# Secretory Functions of the Alimentary Tract

## -Basic mechanism of secretion by glandular cells:

**We talked before about GI motility, today we are going to talk about another function of the GIT, which is secretion.**

**Types of secretory glands along the GI tract, include:**

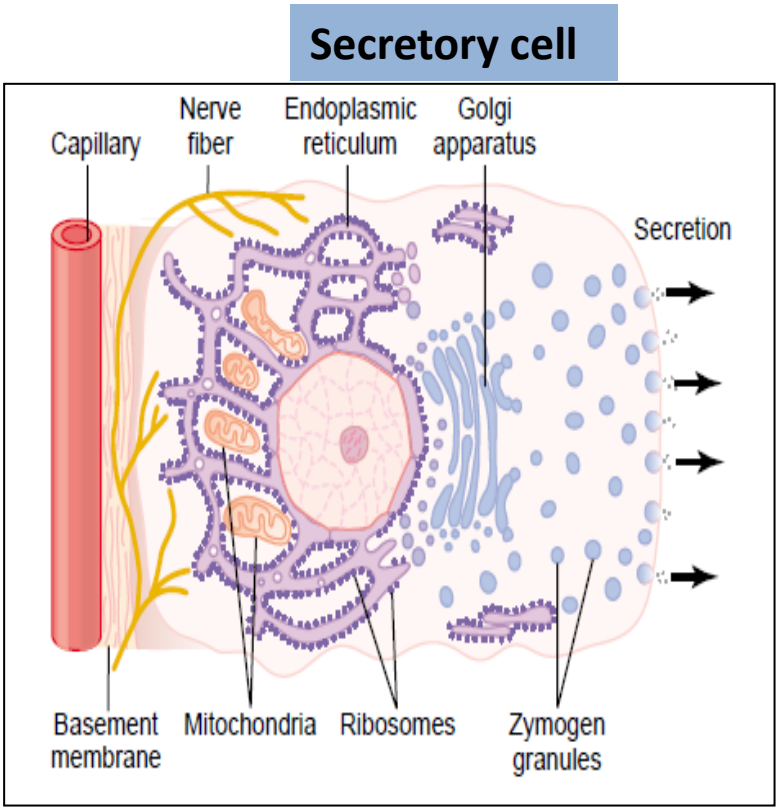
**1)Single-cell secretory glands (goblet cells).**

**2)Pits (invaginations of the epithelium in the submucosa)**

**Pits in small intestine are known as "Crypts of Lieberklihn".**

**Pits in the stomach are known as "Tubular glands".**

**3)Complex glands: in associated (accessory) organs, like Salivary glands, Pancreas and Liver.**




**GI secretions serves to:**

**- Digest food → digestive enzymes**

**- Lubricate and protect the mucosa → mucous**

**The composition of secretion includes:**

**1)Organic materials (e.g Enzymes), GI organs from mouth to ileum secrete enzymes, (not all GI segments secrete enzymes). The raw material for enzymes come from the blood, then the secretory cell builds organic material (enzymes) and store it in zymogen (enzymatic) granules, granules content is secreted (by exocytosis) upon stimulation by neural mechanism (enteric or autonomic nervous systems) or by hormonal mechanism.**

**2)Mucous, GI organs from mouth to anus secrete mucous.**

**3)Water and electrolytes (solution) → these components come from blood.**

## -Regulation of glandular secretion:

**1)ENS regulation (submucosal plexus) → intrinsic regulation. Presence of food initiates the secretory ENS reflex, which increases glandular secretion.**

**2)Autonomic regulation (Sympathetic and Parasympathetic) → extrinsic regulation.**

**Sympathetic stimulation increases fusion of zymogen granules with cell membrane (exocytosis) → more secretion of organic material (enzymes) specifically. Sympathetic stimulation causes vasoconstriction → less blood flow → less fluid (water and electrolytes) entering secretory cells → less fluid secretion.**

**Parasympathetic stimulation increases glandular secretion.**

**3)Hormonal regulation.**

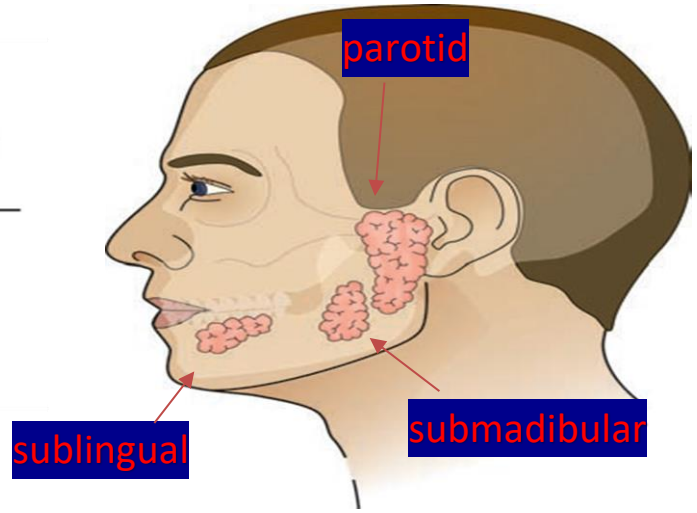
**The main stimulus for all of these mechanisms is the presence of food.**

## -Secretion of saliva:

**Main salivary glands are: parotid, submandibular and sublingual glands.**

**Salivary Glands**

| Name of Gland | Type of Saliva | % of Total Saliva Secreted |
|---|---|---|
| Submandibular | Mucous-serous | 70 |
| Parotid | Serous | 25 |
| Sublingual | Mucous<br>Serous | 5 |




**Around two thirds (2/3) of saliva is secreted by submandibular gland, one fourth (1/4) of saliva is secreted by parotid gland, the remainder is secreted by sublingual gland.**

**Saliva secreted by these glands differ significantly; submandibular and sublingual glands secrete mucous and serous, but parotid gland only secretes serous.**

**-Saliva is composed of two major constituents:**

**1)Serous (digesting): consists of proteins (salivary α-amylase=ptyalin, enzymes)**

**2)Mucinous (lubricating): consists of a glycoprotein called mucin → most abundant protein in saliva.**

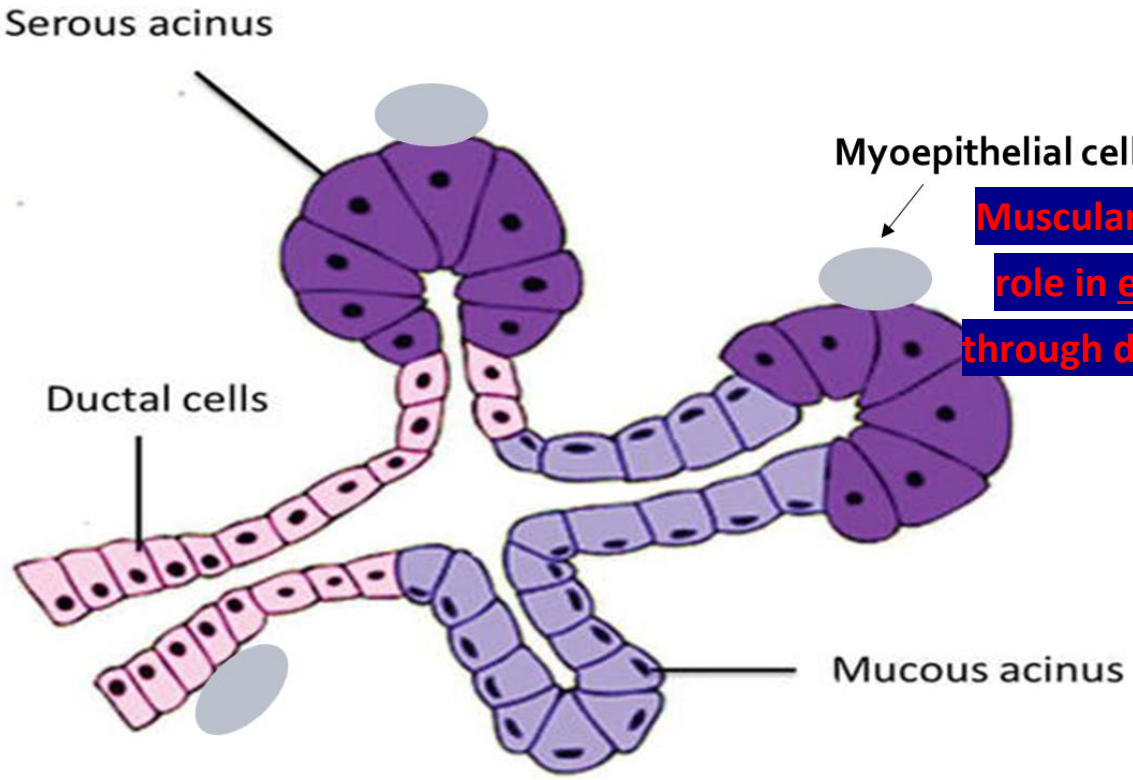
**Salivary glands are exocrine and have ducts to deliver its secretions. Mucous is more viscous than serous, and move slowly in ducts, that's why mucous is secreted by glands that are close to the oral cavity, parotid gland is relatively far from oral cavity, so it only secretes serous.**

**Salivary secretion (saliva) is nearly 1L of fluid/day.**

**It begins the process of digestion and lubricate foods.**

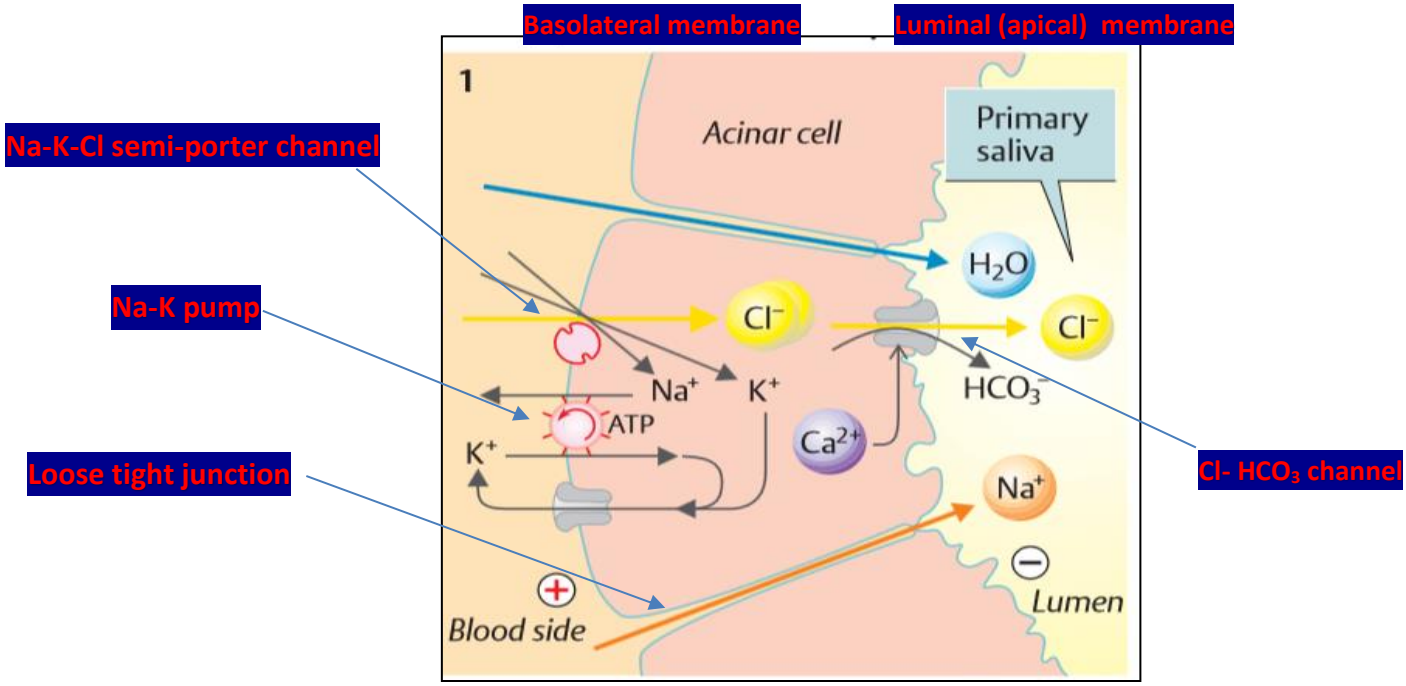
**It is critical for proper oral hygiene.**

## -Secretion of saliva:




**Saliva is not ultra-filtrate of plasma. Salivary secretion has two steps:**

1) **Primary saliva: <u>formation</u> of isotonic plasma-like solution in acini.**




**The acinar cells also secrete organic constituents.**

**Na-k pump leads to efflux of Na→ Na gradient→ driving force of entrance of Na-K-Cl into acinar cells.**

**Parasympathetic stimulation (Ach)→ Ca release→ opening of Cl-HCO3 channels→ Cl-HCO3 enter lumen→ osmotic and electric gradients→ attraction of water and electrolytes into the cell.**

**Tight junctions between acinar cells are loose, meaning that acinar cells are highly permeable. H20 and Na can enter through these junctions via para-cellular transportation. H2O can enter via trans-cellular transportation through aqua-porin 5 carriers.**

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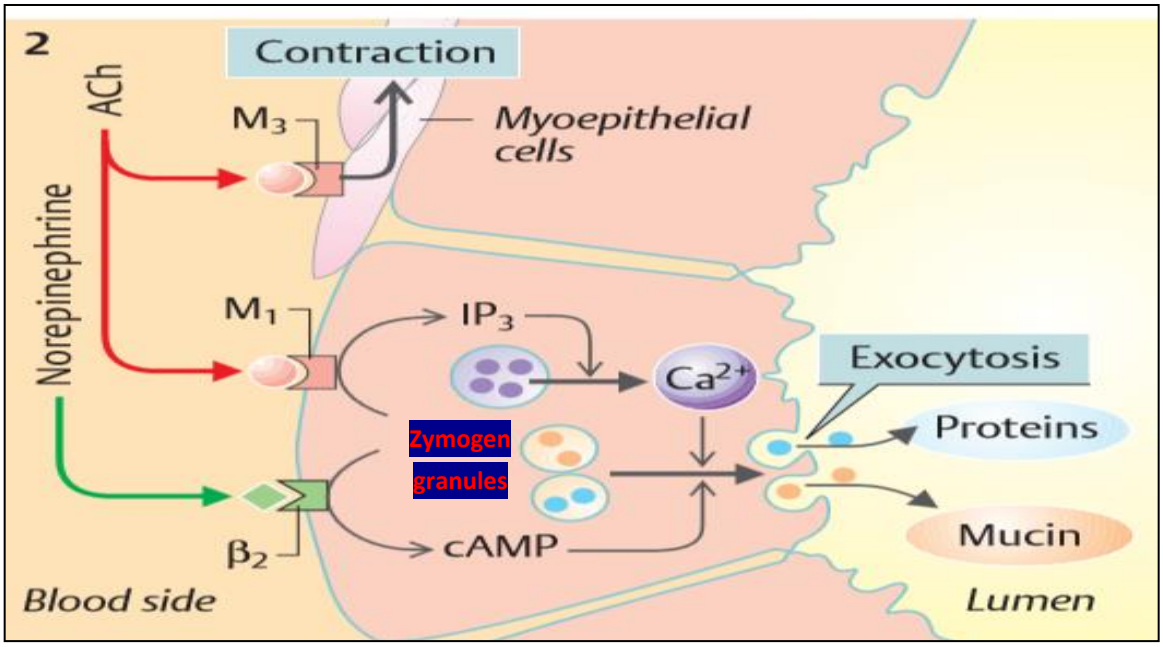
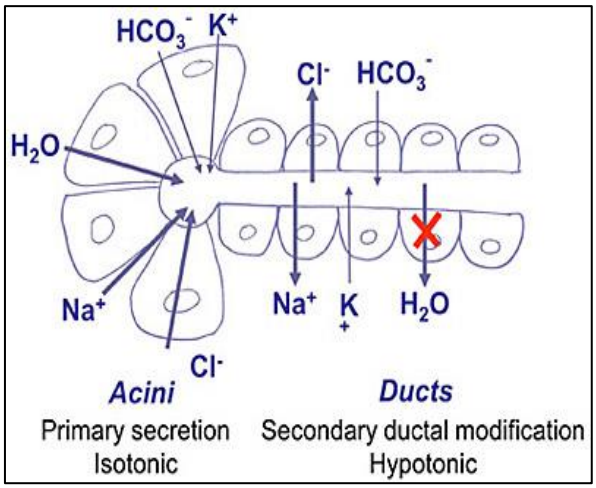


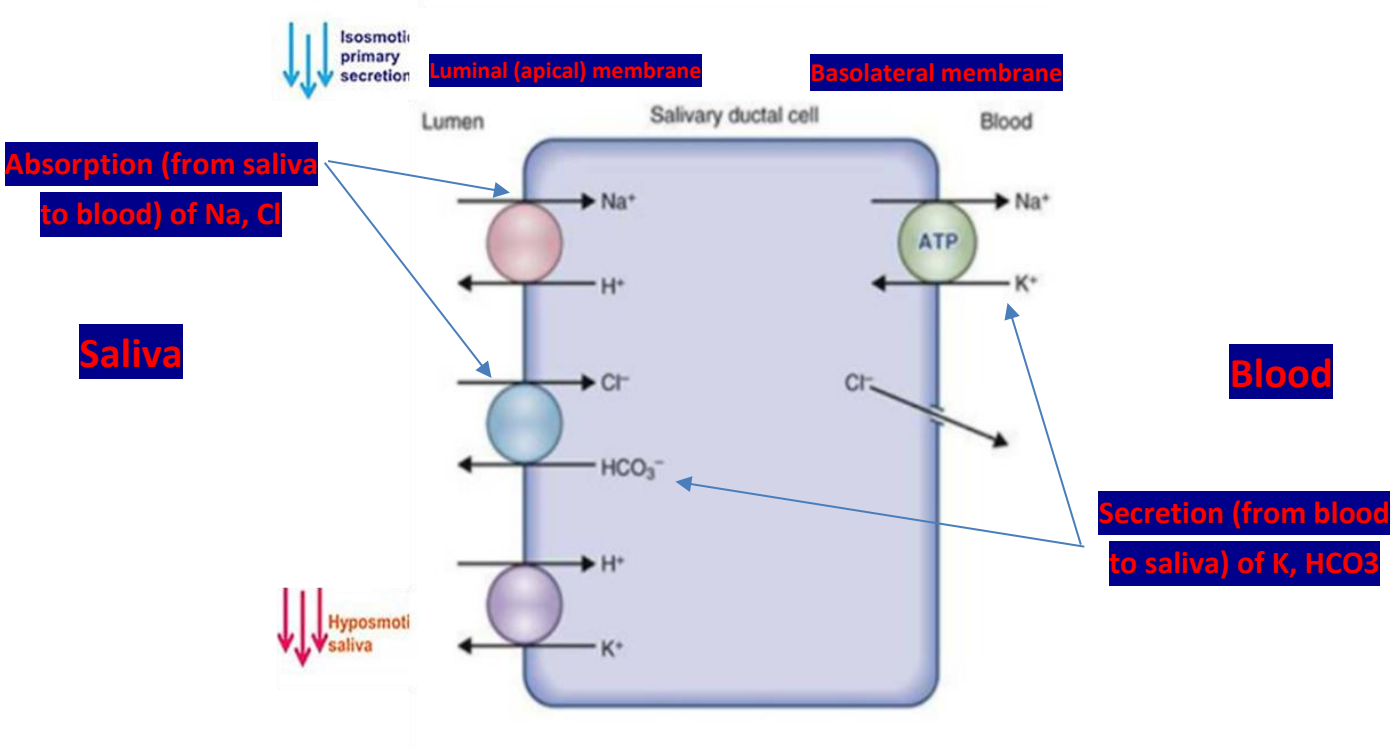

**Parasympathetic stimulation: When Ach binds to muscarinic (M1) receptors, IP3-Ca signaling pathway becomes activated, IP3 and Ca stimulate fusion and exocytosis of the granules that contain secretory proteins. Ach binds to M3 to increase contraction of myoepithelial cells→ ejection of saliva. Parasympathetic stimulation increases secretion of <u>proteins and electrolytes</u>.**

**Sympathetic stimulation: NE binds beta receptors (beta 2), cAMP signaling pathway becomes activated, which leads to more secretion of <u>organic material (proteins), mainly mucin.</u>**

**2)Secondary saliva: <u>modification</u> of primary isotonic saliva to hypotonic secondary saliva in ducts.**

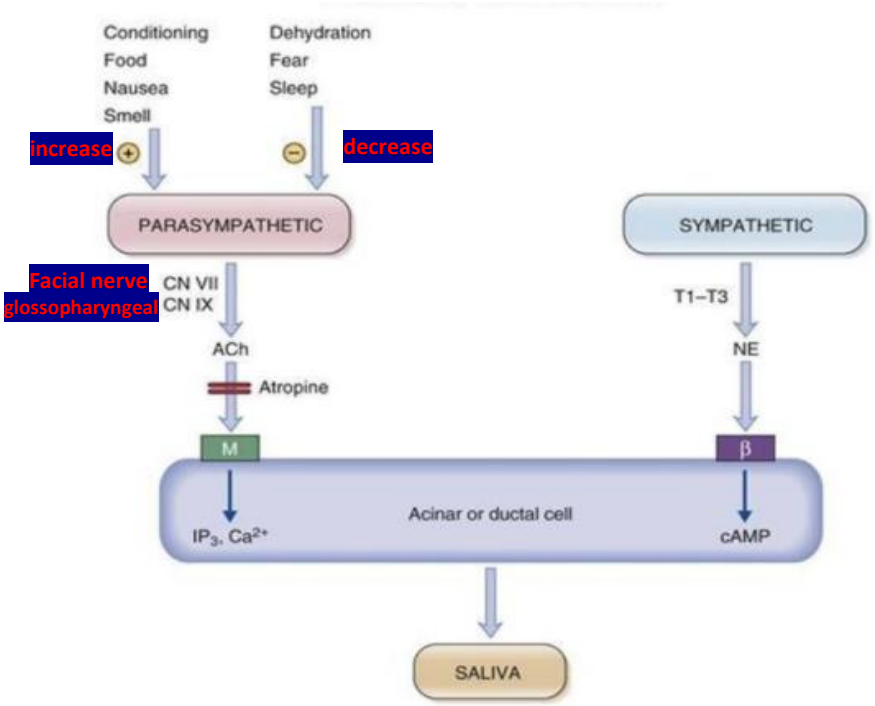


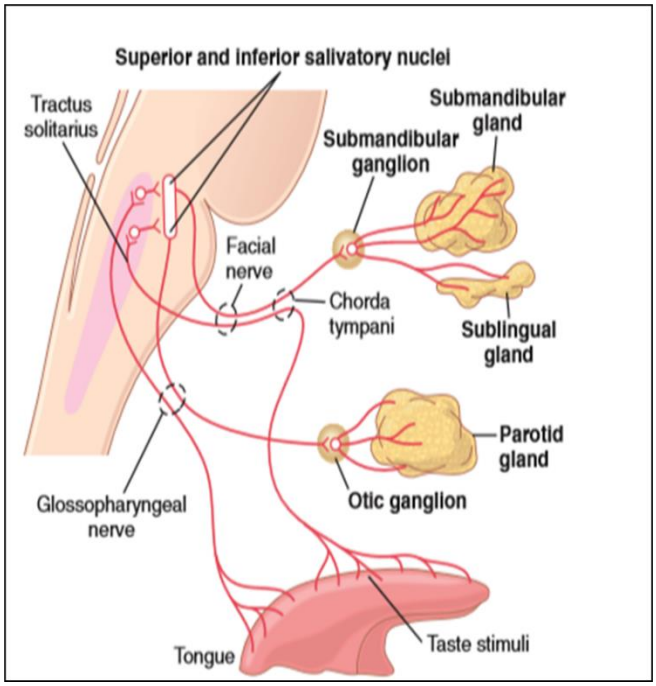

**Secondary saliva become hypotonic, because of Na,Cl absorption is more than K,HCO3 secretion, and duct cells are not permeable to water, unlike acini cells.**



## -Regulation of salivary secretion:

**Saliva secretion is only regulated by neural mechanisms, not hormonal.**




**Parasympathetic nerves:**

**facial nerve → affects submandibular and lingual (increases serous and mucous secretion**

**glossopharyngeal → affects parotid (increases serous secretion)**

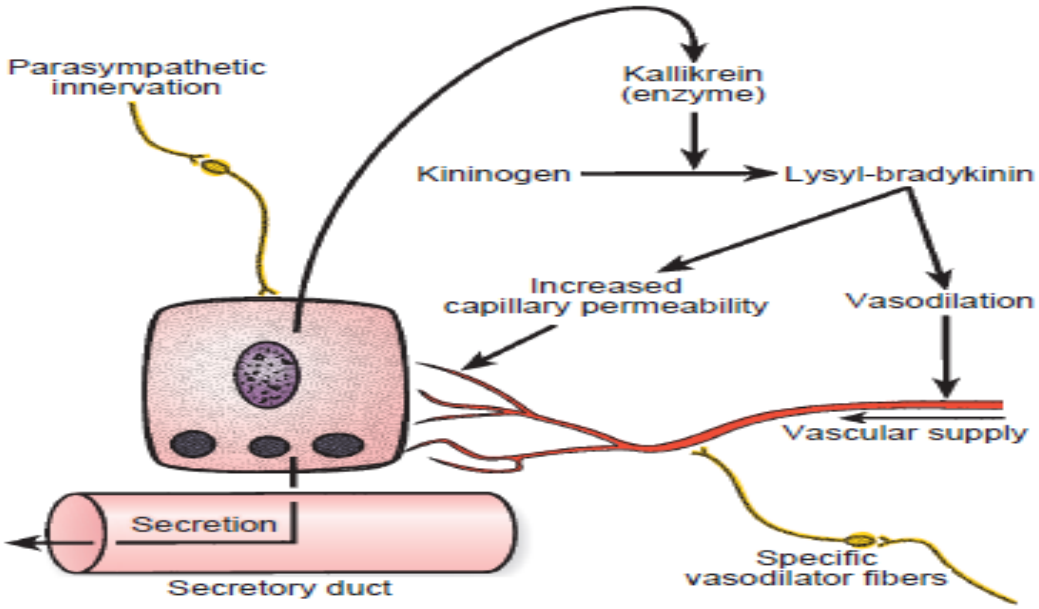
***we talked about stimulation mechanisms in previous pages.**

## -control of saliva secretion in acinar cells:

**In general, secretion is accompanied by vasodilation, to increase blood flow → increase secretion constituents (raw material for organic constituents, water, electrolytes). Blood flow to salivary glands is 10 times more than exercising skeletal muscle.**

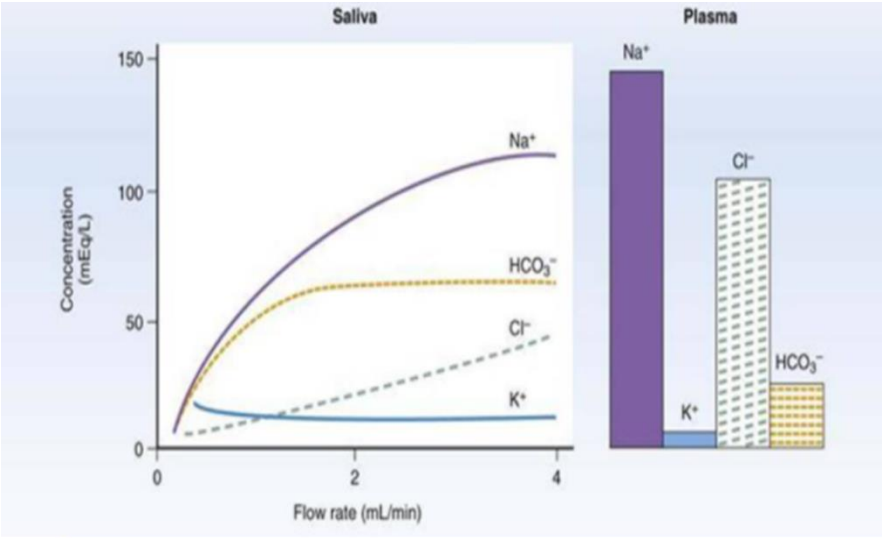
**More vasodilation (blood flow) → more saliva**

**Kallikrein converts kininogen to lysyl-bradykinin, which causes vasodilation and increased permeability.**




## -The effect of flow rate on saliva composition:

**As flow rate increases, (Na, Cl,HCO3) increase, but (K) decreases. Because in high flow rate, contact time between saliva and duct cells is too small, so modification mechanism is overwhelmed (doesn't occur properly) → less absorption of Na,Cl. And less secretion of K.**




The ionic composition of saliva changes as the salivary flow rate changes

**HCO3 increases because it can be selectively stimulated when saliva secretion is stimulated. So HCO3 doesn't follow the contact time theory which we explained previously.**