Endocrinology of Fish

MS I (Semester-II)

Maj/Zoo-S-406

Lecture – 10

GIT Hormones

Gastrin

- peptide hormone that stimulates secretion of gastric acid (HCl) by the parietal cells of the stomach
- aids in gastric motility.
- released by G cells in the pyloric antrum (proximal to the pyloric sphincter, which separates the stomach and the duodenum) of the stomach, duodenum, and the pancreas.

Stimuli

- Stomach antrum distension
- the presence of partially digested proteins, especially amino acids, in the stomach
- hypercalcemia
- Gastrin release is inhibited by
- The presence of acid, Somatostatin, secretin, glucagon and calcitonin.

Functions

- Stimulates secretion of HCl
- directly on the parietal cell
- indirectly via binding onto CCK2/gastrin receptors on enterochromaffin-like cells (ECL) in the stomach
- ECL release histamine,
- induces the insertion of K+/H+ ATPase pumps into the apical membrane of parietal cells
- stimulating them to secrete H+ ions.

Functions

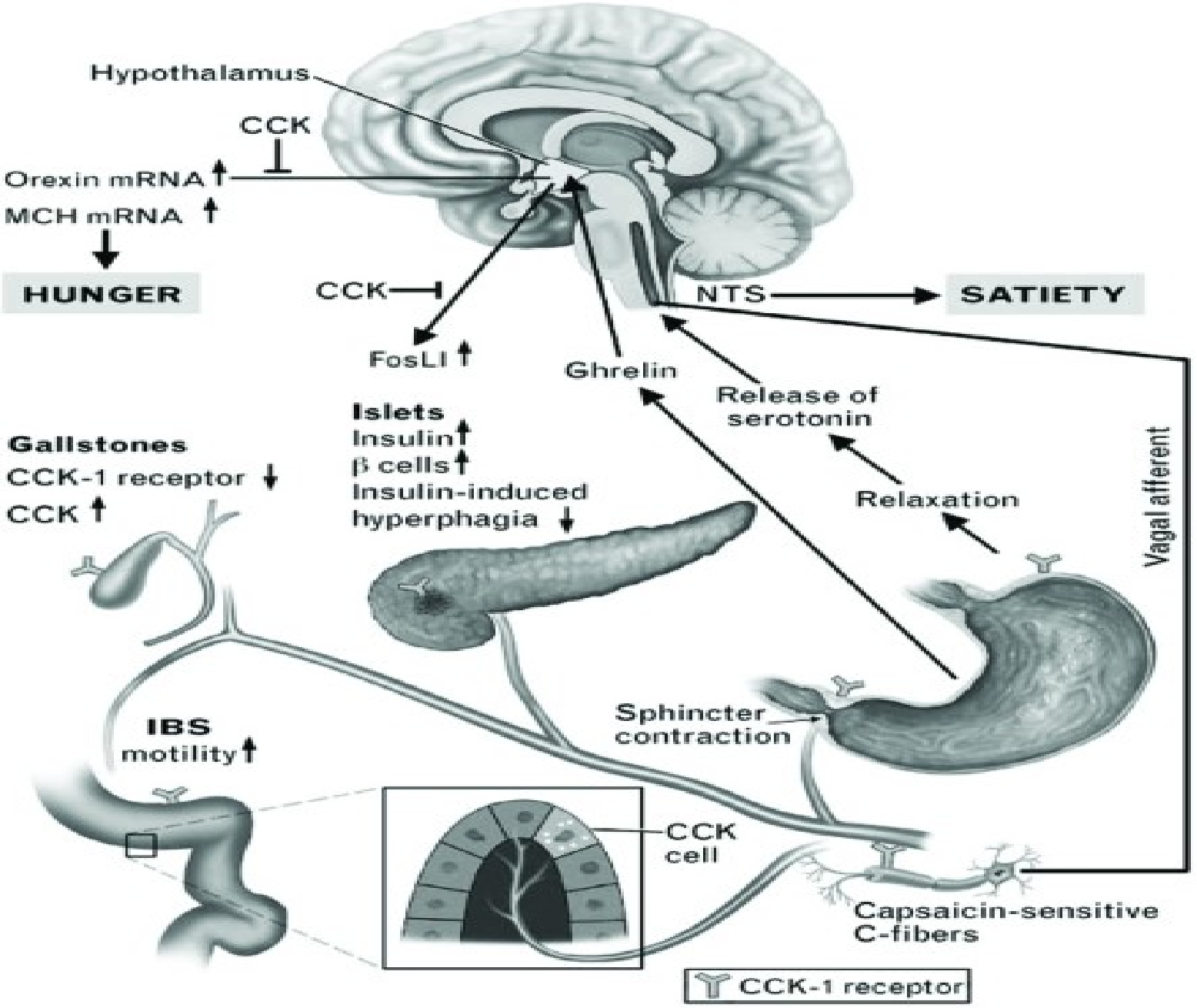
- Stimulates parietal cell maturation
- Causes chief cells to secrete pepsinogen, the zymogen (inactive) form of the digestive enzyme pepsin.
- Increases antral muscle mobility and promotes stomach contractions.
- Strengthens antral contractions against the pylorus, and relaxes the pyloric sphincter, which increases the rate of gastric emptying.

Functions

- Induces pancreatic secretions and gallbladder emptying.

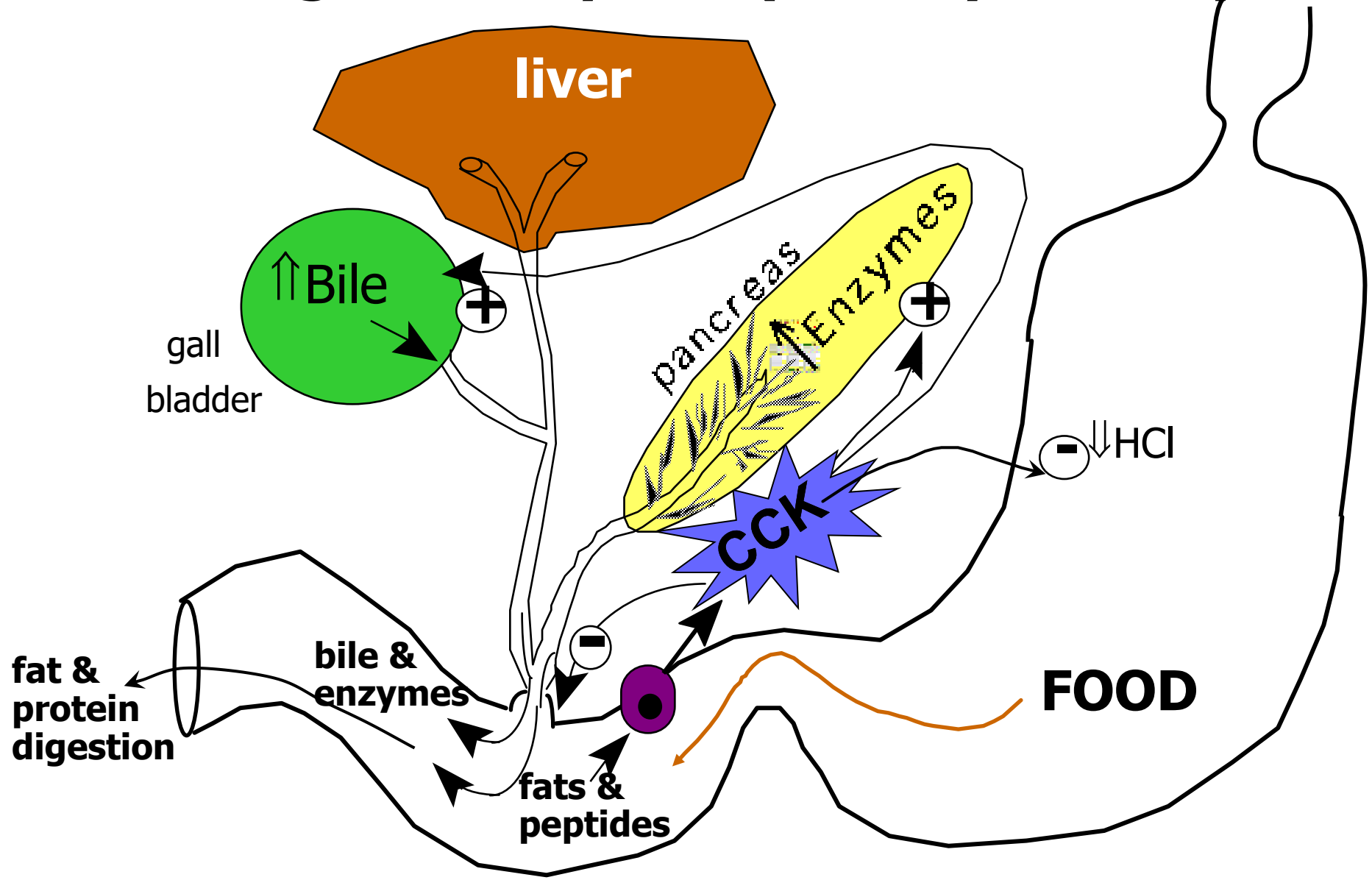
Cholecystokinin

- peptide hormone of the gastrointestinal system responsible for stimulating the digestion of fat and protein
- synthesized and secreted by enteroendocrine cells (L cells) in the duodenum
- causes the release of digestive enzymes and bile from the pancreas and gallbladder,


Hypothalamus
CCK
Orexin mRNA
MCH mRNA
HUNGER
CCK
NTS
SATIETY
FosLI
Ghrelin
Release of serotonin
Islets
Insulin
β cells
Insulin-induced hyperphagia
Gallstones
CCK-1 receptor
CCK
Relaxation
Vagal afferent
IBS
motility
Sphincter contraction
CCK cell
Capsaicin-sensitive C-fibers
CCK-1 receptor

2. Duodenal Response to Food

Regulation by CCK (Cholecystokinin)



Functions

- I cells release CCK rapidly into the circulation in response to a meal.
- The greatest stimulator of CCK release is the presence of fatty acids and/or certain amino acids in the chyme entering the duodenum.
- In addition, release of CCK is stimulated by acetylcholine
- Once in the circulatory system, CCK has a relatively short half-life

Functions

- CCK mediates digestion in the small intestine by inhibiting gastric emptying.
- It stimulates the acinar cells of the pancreas to release a juice rich in pancreatic digestive enzymes that catalyze the digestion of fat, protein, and carbohydrates.

Functions

- CCK also causes the increased production of hepatic bile
- stimulates the contraction of the gall bladder
- delivery of bile into the duodenal part of the small intestine.
- Bile salts form amphipathic lipids, micelles that emulsify fats, aiding in their digestion and absorption.

Negative feedback

- Trypsin, a protease released by pancreatic acinar cells, hydrolyzes CCK-releasing peptide and monitor peptide
- Digest COH, fats and proteins which drop the levels of hormone

Ghrelin

- peptide hormone produced by ghrelinergic cells in the gastrointestinal tractstomach and duodenum, but also in the jejunum.
- neuropeptide in the central nervous system
- It acts on hypothalamic brain cells both to increase hunger, and to increase gastric acid secretion and gastrointestinal motility to prepare the body for food intake.

Ghrelin

- The receptor for ghrelin, the ghrelin/growth hormone secretagogue receptor (GHSR), is found on the same cells in the brain
- Higher levels of ghrelin increases the appetite and intake of food

- Ghrelin inhibits glucose-stimulated insulin secretion from beta cells in the pancreatic islets. Ghrelin does this indirectly by promoting local negative feedback mediated by somatostatin from pancreatic delta cells, which selectively express the ghrelin receptor

Secretin

- 72 AA peptide hormone produced in the S cells of the duodenal mucosa.
- pH of chyme is acidic.
- To save duodenum from damage of acid, secreting helps
- Already present in duodenum in inactive form – prosecretin-120 AA
- Activated by low pH ranges between 2 and 4.5

- Active form – secretin stimulates gall bladder and pancreas to secrete their juices alongwith CCK.
- Bile contain bicarbonates which neutralizes pH.

Functions

- Secretin targets pancreatic centroacinar cells
- secretin binds to these receptors, it stimulates adenylate cyclase activity and converts ATP to cyclic AMP
- cAMP acts as second messenger in intracellular signal transduction and causes the organ to secrete a bicarbonate-rich fluid
- Which flows into the intestine.
- Bicarbonate is a base that neutralizes the acid, thus establishing a pH favorable to the action of other digestive enzymes in the small intestine

Functions

- reduces acid secretion by parietal cells of the stomach.
- It does this through at least three mechanisms:

1) By stimulating release of somatostatin,

2) By inhibiting release of gastrin in the pyloric antrum

3) By direct downregulation of the parietal cell acid secretory mechanics.

Functions

Osmoregulation

- modulates water and electrolyte transport in pancreatic duct cells
- It works through neurohypophysial tract
- In hypothalamus, it activates vasopressin release.
- Vassopressin causes vasoconstriction thus increasing the reabsorption of electrolytes and water from blood by nephrons.
- It works with angiotensin II.

Somatostatin

- Peptide hormone also known as growth hormone–inhibiting hormone (GHIH).
- Somatostatin is secreted at several locations in the digestive system:
- Delta cells in the pyloric antrum, the duodenum and the pancreatic islets.

Functions

- In the stomach, somatostatin acts directly on the acid-producing parietal cells via a G-protein coupled receptor
- which inhibits adenylate cyclase, thus effectively antagonising the stimulatory effect of histamine to reduce acid secretion.
- indirectly decrease stomach acid production by preventing the release of other hormones, including gastrin, secretin and histamine

Function in brain

Anterior pituitary

- Inhibit the release of growth hormone thus opposing the effects of growth hormone–releasing hormone (GHRH))
- Inhibit the release of thyroid-stimulating hormone
- Inhibit adenylyl cyclase in parietal cells.
- Inhibits the release of prolactin.

Functions in GIT

- Somatostatin suppresses the release of gastrointestinal hormones
- Gastrin
- Cholecystokinin (CCK)
- Secretin
- Motilin
- Gastric inhibitory polypeptide (GIP)

Functions in GIT

- Decrease rate of gastric emptying, and reduces smooth muscle contractions and blood flow within the intestine
- Suppresses the release of pancreatic hormones
- Somatostatin release inhibits insulin release.
- Inhibits the release of glucagon
- Suppresses the exocrine secretory action of pancreas.