CHAPTER 4

The Gastrointestinal Tract (GI) and Nutrition
• GI tract = gastrointestinal tract
• GI is important to those who study nutrition because of its influence on the utilization of food and nutrients.
• Digestion:
  1. mechanical forces (chewing muscular contraction of GI tract)
  2. chemical action (HCL, bile)
     3. hydrolysis of ingesta (enzymes from GI tract or microorganisms)
• Absorption:
  small molecules from lumen → mucosal surface → blood, lymph systems
• GI tract of mammals include:
• Mouth (gland), esophagus, stomach, small intestine, large intestine
• Associated organs: liver (bile), pancreas (enzymes)
Types of GI tracts

**monogastric** (nonruminant), **ruminant** stomachs have several compartments but only one glandular stomach compartment

**Carnivores**: relatively short and uncomplicated intestine (large intestine), are classified as hind gut fermentation (rabbit): dog, mink.

The diet is relatively concentrated and highly digestible

**Omnivore**:

- Colonic digesters: long small intestine, moderately cecum and a sacculated large intestine: pig
- Cecal fermentor: short small intestine, enlarged cecum and unsacculated large intestine: rat
Coprophagy (feces eating) : rabbit

- Depend heavily on cecal fermentation.
- soft feces(recycling), hard feces
- supply of vitamins and amino acid are beneficial to the animal.
GI tract of nonruminant (Fig 4.2)

Stomach: 6-8 L in adult pig.
1. esophagus region
2. cardiac region: produce mucus, protecting the stomach
3. fundus gland region: peptic cells produce proteolytic enzyme, parietal cell secrete HCl.
4. pyloric gland region:

Small intestine: covered with villi (fingerlike projection) to increase absorptive surface area
   – duodenum
   – jejunum
   – ileum
GI tract of nonruminant

**Large intestine**: absorption of water and secretion of inorganic element, element. Bacterial fermentation (VFA., H2, Vit)
- Cecum
- Colon
- Rectum

**Pancreas, Liver**: enzyme and bile (lipid emulsification)
GI tract of avian (Fig. 4.5)

1. crop: fermentation (lactobacillus)
2. proventriculus: gastric juices,
3. Gizzard: like teeth in mammal
4. small intestine: enzyme
5. ceca: bacterial fermentation
6. colonic – return
GI tract of ruminant (Fig. 4.6)

1. Saliva:
   - 150L/day (cow), 10L/day (sheep)
   - eating and ruminating produced greater quantities than resting.
   - Provide a source of N (urea and mucoproteins), P, and Na for rumen microorganisms to use.
   - Buffered and maintaining pH in the rumen.
GI tract of ruminant (Fig. 4.6)

2. Stomach

- Reticulum: moving food into rumen or into the omasum.
- Rumen: high population of microorganism \((10^{10} – 10^{12})\) fermentation.
- Omasum: reducing particle size, control passage of ingesta.
- Abomasum: glandular stomach
reticular groove (esophageal groove)

• begins at the lower end of the esophagus and, when closed, forms a tube from the esophagus into the omasum.
• Allow milk bypass the reticulorumen, and escape bacterial fermentation.
• It is stimulated by the sucking, certain ions, solid in liquid.
• Not appear in older animal stopped suckle milk.
rumination

- semi-liquid materials regurgitate up the esophagus, swallowed the liquid, and remastication of and swallowed the bolus.
- 8 h/day in rumination result reduced in feed intake.
- Coarse, fibrous diets longer rumination time.
Eructation

• Microbial fermentation in the rumen results in production of large amount of gases.
• contraction of the upper sacs of the rumen which force the gas forward and down; the esophagus then dilates and allow the gas to escape.
Role of GI tract secretions in digestion

- table 4.3 and 4.4
- In nonruminant and avian, digestive enzyme works before microbial action.
- In ruminant, digestion occurs first in the rumen as a result of microbial fermentation. The glandular stomach and pancreas are the major source of digestive enzyme.
Rumen metabolism

- Most of the ingesta is fermented by microbes before it is exposed to typical gastric and enteric digestive enzymes and chemicals.
- Rumen microorganisms who pass into the abomasum and intestines will be digested by enzyme and provide nutrients for the animal.
Rumen fermentation

- Carbohydrate: VFA
- Protein:
- Lipid
- Gas production
- Vitamin synthesis
Role of the GI tract in transport of nutrients

• The passage of nutrients from the intestine lumen into the intestinal epithelial cell and then into the blood or lymph by
  1. passive diffusion
  2. active transport
  3. pinocytosis (phagocytosis)

• pinocytosis occurs in new born animal to absorption of immune globulins, proteins, peptide from colostrum.
transport route

1. penetration of the microvillus and plasma membrane
2. migration through the cell interior
3. possible metabolism within the cell
4. extrusion from lateral and basal aspects of the cell
5. passage through the basement membrane
6. penetration through the epithelium into blood or lymph
Blood and Nutrition

• Blood is the vehicle for transport of nutrients and metabolites among organs, tissues and cells of the body, Nutrients transport by carrier or binding protein:
  * ferritin: transport protein for ion
  * ceruloplasmin: transport protein for Cu
  * high-density lipoprotein (HDL)
  * low-density lipoprotein (LDL)
  * enzyme, hormones
Blood evaluation in nutrition

• Anemia:
  – Develop as a result of deficiencies of Fe, Cu, Co, Vit $B_{12}$, folic acid, or protein
  – Confirmed by
    • Presence of low PCV,
    • low hemoglobin content in blood,
    • Microscopic exam of red cells

• blood component assay