

# **Animal physiology**

## **Third lecture**

### **Digestive system**

**Dr.Pakiza Hamira Wasman**

## Classification of various digestive systems:

One variation between the gastrointestinal (GI) tracts of the common domestic animals is classified into groups based on their type of diet with many sub-groups:

- 1- **Herbivores** – Animals that consume primarily **plant materials**.
- 2- **Carnivores** - Animals that **eat other animals**.
- 3- **Omnivores** - Animals that eat a **combination of plant and animal matter**.

## **Animals classification based on their digestive physiology:**

### **A. Non- ruminant animals:**

1. **Poultry:** Non-ruminants that are omnivorous and they have a complex foregut (three sections that replaces the normal stomach) and a relatively simple intestinal tract.
2. **Dogs and cats:** Non-ruminant animals those are carnivorous.
3. **Horses and mules:** Non-ruminant animals, but they are herbivorous and have rather large and complex large intestine.
4. **Rabbits:** Non-ruminant animals that is an herbivorous with a complex large intestine.

### **B. Ruminant animals:**

Capable to consume and digest plant materials and classified as herbivorous. Include **cattle, sheep, goat, deer** and many **other wild species**.

## **Digestion:**

- Breaking down large, nutrient macromolecules into simpler molecules for use by an organism.
- Food enters the mouth and goes through mechanical and chemical changes as it passes through the alimentary canal.

## **Treatment of food:**

Whether an animal eats plants or feed, the carbohydrates, fats and proteins in the food it eats are generally giant molecules. These need to be digested (split up) into smaller ones before they can pass into the blood and enter the cells to be used for energy or to make new cell constituents. For example:

- 1- **Carbohydrates** like **cellulose, starch**, and **glycogen** need to be digested into **glucose** and other **monosaccharides**;
- 2- **Proteins** need to be digested into **amino acids**.
- 3- **Fats** or lipids need to be digested into **fatty acids** and **glycerol**.

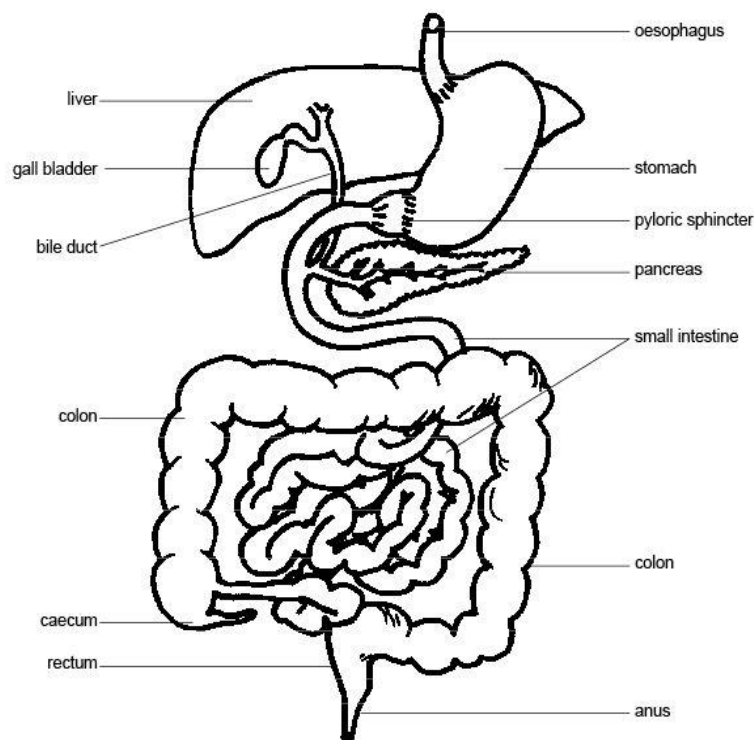
## The Gut:

- The digestive tract, alimentary canal or gut is a hollow tube stretching from the mouth to the anus.
- It is the organ system concerned with the treatment of foods.
- At the mouth the large food molecules are taken into the gut - this is called **ingestion**. They must then be **broken down into smaller ones** by **digestive enzymes (digestion)** before they can be taken from the **gut into the blood stream (absorption)**.
- The cells of the body can then use these small molecules (**assimilation**). The indigestible waste products are eliminated from the body by the act of.

## The major functions of the gut are:

1. Transporting the food;
2. Processing the food physically by breaking it up (chewing), mixing, adding fluid etc.
3. Processing the food chemically by adding digestive enzymes to split large food molecules into smaller ones.
4. Absorbing these small molecules into the blood stream so the body can use them.

The regions of a typical mammals gut (for example a monogastric animals: rabbit, cat or dog) are shown in diagram 1.



**Diagram 1 - A typical mammalian gut**

## Parts of monogastric Digestive Tract:

The food that enters the mouth passes to the esophagus, then to the stomach, small intestine, cecum, large intestine, rectum and finally undigested material exits at the anus. The liver and pancreas produce secretions that aid digestion and the gall bladder stores bile.

- ▶ **Mouth:** initial opening of alimentary canal
  - **Salivary Glands**
    - secrete juices that contain enzymes to help break up the food
  - **Mastication**
    - chewing, crushing, preparing food for swallowing
- ▶ **Pharynx:** funnel shaped muscle between mouth and esophagus
  - part of digestive and respiratory tracts
- ▶ **Esophagus:** muscular tube connecting pharynx to stomach
  - muscle contractions move food down to stomach.
- ▶ **Stomach:** located between esophagus and small intestine
  - Two basic types
    - Simple
    - Ruminant

## Simple Stomach

- Humans, swine, rabbits and horses
- Split into 4 parts:
  - ▶ **Esophageal**
    - Non-glandular
    - Connects the stomach to the esophagus
  - ▶ **Cardiac**
    - Mucus secretion starts here
  - ▶ **Fundic**
    - Body of the stomach
    - Digestion and churning takes place here
    - Mucus secretion
  - ▶ **Pyloric**
    - Connects to small intestines
    - Mucus secretion

**Digestion:** is mechanical, muscle contractions is chemical, enzymes soften and break down macromolecules of food enzymes are catalysts, they start the chemical reactions.

- ▶ HCl is produced, denatures proteins and prepares them to be broken down
- ▶ Pepsinogen is the inactive form of Pepsin
- ▶ Pepsin, activated form of Pepsinogen, activated by HCl
- ▶ Pepsin breaks down and digests the denatured protein
- ▶ The monogastric stomach is very acidic
- ▶ pH drops to 2.0-3.5
- ▶ Amylase quits working due to low pH
- ▶ Has a mucus lining to protect the stomach from digesting itself
- ▶ Made of smooth muscle to aid in constant churning/mixing

## Small Intestine

Most of the **breakdown of the large food molecules** and **absorption of the smaller molecules** take place in the long and narrow small intestine.

- The total length varies but it is about 6.5 meters in humans, 21 meters in the horse, and over 150 meters in the blue whale.
  - enzymatic digestion and absorption
- **Functions of the small intestine:** digestion of proteins, carbohydrates, and fats; absorption of The end products of digestion
- It is divided into 3 sections: the **duodenum** (after the stomach), **jejunum** and **ileum**.
  1. **duodenum** - most digestion occurs here
  2. **jejunum** - some digestion and some absorption occur
  3. **ileum** - mostly absorption
- The duodenum receives 3 different secretions:
  1. **Bile:** made in liver, stored in gall bladder, active In the small intestine, emulsifies fat to aid in digestion.
  2. **Pancreatic juice** from the pancreas.
  3. **Intestinal juice** from glands in the intestinal wall.
- These complete the digestion of starch, fats and protein.

The products of digestion are absorbed into the blood and lymphatic system through the wall of the intestine, which is lined with tiny finger-like projections called **villi** that increase the surface area for more efficient absorption.

**Cecum** : essentially non-functioning in many monogastrics. Rabbits and horses have an enlarged cecum that acts like a rumen and is involved with microbial digestion (fermentation).

**Large Intestine**

- bacterial activity
- water absorption
- waste storage

**Enzymes that break down food**

- o Gastric-break down proteins in stomach
- o Liver and pancreatic-break down fats in small intestine
- o Intestinal-break down carbohydrates and proteins in small intestine

<b>Enzyme</b>	<b>Function</b>	<b>Source</b>
trypsin	digest proteins	secreted from pancreas
chymotrypsin		
carboxypeptidases		
pancreatic amylase	digests carbohydrates	secreted from pancreas
lipases	digests lipids	
disaccharidases	digests carbohydrates	secreted from small intestine
dipeptidases	digest peptides	