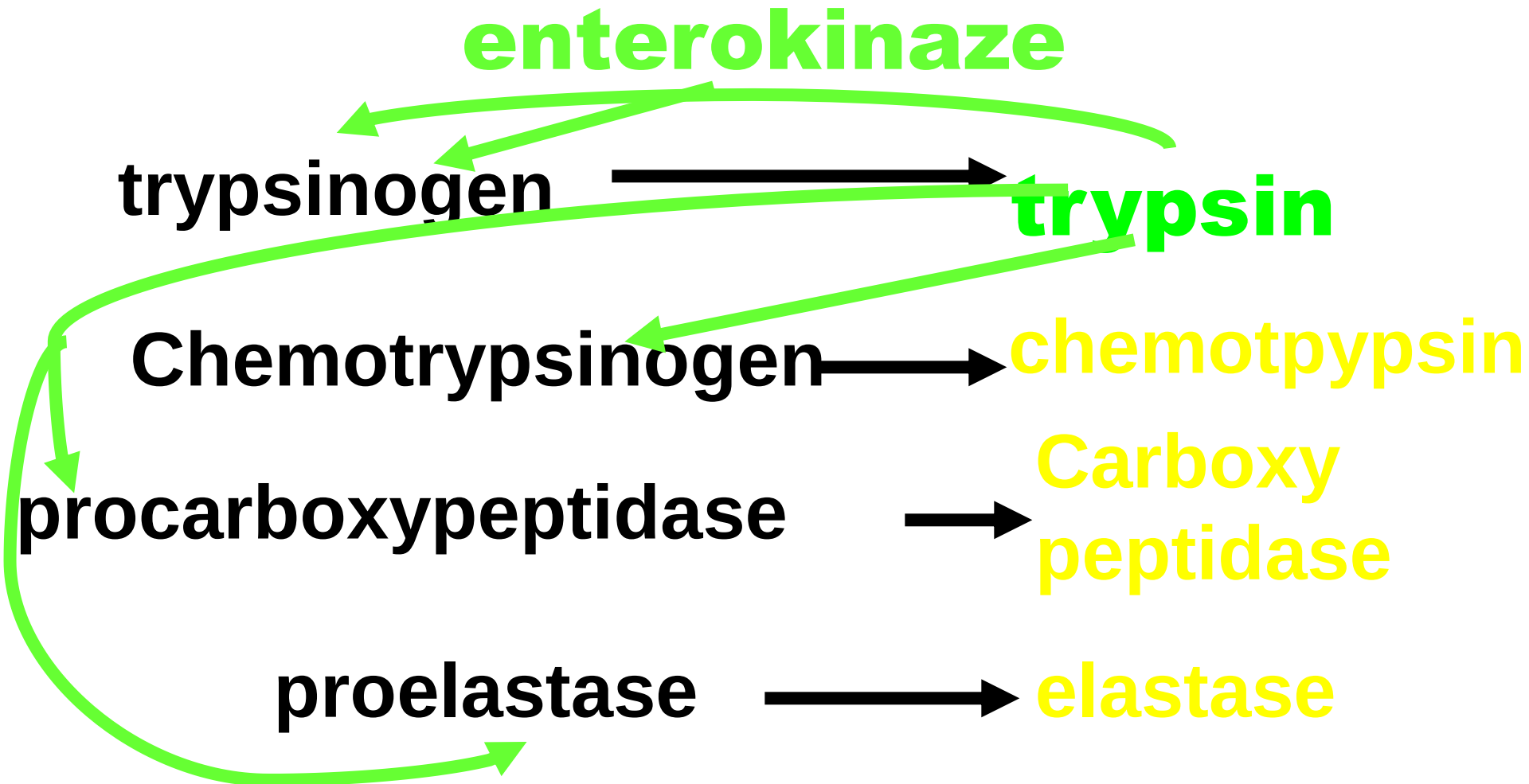
- 1) Sodium bicarbonates – 126 mmol/l ;**
- 2) Na^+ , K^+ , Ca^{2+} , Mg^{2+}**
- 3) Cl^- , SO_4^{2-} и фосфатной кислот;**
- 4) Proteins – 10% of the volume – enzymes.**

Pancreatic enzymes

- I. **Proteases secreted inactive (zymogenes)**
- II. **alfa-amylase**
- III. **Lypase & phospholypase**
- IV. **nuclease**

Optimal pH - 8

Zymogens activation



Phases of pancreatic secretion

- I. Cephalic (complex reflexes) – n.vagus**
- II. Gastric – neuro-humoral - n.vagus, sympathetic nerves, gastrin**
- III. Enteral – humoral – secretin, ChK-Pz**

NERVOUS REGULATION OF PANCREATIC SECRETION

Activation of the sympathetic autonomic nervous system inhibits secretion, increases the reabsorption of water from the primary juice in the ducts of the gland, reabsorbs sodium, secretes potassium, removes alkaline ions and acidifies pancreatic juice. Its digestive power decreases.

Activation of the parasympathetic division of the autonomic nervous system stimulates the cells of the acinus and ducts of the gland. The volume of the juice, the content of enzymes, its alkalinity and the digestive power of the juice increase.

HUMORAL REGULATION OF PANCREATIC SECRETION

Increased synthesis of pancreatic enzymes by acinus of the gland occurs under the influence of hormones gastrin, histamine, CCK.

The increase in the volume of pancreatic juice, the secretion of bicarbonate ions and the increase in the alkalinity of pancreatic juice occur under the influence of secretin. The hydrolytic power of enzymes increases.

NERVOUS REGULATION OF BILE FORMATION AND BILE EXPOSURE

Bile is formed constantly.

When activating the **SNS**, the formation of bile is **inhibited** and bile components remain in the blood.

When the **parasympathetic** nervous system is activated, the amount of bile increases. Hormones **gastrin**, **histamine**, **secretin** increase bile synthesis.

The hormones **somatostatin** and **adrenaline** inhibit bile synthesis.

Bile secretion depends on the motility of the bile ducts and gallbladder.

Activation of **SNS** increases the contraction of the gallbladder sphincter and spasm of the smooth muscles of the bile ducts. Relaxes the body of the gallbladder.

Activation of the **parasympathetic** autonomic nervous system relaxes the gallbladder sphincter and bile duct smooth muscle. Enhances the contraction of the gallbladder body.

Increased bile secretion due to the hormone **CCK**.

Bile secretion is inhibited by the **adrenaline**.

liver

Digestive function

- Bile formation and bile secretion
- Neutralization of toxic substances formed during food rotting in the intestines (indole, skatole, etc.) - barrier function

Bile content

Secreted substances:

- Bile acids –Chenodezoxycholic, cholic;
- Bile acids salts;
- Cholesterin – bile acids precursor;
- Fatty acids
- Lecytin

Bile acids & their salts functions

1. **Creating alkaline medium of the chyme:**
 - ✓ **Neutralization of HCl;**
 - ✓ **Optimum pH for pancreatic proteases activity;**
 - ✓ **Activation of lipase & amylase**
 - ✓ **Inactivation of gastric juice pepsins;**
 - ✓ **Chyme passage from stomach to duodenum**

Bile acids & their salts functions

2. **Fats emulsification:**

- ✓ **Increases the surface of contact with lipases;**
- ✓ **Absorption of low molecular fats in the form of thin emulsion**

Bile acids & their salts functions

- 3. Fatty acids absorption due to micells formation.**
- 4. Motor function activation.**
- 5. Bacteriostatic effect**

Bile secretion

- **Hepatocytes secrete bile constantly and excrete into bile capillaries (600 ml / day) –0.5-1.0 l, pH - 7.8-8.6.**
- **Bile reaches the gallbladder through the bile ducts.**
- **In the gallbladder, bile is concentrated (the bladder can hold bile in 12 hours)**
- **During digestion, bile is secreted into the duodenum.**

Gall bladder

- **Volume - 50-80 ml**
- **Concentrates bile 7-10 times**
- **Suction of bicarbonates and salt formation in progress**
- **pH drops to 6.0-7.0**
- **The g bladder is released in 15-90 minutes**
- **Excretion of bile - the walls of the bladder contract, the sphincter of Oddi relaxes. Stimulates the secretion of the vagus nerve and CCK-PZ.**

Regulation of bile formation

- reflectory mechanism, as for the pancreas
- Humoral: bile itself (bile acid cycle)
- Secretin stimulates the processes of electrolyte metabolism in the ducts

Regulation of bile secretion

- Occurs only when eating.
- The vagus nerve stimulates contraction of the gallbladder and relaxation of the sphincter of Oddi
- CCK-PZ and gastrin -

The movement of bile follows the pressure gradient created in the ducts and duodenum

stimulating factors

- Bile formation:
 - Substances that can be actively excreted through the biliary tract - bile, fatty acids, egg yolks.
- Bile formation:
 - Substances that stimulate the production of the CCK-PZ hormone - meat, fats, liquid oil, polypeptides, etc.
 - Substances that create high osmotic pressure - magnesia sulfate

Liver barrier function

Ways to neutralize toxic substances in the liver:

Oxidation

Recovery

Methylation

Acetylation

conjugation

- Thank you for attention!