Fisiologi saluran pencernaan
Ternak monogastrik

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Digestive System

- Large complex molecules broken down into simpler molecules
- Long tube beginning with mouth and ending with the anus
Digestive Systems

- Man & Pig have a simple stomach with an extensive intestinal system
- Ruminants have a complex stomach with a simpler intestinal system
- Horses & Rabbits have a simple stomach with an extensive intestinal system and an enlarged cecum
Mouth: “Prehension” tool (grasps food)
Salivary Glands secrete juices containing enzymes (digest food)
Chewing food breaks down also
Esophagus: muscular tube that connects mouth to stomach
Peristaltic Movement: sequential contraction of ringlike muscles
Reverse Peristalsis = blowing chunks
Simple Stomach

- Muscular contractions break down food.
- Enzymes break down food:
  - Gastric: proteins
  - Liver & Pancreatic: fats
Three (3) basic types of digestive systems:

- **Monogastric** – simple stomach.


- **Hind gut (caudal) fermentor** – simple stomach, but very large and complex large intestine.
Types of Digestive Systems

Monogastrics
- Chickens
- Pigs
- Turkeys
- Dogs
- Cats

Ruminants
- Beef Cattle
- Dairy Cattle
- Goats
- Sheep
- Deer

Hind Gut Fermentors
- Horses
- Rabbits
- Ostrich
NonRuminants

- Foragers: Horse, rabbit
- NonForagers: pig, poultry
Animal Classification By Type of Food Consumed

• Herbivore - Depends entirely on plant food
  - Sheep, Cattle, Horses

• Carnivore – Almost entirely on meat for food
  - Dog

• Omnivore – Both meat and plants for food
  - Swine, Chickens, Humans
Animal Classification By Type Digestive System

Monogastrics – Major Category

• 1. Simple Stomach – Pigs, Humans, Dogs
• 2. Avian – Chickens, Turkeys
• 3. Pseudo Ruminants – Horses, Rabbits

Ruminants – Cattle, Sheep, Goats
Swine: - “Simple stomach”, Limited capacity
- Chemical secretions and enzymes are critical for digestion
- Limited microbial action, limited fiber digestion

Figure 6-3: Swine digestive tract.
**Digestive System Parts and Functions - Swine**

- **Mouth** – Initial breakdown of food, mechanical, amylase in saliva, some lipase

- **Stomach** – Initial digestion of food, broken to smaller particles
  - Hydrochloric acid – HCl, breaking of bonds
  - Pepsin – proteins to polypeptides
• **Small Intestine** – Further breakdown and absorption of food

*Pancreatic Enzymes*

- Lipase - fats to fatty acids and glycerol
- Trypsin - polypeptides to peptides
- Chymotrypsin – peptides to amino acids
- Amylase – starch to disaccharides
- Sucrase, Maltase, etc. – disaccharides to monosaccharides

Reduced particles are absorbed into the bloodstream across wall of the small intestine. Diffusion = passive, Transport = active.
• **Cecum/Large Intestine** – limited plant fiber digestion
  - microbes present produce the enzyme **cellulase**
  - cellulase breaks down cellulose (one type of plant fiber)
  - very inefficient system in monogastrics (except horses)
Chicken Digestive Tract
Avian – monogastric, similar to others except:

- different anatomy since no teeth to chew food
- Limited capacity
- Chemical secretions and enzymes are critical for digestion
- Limited microbial action
- Limited fiber digestion

Figure 6–7: Digestive system of the avian.
• **Beak** – procure food
• **Crop** – feed directly here from esophagus
  - feed stored and soaked with water
• **Proventriculus** – True “stomach” in Avian species, adds and mixes in:
  - Hydrochloric acid – HCl, breaking of bonds
  - Pepsin – proteins to polypeptides
• **Gizzard** – Contains grit, food is crushed and ground to smaller particles by strong muscular contractions.

• **Small Intestine** – Same as swine

• **Cecum/Large Intestine** – Same as swine
Figure 7. Photograph showing the positioning of the Merkel's Diverticulum between the jejunum and ileum portions of the small intestinal tract.
The Liver

- Performs metabolic and hematological regulation and produces bile.
- Histological organization.
Anatomy of the Liver

Figure 24.19b, c

- Coronary ligament
- Falciform ligament
- Gallbladder
- Right lobe
- Left lobe
- Caudate lobe
- Left hepatic vein
- Inferior vena cava
- Hepatic portal vein
- Hepatic artery proper
- Quadrant lobe
- Common bile duct
- Gallbladder
- Hilus

(b) Anterior surface

(c) Posterior surface
Liver lobule is the basic functional unit of the liver.

- Hepatocytes form irregular plates arranged in spoke-like fashion.
- Bile canal carry bile to bile ductules.
- Bile ductules lead to portal areas.
Liver Histology

- Kupffer cells
- Hepatocytes
- Sinusoid
- Bile canaliculi
- Hepatic artery proper
- Bile duct
- Hepatic portal vein
- Central vein
- Interlobular septum
- Portal area
- Bile ductules
Pseudo Ruminants: Monogastric, single compartment stomach

- have a greatly enlarged cecum.
- have a large amount of “hind – gut” fermentation.
- digest fiber, can use forages as part of diet
Functions of the Cecum

- microbes present break down the plant fiber:
  - Produce energy to be absorbed through the cecum as VFAs
    - less efficient than rumen
  - Synthesize more microbes, vitamins and amino acids, not digested and used as efficiently, since cecum is downstream of digestive organs (stomach and small intestine) – Some are absorbed
  - Require higher quality feed and forage than ruminants
Diagram Sistem Pencernaan:

- BM (Batu Melah)
- Tanggung jawab
- Sal. Penc. (Salivary Glands)
- Assesoris
- Mulut
- Pharynx
- Oesophagus
- Lambung
- Usus Halus
- Usus Besar
- Anus

Flux:
- Makanan masuk ke mulut, kemudian melalui pharynx, oesophagus, lambung, usus halus, usus besar, dan akhirnya keluar melalui anus.

Organ dan Fungsi:
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anatomi
Note: Numerical values are those observed in the New Zealand White breed, aged 12 weeks, fed a complete balanced pelleted feed.
Non-ruminant herbivores

- Consumes large amounts of roughage
- Large cecum and colon between the small and large intestines
  - contains bacteria
Rabbit Digestive System

http://courses.washington.edu/vertebra/453/photos/gut_photos/mammal_digestive_photos.htm
stomach

Divided into cardia (entrance), fundus (body) and pylorus (termination)
Stomach Lining

Figure 24.13c, d

- Gastric pit (opening to gastric gland)
- Mucous epithelium
- Lymphatic vessel
- Lamina propria
- Muscularis mucosae
- Submucosa
  - Oblique muscle
  - Circular muscle
- Longitudinal muscle
- Serosa
- Myenteric plexus
- Gastric pit
- Artery and vein
- Gastric gland
- Mucous cells
- Neck
- Parietal cells
- Chief cells
- Smooth muscle cell
- G cell
Cardiac gland region

This is not necessarily in the cardia which is usually non glandular. This mucosa contains glands which produce mucus.

Fundic gland region

Fundic glands are simple and tubular and contain 3 types of cells:

1. Mucus neck cells, which produce mucus
2. Parietal cells, which produce HCl
3. Peptic or zymogen cells, which produce enzymes
Pyloric gland region

These glands are lined entirely with mucus-secreting cells like those within the cardiac glands. The hormone gastrin is produced by G cells of the pyloric gland.

Gastric juice

Is the total secretory product (fluid) from the surface epithelial cells and the cardiac, fundic and pyloric glands of the stomach. It is colourless and is made up of two components; a parietal cell acid component, and an alkaline component containing pepsin, mucin and electrolytes.
Pepsin

Is synthesised in the peptic cells from the inactive precursor, pepsinogen. It begins the digestion of protein in the stomach if the pH is acid. Proteins are converted to proteooses and peptones in the stomach, and digestion of protein is completed in the intestine.
Rennin

Is a milk clotting enzyme secreted as inactive prorennin which is activated by the presence of acid. In addition to clotting milk rennin also exhibits proteolytic properties. It is found in the gastric juices of calves, lambs, and young pigs.
Gastic lipase

Is present in low concentration in the gastric juice of carnivores. It can hydrolyse fats that are emulsified, such as milk fat but probably had little effect on unemulsified fats.
Hydrochloric acid

Is produced by the parietal cells of the fundic glands of the stomach of all vertebrates. HCl activates pepsin and rennin and aids pepsin in protein digestion by lowering the pH of the stomach contents.
Phases of gastric juice secretion

Cephalic phase
Presence of food in the mouth may result in the secretion of gastric juice in the stomach.

Gastric phase
When food reaches the stomach, gastric juice secretion Increases for a period up to several hours.
Intestinal phase

When products of gastric digestion reach the duodenum, intestinal gastrin is produced.
Intestinal Wall
Transversal cross section

CROSS SECTION OF THE SMALL INTESTINE

- Muscle coat
- Submucosa
- Mucosal surfaces
- Villi
- Lumen
- Crypts
- Enterocytes
- Intestinal wall

(Fig.1-3)
Pancreas and pancreatic secretion

The pancreas consists of exocrine and endocrine portions. The exocrine part consists of acini responsible for the production of pancreatic juice and ducts which convey the juice to the duodenum. The endocrine portion is made up of the Islets of Langerhans which secrete insulin into the bloodstream.
Pancreatic juice is secreted under the influence of two hormones produced in the mucosa of the duodenum.

Secretin increases the rate of flow and hydrocarbonate concentration of the pancreatic juice.

Pancreozymin increases the amount of enzymes in the pancreatic juice. An additional factor which results in a pancreatic juice rich in enzymes is neurogenic stimulation by the vagus nerve.
Pancreatic juice contains sodium carbonate, which neutralises acid from the stomach and increases alkalinity of intestinal fluid, and a number of enzymes for the hydrolysis of proteins, fats and carbohydrates.
There are 3 major group of enzymes in pancreatic juice.

1. Pancreatic proteases or proteolitic enzymes in the pancreas are trypsin, chymotrypsin A, chymotrypsin B, and the carboxypeptidases.

2. Pancreatic amylase is an α-amylase, probably structurally identical to salivary amylase secreted in an active state. Amylase attacks starch grains and produces dextrins and maltose. Maltase is also present in pancreatic juice and it hydrolyses maltose to glucose.
Pancreatic lipase is secreted in an active form and it hydrolyses fats into carboxylic (fatty) acids and glycerol. Pancreatic lipase is most effective after the fats have been emulsified by bile.

Bile is a greenish yellow liquid consisting largely of water, bile salts, bile pigments and cholesterol with smaller amount of fats and inorganic salts.
Intestinal secretion

Intestinal juice, called succus entericus, is produced by the intestinal glands scattered throughout the entire small intestine, and submucosal duodenal glands. Secretion of these glands is stimulated by the presence of food in the intestine. The release of intestinal juice is also brought about by hormone called enterocrinin.
In addition to water, salts and mucus, a number of enzymes have been described in the intestinal juice. These include enterokinase (which activates trypsinogen), and the following inverting enzymes:

- **Maltase** - hydrolyses maltose to glucose
- **Sucrase** - sucrose to glucose and levulose
- **Lactase** - lactose to glucose and galactose
- **Peptidase** - peptides to amino acids
- **Polynucleotidase** - splits nucleic acids into mononucleotides
- **Nucleotidase** - nucleotide into nucleosides and phosphoric acid
Taste

A. Total No. of taste buds in the mouth: [Kare & Ficken, 1963. In: Y. Zotterman (Ed.) Olfaction and Taste]

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<td>Human</td>
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1) Taste buds - A group of cells that are approximately 20 x 90 μm in size.
2) Taste buds are located throughout the oral cavity, particularly on tongue in pigs, whereas they are restricted to or located on the back of the mouth in birds.

☞ Taste apparatus is present in fowl, but not extensive as in swine!
prehension

The manner in which food is grasped. Picked up, carried to the mouth, mixed with saliva and manipulated before swallowing.

deglutition

The process in which food particles are swallowed whole and pass to the crop.
Passage of ingesta through the tract

Rate

The rate of feed passage through the alimentary canal is influenced by the consistency, hardness and water content of the feed and by the amount consumed.
Motility
1. Crop and esophagus
2. Proventriculus
3. Gizzard
4. Small intestine
5. Large intestine
Terima kasih
Arigato