Lecture 8

DIGESTION AND ABSORPTION

The body of man and farm animals may be compared to a machine – it needs fuel to make it work. Feeds and food are the fuel for the body and the amount of energy we get from our food is measured in calories for our physical and metabolic activities.

Additionally, feed/food gives us what we need for growth (young animals) and repair and it protects us from diseases.

To achieve these objectives, feed/food goes through a kind of sorting-out process called digestion to separate the different parts of feed/food called nutrients, which have their special functions in the body.

The waste is rejected and the useful nutrients are absorbed, metabolized or stored in the body. There are a lot of factors which affect the process of digestion and absorption in the body.

Summarily, digestion is the breaking down of large macromolecules of feed/food into smaller units, which are then absorbed and either incorporated into the body or metabolized to produce energy.

Digestion is necessary because animal feed consists of organic materials – mainly carbohydrate, proteins and fats. Digestion is achieved in the digestive tract (GIT) with the aid of enzymes.

Intracellular Digestion – this takes within cells. In a unicellular organism, digestion is usually of necessity inside the cell e.g. of a protozoan takes food into the digestive vacuole and enzymes that aid in the digestion of CHO, fat, and proteins are secreted into the vacuole. It also occurs in sponges, coelenterates and turbellarians.

Extracellular Digestion – involves digestion outside the cells. This allows animals to ingest larger pieces of feed/food. It is also associated with a well-developed tract where digestive enzymes secreted by the various tissues associated with the GIT to act on the feed/food materials. The GIT has two openings – the mouth and the anus. Quite common in higher animals.

GASTRO-INTESTINAL TRACT (G.I.T)

The digestive tract comprises four main parts:

(a) It begins at the **mouth** where the food is broken down mechanically by the process of mastication.

(b) From the mouth, food passes down the **oesophagus** into the **stomach**.

(c) The partially digested food is expelled from the stomach largely in liquid form, in a series of squirts through the **pylorus** into the **small intestine**. This is a long, narrow, convoluted tube made up of three sections – the **duodenum**, the **jejunum** and the **ileum**.

(d) The ileum of the small intestine leads to the **large intestine** which is made up of four parts – the **caecum**, the **ascending colon** on the right side of the abdomen, the **transverse section** extending from right to left and the **descending colon** on the left side of the abdomen. The large intestine terminates at the anus.

DIGESTION PROCESSES

(1) **The Mouth** – (Little is absorbed in the mouth. Absorbs salt, Vit. C, glucose, alcohol and certain soluble drugs).

Essentially teeth and tongue begin mechanical digestion by breaking feed/food particles apart via mastication. Contributes to the digestive process by the secretion of saliva by salivary glands controlled by reflex action.

Saliva has two (2) functions in digestion

(i) Contains mucin which lubricates dry food, assisting with its mixing and makes swallowing easier.

(ii) Contains enzyme amylase, ptyalin concerned with the break-up of large molecules of starch into dextrins and maltose.

(2) **Stomach** – (Absorbs soluble substances as alcohol, sugars, salts, water-soluble vitamins and some of the products of protein digestion

The stomach has two functions in the digestive process –

(i) It acts as a container for food undergoing digestion.

(ii) Allows salivary digestion to starch to continue until it is stopped by the (HCl) acid present and the digestion of protein and of a small amount of fat to begin together with the hydrolysis of some disaccharides.

(a) Gastric Enzymes: Three digestive enzymes are secreted in the stomach:

Pepsin – which break down protein

Rennin – converts the soluble protein in milk – caseinogens into a form which can combine with calcium to produce calcium – caseinate which can then be digested by pepsin (in children/lactating animal)

Lipases – present low concentration breakdown fats.

(b) Hydrochloric acid – secreted in the stomach and allows the normal functioning of pepsin enzyme to breakdown proteins. The hydrochloric acid and pepsin acts to digest and destroy bacteria, thus acting as antiseptic (protection against food poisoning bacteria).

(c) Mucus – a slimy, viscid substance secreted by the stomach and in conjunction with enzymes and HCl, serves to protect the stomach itself against its own acidity.

(d) Stomach environment – waves of muscular contraction of the stomach occur at intervals which help digestion by moving the stomach contents about mixing them with gastric secretions.

Gradually the chime is forced into lower part called pylorus, then into the small intestine.

(3) **The Small Intestine** – (Absorbs sugars from CHO, amino acids from protein digesta respectively. Glycerol and other products affect digestion, vitamins)

The long convoluted tube of the small intestine is a highly effective digestive organ. The contents of the small intestine are slightly alkaline. Further digestion occurs by enzymes produced by glands outside the small intestine.

(i) Pancreatic enzymes

The pancreas is made up of a group of specialized cells which lie in the loop of the duodenum and functions mainly to supply protein, carbohydrates and fat-splitting enzymes to the small intestine. These are:

(a) Protein – splitting enzymes – Trypsin breaks down protein mor completely and undigested proteins too. Chymotrypsin which supplements the action of trypsin in breaking down partially degraded proteins.

(b) Carbohydrate – splitting enzymes – pancreatic amylase splits starch much more efficiently than ptyalin present in saliva. Present in adults and absent in infants/babies.

(c) Fat – splitting enzymes – Lipase secreted by pancrease splits fats into fatty acids and glycerol which are soluble in water. The alkali present in the small intestine changes part

of the fatty acids into their alkali-metal salts which facilitate the absorption of far through the intestinal wall; eventually into blood stream.

Pancreatic – lipase activity is related to bile secreted by gall bladder.

(1) Intestinal enzymes

These are secreted by the cells lining the small intestine. This includes:

(a) Protein – splitting enzymes – Peptidases are a group of enzymes which complete the breakdown of protein fragments into their constituent amino acids. Nucleases can split nucleic acids, which are concerned with protein synthesis and are present in the nuclei of the cells of both animals and plant feeds.

(b) Carbohydrate – splitting enzymes – maltase, sucrose (also called invetase) and lactase are supplementary CHO – splitting enzymes. Maltase split sugar maltose into glucose, sucrose split sucrose into glucose and fructose while lactase split lactose into glucose and galactose (in milk) present in large quantities in infants/babies on milk diet (lactation).

(c) Fat – splitting enzyme – intestinal lipases supplements the action of lipases secreted in the stomach and by the pancrease (gastric lipase and pancreatic lipase respectively).

(2) Bile – is an alkaline liquid with a colour varying from reddish-brown to yellow and even green, with musky smell and bittersweet taste. Bile is secreted by the liver and gradually fills up the gall bladder through bile duct. Bile itself has little digestive action, however, it greatly increases the extent of the splitting of fats in the small intestine by the pancreatic lipases.

- Bile promotes the emulsifying of the fats in the liquid contents of the intestine.
- Bile also assists the absorption of the fat-soluble vitamins – A, D, K.
- Bile also increases the efficiency of the enzymes which digest CHO and protein.

(3) The large intestine – (Absorbs vitamins of the B-group and small amount of sugars arising from the breakdown of fibrous material)

The large intestine has three digestive functions:

(i) It absorbs any remaining food broken down by the digestive activities of the mouth, stomach and small intestine which has not already passed into the blood stream.

(ii) Re-absorbs much of water which is the major component of the mainly fluid mixture in which digestion takes place in the stomach and small intestine. Waste material and bacterial debris can therefore leave the body in dry form as faeces.

(iii) Serves as an incubator in which certain harmless bacteria can grow, they break down some tougher food components which are resistant to the digestive enzymes. By this action they multiply inside the large intestine, the bacteria synthesize some vitamins (B-group) which contribute to the body's total nutritional intake.