Chapter 1: Digestion in the Dairy Cow

DEPARTMENT OF ANIMAL AND VETERINARY SCIENCES

INTRODUCTION

Dairy cows and other animals such as sheep, goats, buffaloes, camels and giraffes are ruminants. They differ from non-ruminants (e.g., humans, pigs, dogs) in their digestive system. Only ruminants can utilize non-protein nitrogen (NPN) and fiber. The digestive system of ruminants includes reticulum, rumen, omasum, and abomasum. The reticulum (cervical stomach) is the first of the stomachs and functions as a sort of a sieve. It contains saliva and can be emptied into the rumen. The saliva contains enzymes which digest the food and secrete a weak acid. The food is stored in the reticulum for several hours. The rumen (reticulo-rumen) is the largest stomach and functions as a fermenter. The microorganisms (bacteria, protozoa, and fungi) live in the rumen. They secrete enzymes and ferment organic material, producing a number of end-products that can be used by the animal. The rumen is the site of gas production in ruminants. The omasum is a small organ with great absorption capacity. It allows the recycling of water and the recovery of calories from fiber. The abomasum is the fourth stomach. It secretes a strong acid and many digestive enzymes. In non-ruminants, ingested feeds are first digested in the small intestine. The abomasum is absent in camels, llamas and alpacas (pseudoruminants).

ADAPTIONS TO UTILIZE FIBER AND NON-PROTEIN NITROGEN

Plant fiber is used efficiently by ruminants because of the two stages of fiber digestion. The first stage occurs in the reticulum and rumen where the fiber is reduced to smaller particles (cellulose, hemicelluloses, pectins) so that microorganisms (bacteria) can access and break down. The second stage occurs in the small intestine. Simple sugars are absorbed, while cellulose is not. The nitrogen required in the ration of a cow comes from the amino acids found in proteins and other sources of non-protein nitrogen (NPN). Non-protein nitrogen compounds cannot be used by the animal directly. As ruminal microbes grow, they synthesize amino acids, the building blocks of proteins. Bacteria produce amino acids of bacterial proteins that are digested by the animal and used to synthesize milk proteins. The nitrogen required in the ration of a cow comes from the amino acids found in proteins and other sources of non-protein nitrogen (NPN).

THE RUMEN TRACT

The rumen is a large, complex stomach that has several compartments. There are three chambers in the rumen: the reticulum, rumen, and omasum. The reticulum is round (Figure 1) and has a capacity of about 10 liters. The rumen is a long, bag-like organ that is capable of expanding up to 50 liters if rumination is not stimulated (too much fiber). The omasum is a small organ with great absorption capacity. It allows the recycling of water and the recovery of calories from fiber. The reticulum and rumen are connected almost continuously (once every minute). Both empty into the omasum. The omasum is a small organ with great absorption capacity. It allows the recycling of water and the recovery of calories from fiber. The reticulum and rumen are connected almost continuously (once every minute). Both empty into the omasum.

THE DIGESTIVE TRACT AND THEIR FUNCTIONS

1. Reticulum (least part of the stomach) and rumen (reticulo-rumen) - responsible for the first stage of digestion. The reticulum is the first of the stomachs and functions as a sort of sieve in which the saliva of the cow is mixed with the food. The saliva contains enzymes which digest the food and secrete a weak acid. The food is stored in the reticulum for several hours. The rumen (reticulo-rumen) is the largest stomach and functions as a fermenter. The microorganisms (bacteria, protozoa, and fungi) live in the rumen. They secrete enzymes and ferment organic material, producing a number of end-products that can be used by the animal. The rumen is the site of gas production in ruminants. The rumen is the site of gas production in ruminants.

2. Rumen (dominant of the stomach) - responsible for the second stage of digestion. The rumen is the major site of digestion and protein synthesis in ruminants. The.most important rumen products are: volatile fatty acids (VFA) as end-products of fermentation. The VFA are produced primarily by the bacterial fermentation of carbohydrates in the rumen. The VFA cross the rumen wall and become the major sources of energy to the cow. VFA are also produced in the small intestine, but they are absorbed more efficiently in the rumen. The rumen is the site of gas production in ruminants.

3. Omasum (recycling some nutrients) - responsible for the third stage of digestion. The omasum is a small organ with great absorption capacity. It allows the recycling of water and the recovery of calories from fiber. The omasum is the site of absorption of water and feces formation.

4. Abomasum (dominant of the stomach) - responsible for the fourth stage of digestion. The abomasum (true stomach) is a small organ with great absorption capacity. It allows the recycling of water and the recovery of calories from fiber. The abomasum is like the stomach of non-ruminants. It secretes a strong acid and many digestive enzymes. In non-ruminants, ingested feeds are first digested in the small intestine.

SOME DEFINITIONS

Abomasum: the last stomach of ruminants that secretes a strong acid and many digestive enzymes. In non-ruminants, ingested feeds are first digested in the small intestine.

Absorption: the process by which nutrients from food enter the blood stream. Absorption occurs in the small intestine of non-ruminants, but may be used by ruminal bacteria for the synthesis of proteins. The nitrogen required in the ration of a cow comes from the amino acids found in proteins and other sources of non-protein nitrogen (NPN). Non-protein nitrogen compounds cannot be used by the animal directly. The nitrogen required in the ration of a cow comes from the amino acids found in proteins and other sources of non-protein nitrogen (NPN).

Ammonia: a nitrogen-containing compound that is produced by the breakdown of proteins and nucleic acids. Ammonia is converted to urea in the liver and released into the blood stream. Urea is transported to the rumen where it is converted to ammonia and used by ruminal bacteria for the synthesis of proteins.

Digestion: the process by which food is broken down into simpler substances that can be absorbed by the body. Digestion occurs in the reticulum and rumen of ruminants, and in the small intestine of non-ruminants. Digestion occurs in the reticulum and rumen of ruminants, and in the small intestine of non-ruminants. Digestion is the process by which food is broken down into simpler substances that can be absorbed by the body. Digestion occurs in the reticulum and rumen of ruminants, and in the small intestine of non-ruminants.

Fermenation: the process by which microorganisms break down organic material and produce end-products that can be used by the body. Fermentation occurs in the rumen of ruminants, and in the small intestine of non-ruminants.

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