DIGESTION OF PROTEINS

- Enzymatic hydrolysis in GIT

Stomach

- Protein entry in stomach stimulate secretion of hormone GASTRIN
- Gastrin in turn stimulates

1.HCl secretion by parietal cells (gastric glands)

2.Pepsinogen secretion by chief cells (gastric glands)

- pH of gastric juice: 1.5-2.5
- Acidity of gastric juice
    1. acts as antiseptic & kills most bacteria

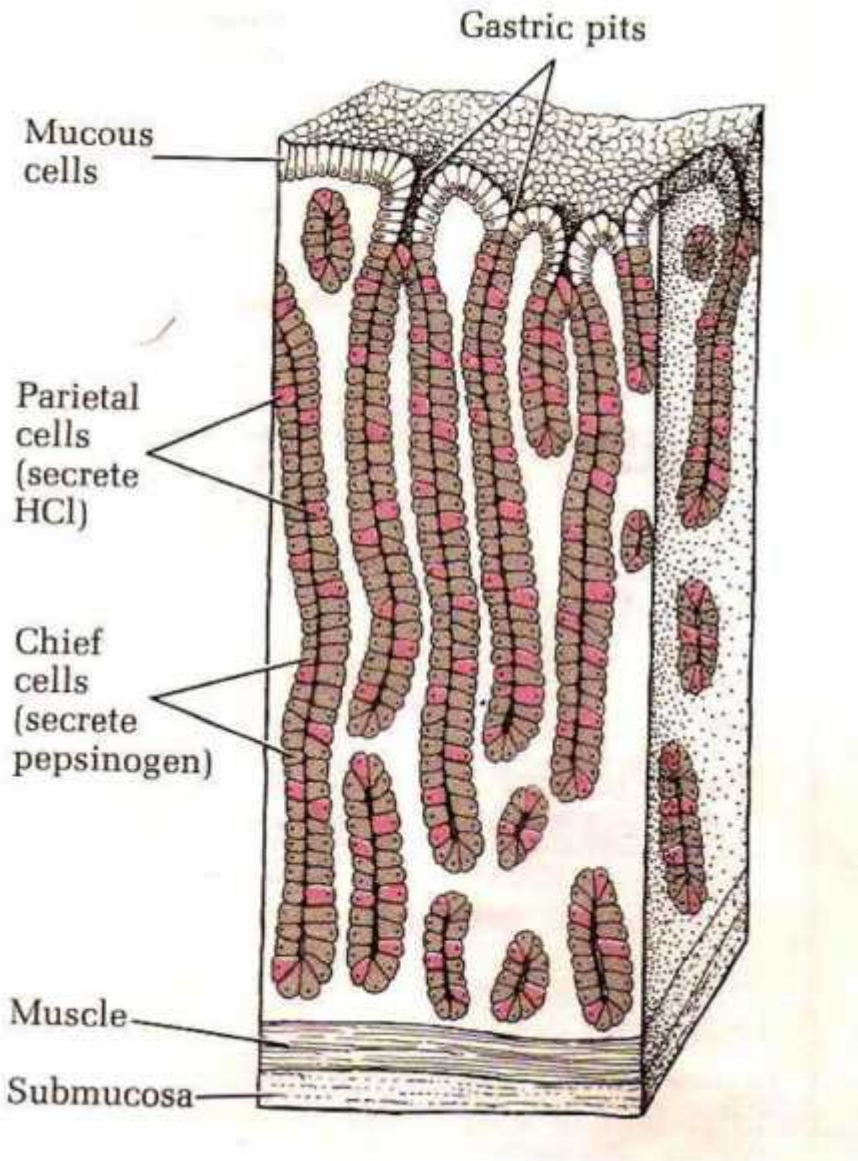


Figure 24-3
Gastric glands in the stomach lining. The parietal cells secrete HCl in response to the hormone gastrin, formed by epithelial cells when protein enters the stomach. The chief cells secrete pepsinogen.

2.causes globular proteins to undergo denaturation or unfolding, rendering internal peptide bonds more accessible to E action

Pepsinogen

- MW 40, 000
- Zymogen
- Converted to pepsin by HCl & pepsin itself
- Autocatalysis
- 42 amino acids removed from amino-terminal
- Pepsin MW 33, 000

- Pepsin hydrolyze peptide bonds with Tyr, Phe, Trp amino acids, among others
- Converts long polypeptide chains into smaller peptides

Small Intestine

- Low pH triggers secretion of SECRETIN hormone in blood
- It stimulate the pancreas to secrete bicarbonate into small intestine
- pH rises from 1.5-2.5 to 7
- Entry of amino acids in duodenum release hormone CHOLECYSTOKININ

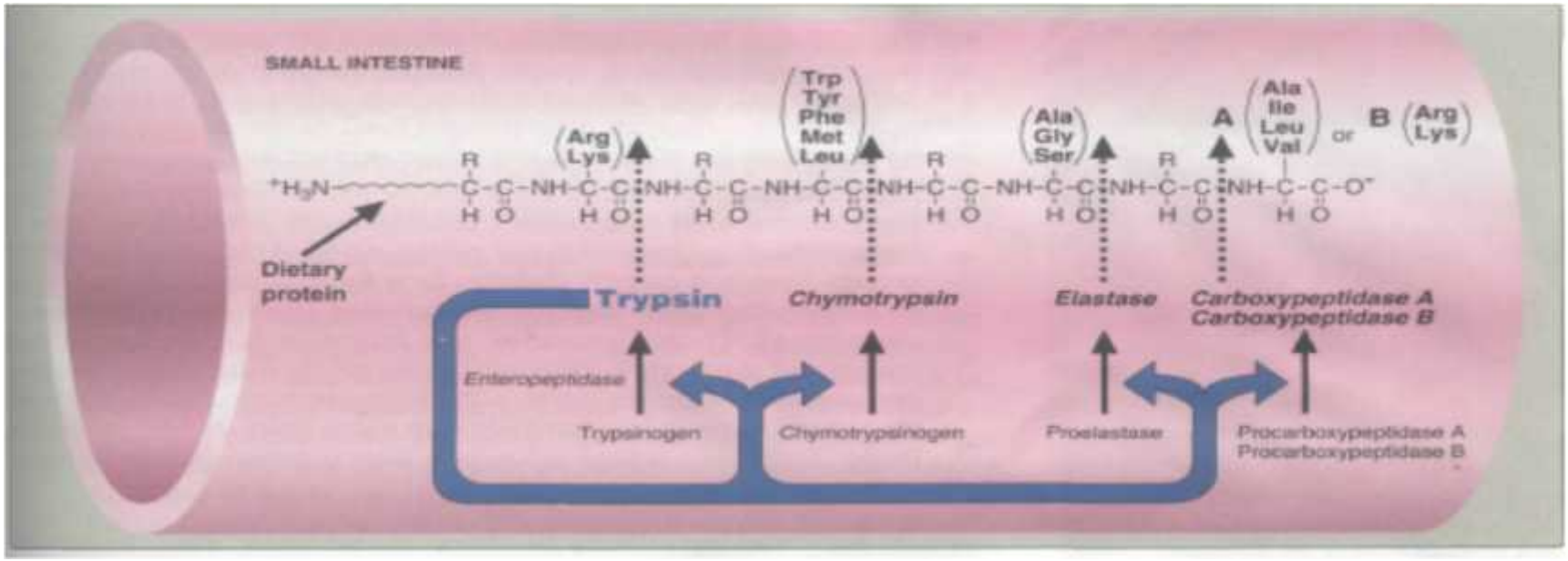
- Cholecystokinin stimulate secretion of several E by pancreas
- These E are trypsin, chymotrypsin, carboxypeptidase (made by exocrine cells)
- All these E are produced as zymogens
- Their synthesis as inactive form protects exocrine cells from destructive proteolytic attack
- Enterokinase (enteropeptidase), an intestinal hormone activates trypsinogen – converted to trypsin

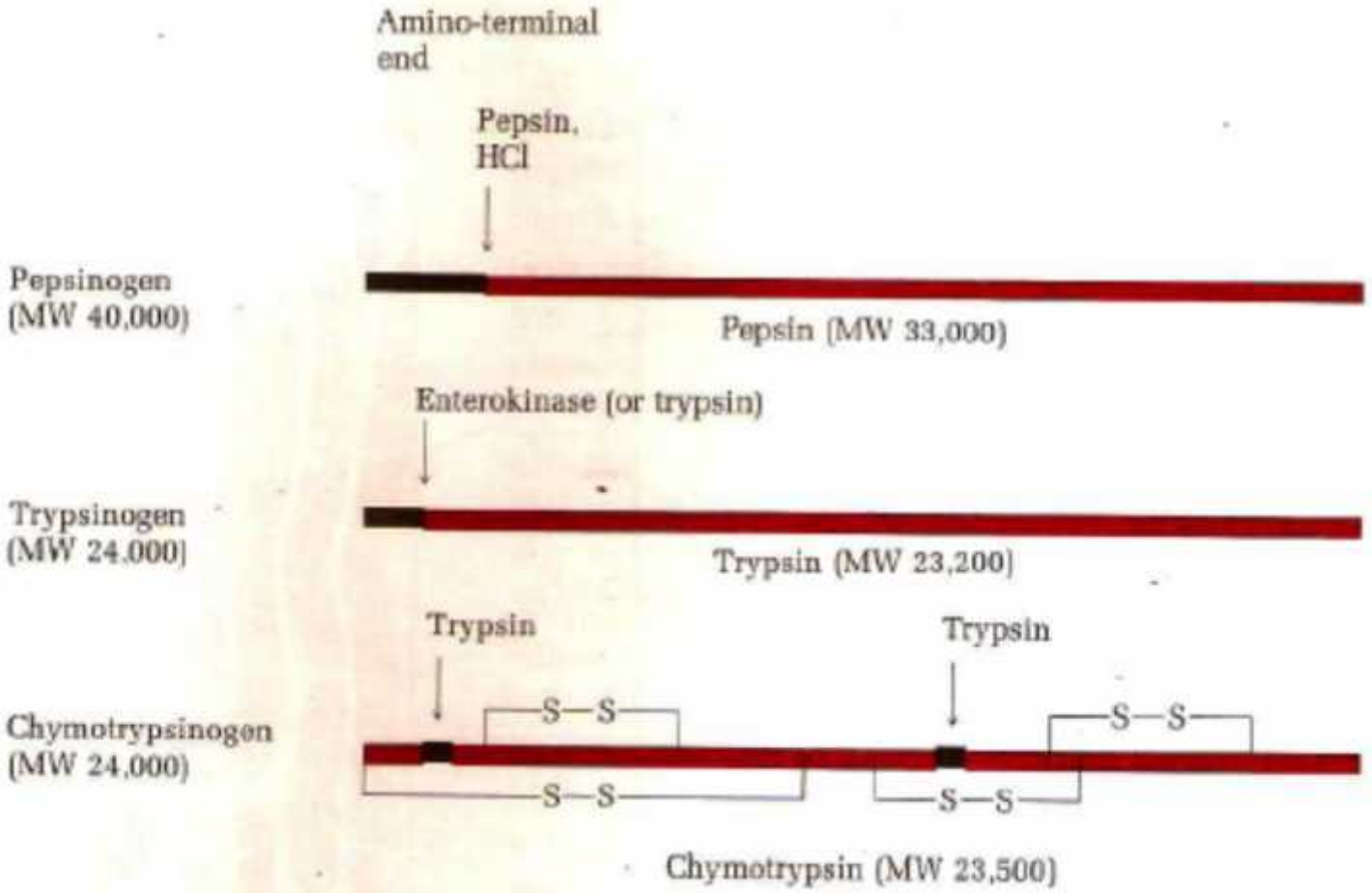
Trypsinogen

- MW 24, 000
- Hexapeptide removal from amino terminal
- Trypsin MW 23, 200
- Autoactivation also observed
- Hydrolyze peptide bonds with C-terminal contributed by Arg, Lys amino acids

Chymotrypsinogen

- MW 24, 000
- Activation by trypsin
- Excision of 2 dipeptides
- Chymotrypsin – active form MW 23, 500
- Chymotrypsin act on peptide bonds with Trp, Tyr, Phe, & others





ure 24-4

Figure 24-4
Activation of the zymogens of pepsin, trypsin, and chymotrypsin. The diagrams show the sites of proteolytic attack in the zymogens that set free the active enzymes (color). Segments of the polypeptide chains of the zymogens that are removed or excised are in black. Note that chymotrypsin has three polypeptide chains, held together covalently by two disulfide linkages and noncovalently by hydrogen bonds and hydrophobic interactions (page 229).

Table 24-1 **Enzymes Involved in Protein Digestion and Their Peptide Bond Specificity**

Pepsin	—Tyr, Phe, Trp; also Leu, Glu, Gln
Trypsin	Lys, Arg —
Chymotrypsin	Tyr, Phe, Trp
Carboxypeptidase	Successive carboxy-terminal residues
Aminopeptidase	Successive amino-terminal residues (except proline)

- Action of ALL E covert proteins into smaller peptides
- Hydrolysis – effective as all E act on specific terminals mostly
- Degradation of short peptides in small intestine – other E
- First E:Carboxypeptidase A & B
- Zn containing E
- Produced by pancreas as Procarboxypeptidase
- Carboxypeptidase remove C terminal residues
- Second E: Aminopeptidase
- Secreted by small intestine
- Act on N terminal residues

- Sequential action of all E – ingested proteins give mixture of free amino acids
- Which are transported across epithelial cells lining small intestine
- Free amino acids enter the blood capillaries in the villi and go to liver

ALL PROTEINS ARE NOT DIGESTED BY HUMANS

- Most animal proteins – complete hydrolysis occurs
- BUT some fibrous proteins (**keratins**) are partially digested
- Plant origin proteins – cereal grain not digested
- Protein part of grains/seeds have cellulose coatings

Celiac Disease

- Rare condition
- Intestinal E cannot digest water-insoluble wheat proteins, GLIADIN
- Gliadin injures intestinal cells
- Patients to avoid wheat products

Acute Pancreatitis

- Obstruction of normal secretion of pancreatic E into intestine
- Zymogens converted to active Enzymes prematurely in pancreas
- Attack pancreas

- Painful destruction of organ, can be fatal
- Normally, pancreatic zymogens are activated in intestine
- Pancreas protects itself from self-digestion by producing **trypsin inhibitors**
- As trypsin activate many other enzymes
- It prevent premature production of free proteolytic E in pancreas

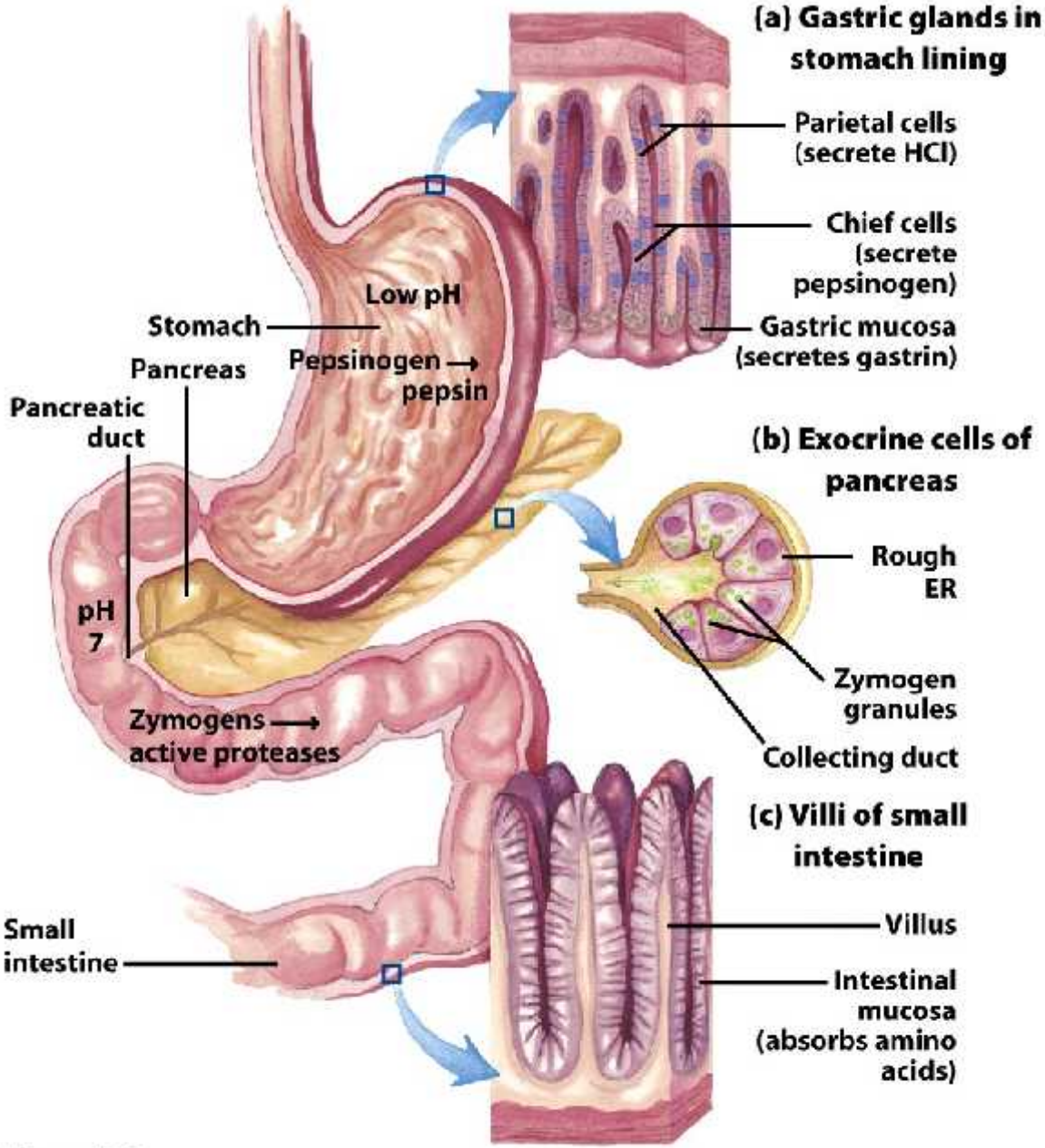
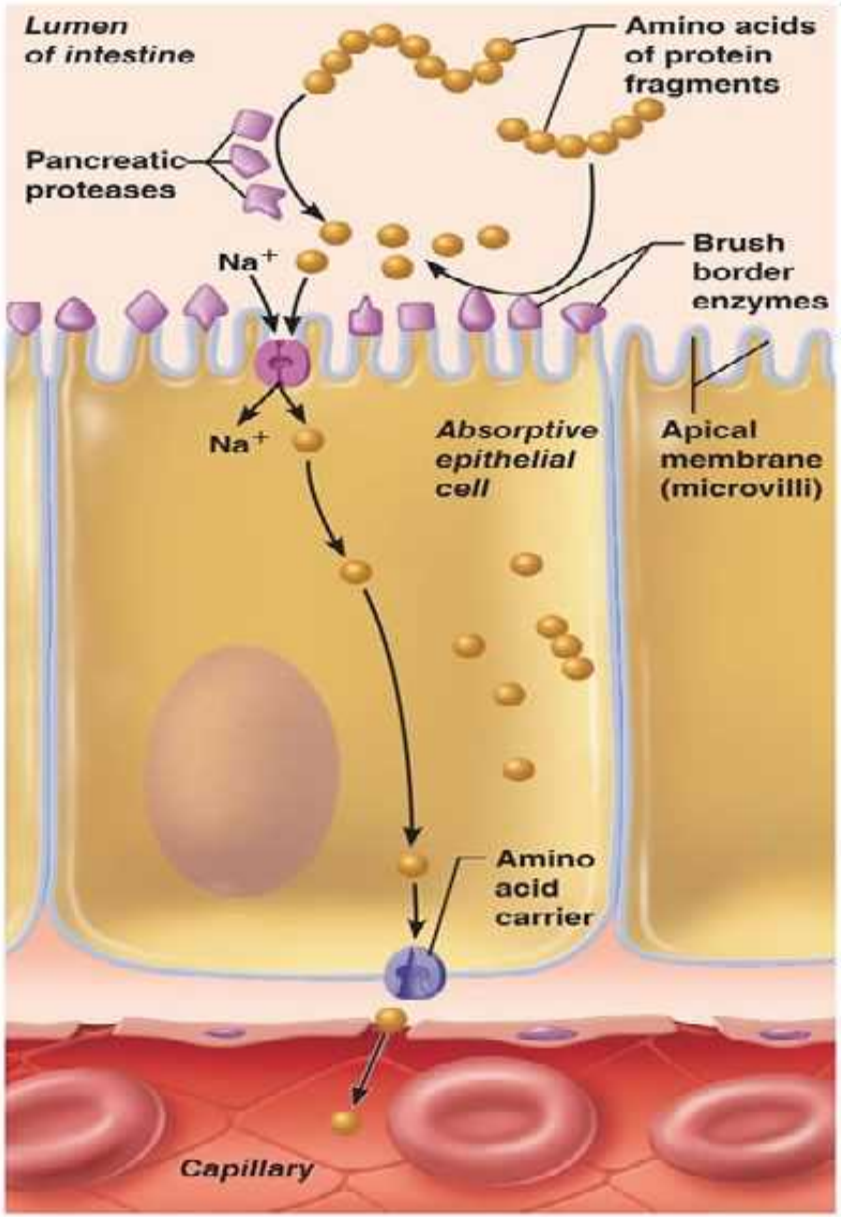


Figure 18-3
Lehninger Principles of Biochemistry, Fifth Edition



① Proteins and protein fragments are digested to amino acids by pancreatic proteases (trypsin, chymotrypsin, and carboxy- peptidase), and by brush border enzymes (carboxypeptidase, aminopeptidase, and dipeptidase) of mucosal cells.

② The amino acids are then absorbed by active transport into the absorptive cells, and move to their opposite side.

③ The amino acids leave the villus epithelial cell by facilitated diffusion and enter the capillary via intercellular clefts.