

# **Regulation of digestion**

# Regulation of Gastric Activity

The production of acid and enzymes by the gastric mucosa can be (1) controlled by the CNS, (2) regulated by short reflexes of the enteric nervous system, coordinated in the wall of the stomach, and (3) regulated by hormones of the digestive tract.

- Gastric control proceeds in three overlapping phases, named according to the location of the control center: the cephalic phase, the gastric phase, and the intestinal phase.

# The cephalic phase

The cephalic phase of gastric secretion begins when you see, smell, taste, or think of food (Figure 1).

This stage, which is directed by the CNS, prepares the stomach to receive food. The neural output proceeds by way of the parasympathetic division of the autonomic nervous system, and the vagus nerves innervate the submucosal plexus of the stomach. Next, parasympathetic fibers innervate mucous cells, chief cells, parietal cells, and G cells of the stomach.

# (Figure 1)

## (a) The Cephalic Phase

Sight, smell, taste, or thoughts of food



Central Nervous System

### Function:

Prepare stomach for arrival of food

### Duration:

Short (minutes)

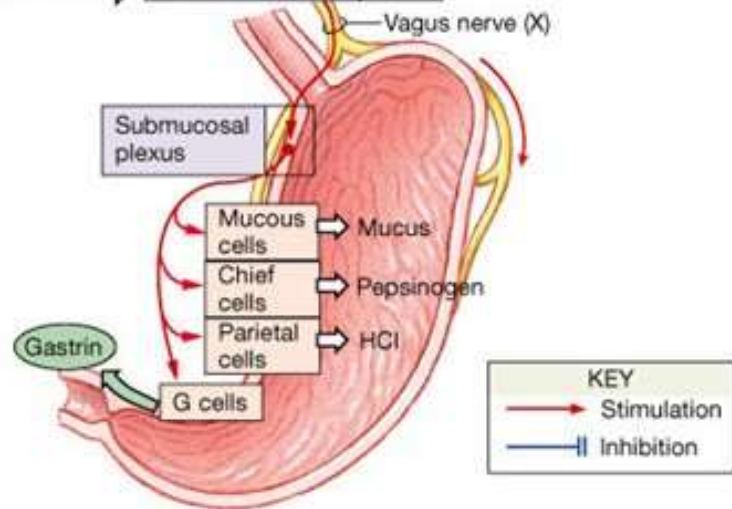
### Mechanism:

Neural, via preganglionic fibers in vagus nerve and synapses in submucosal plexus

### Actions:

Primary: stimulation of mucus, enzyme, and acid production, leading to increased volume of gastric juice

Secondary: stimulation of gastrin release by G cells



In response to stimulation, the production of gastric juice accelerates, reaching rates of about 500 ml/h. This phase generally lasts only minutes. Emotional states can exaggerate or inhibit the cephalic phase. For example, anger or hostility leads to excessive gastric secretion, whereas anxiety, stress, or fear decreases gastric secretion and gastric contractions, or motility.

# The Gastric Phase

The gastric phase begins with the arrival of food in the stomach and builds on the stimulation provided during the cephalic phase (Figure 2).

**The stimuli** that initiate the gastric phase are (1) distension of the stomach, (2) an increase in the pH of the gastric contents, and (3) the presence of undigested materials in the stomach, especially proteins and pep-tides.

# (Figure 2)

## (b) The Gastric Phase

### Functions:

- Enhance secretion started in cephalic stage; homogenize and acidify chyme;
- initiate digestion of proteins by pepsin

### Duration:

- Long (3–4 hours)

### Mechanisms:

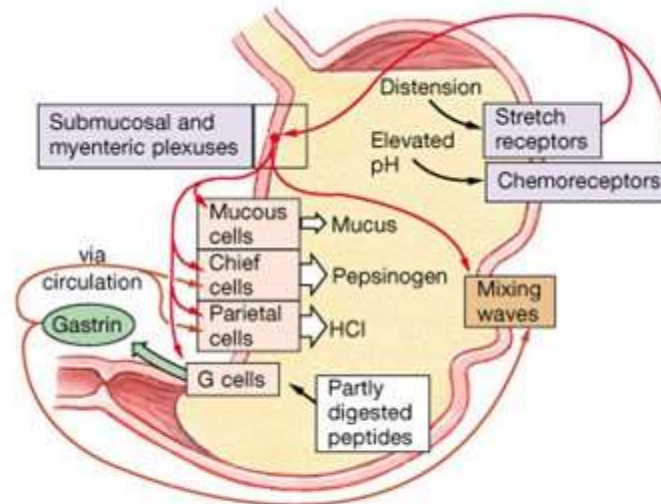
- Neural:* short reflexes triggered by
  - (1) stimulation of stretch receptors as stomach fills
  - (2) stimulation of chemoreceptors as pH increases

- Hormonal:* stimulation of gastrin release by G cells through parasympathetic activity and presence of peptides and amino acids in chyme

- Local:* release of histamine by mast cells as stomach fills (not shown)

### Actions:

- Increased acid and pepsinogen production;
- increased motility and initiation of mixing waves





# The gastric phase consists of the following mechanisms:

- A Neural Response:

The stimulation of stretch receptors in the stomach wall and chemoreceptors in the mucosa triggers short reflexes coordinated in the submucosal and myenteric plexuses. The nerve fibers leaving the submucosal plexus innervate parietal cells and chief cells, and the release of ACh stimulates their secretion.

The stimulation of the myenteric plexus produces mixing waves in the muscularis externa.

- A Hormonal Response:

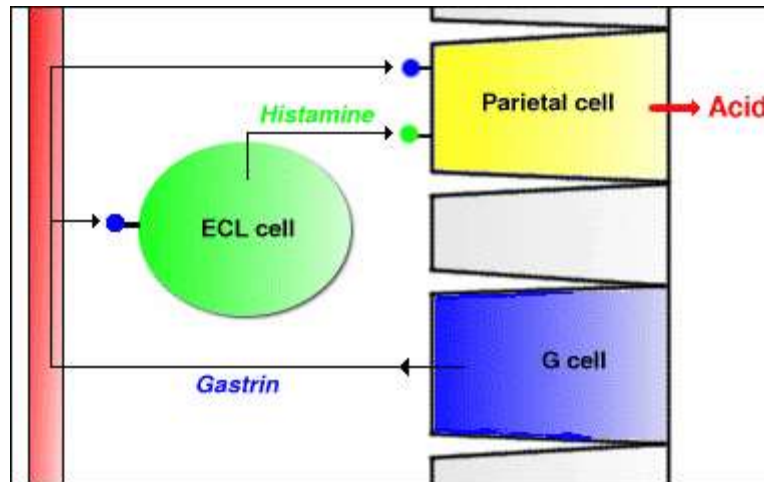
presence of peptides and amino acids in chyme stimulate the secretion of gastrin, primarily by G cells of the pyloric antrum. Both parietal and chief cells respond to the presence of gastrin by accelerating their rates of secretion. The effect on the parietal cells is the most pronounced, and the pH of the gastric juice declines as a result. In addition, gastrin stimulates gastric motility.

- A Local Response:

Distention of the gastric wall also stimulates the release of histamine in the lamina propria. The source of the histamine is thought to be mast cells in the connective tissue of that layer.

Histamine binds to receptors on the parietal cells and stimulates acid secretion.

# enterochromaffin-like (ECL) cells



The gastric phase may continue for three to four hours while the ingested materials are processed by the acids and enzymes.