Agricultural Innovation Program (AIP) for Pakistan

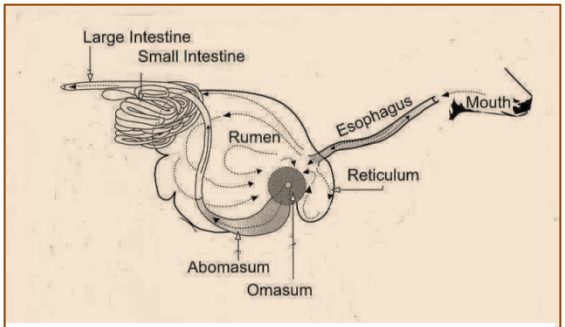
AIP-Livestock: Fact Sheet no: 01

DAIRY EXTENSION MATERIAL

DIGESTION IN THE RUMEN

The Digestive Tract

Cattle belong to the group of animals referred to as ruminants. These animals have a "complex" stomach comprising four different compartments, which enable them to utilize various roughages efficiently and to obtain nutrients from them.



Parts of the digestive tract

The four compartments are rumen, reticulum, omasum and abomasum. The abomasum is the true stomach and is comparable to the "simple" stomach of the non-ruminants. The other three are the "fore" stomachs.

The **reticulum** is a pouch-like structure, and the tissues are arranged in a network resembling a honeycomb. A small fold of tissue lies between the reticulum and the **rumen**, but the two are not actually separate compartments. Collectively they are called the **rumino-reticulum**.

The **omasum** is globe-shaped structure and contains leaves of tissue (like pages in a book). The omasum absorbs water and other substances from digestive contents.

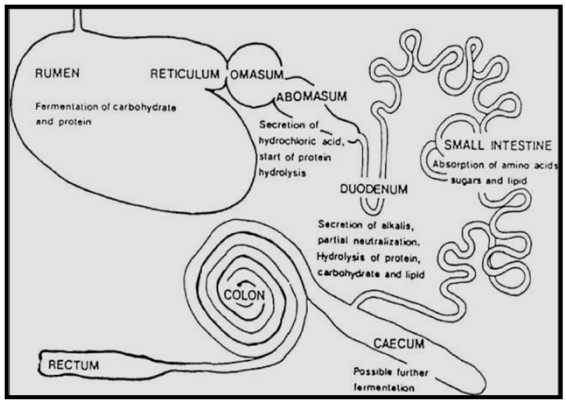
The **abomasum** is the only compartment (also called the true stomach) with a glandular lining. Hydrochloric acid and digestive enzymes, needed for the breakdown of feeds, are secreted into the abomasum. The abomasum is comparable to the stomach of the non-ruminant.

The **small intestine** is about 40 metres long and has three parts, the **duodenum**, **jejunum** and **ileum**. The small intestine receives the secretions of the **pancreas** and the **gallbladder**, which aid digestion. Most of the digestive process is completed here, and many nutrients are absorbed through the villi (small finger-like projections) into the blood and lymphatic systems.

The **caecum** is the large area located at the junction of the small and large intestine, where some previously undigested fibre may be broken down.

The **large intestine** is the last segment of the tract through which undigested feedstuffs pass. Absorption of water is the primary digestive activity occurring in the large intestine.

The Digestion Process



Within the **rumen** are billions of micro-organisms, both bacteria and protozoa. These micro-organisms initiate the process of digestion by:

- converting the carbohydrates (e.g. sugars, starches, cellulose etc.) to volatile fatty acids (VFA);

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- breaking down the proteins into amino acids and even further into ammonia, carbon dioxide and VFA;
- forming new amino acids (including the "essential" amino acids) and more proteins by multiplying themselves.

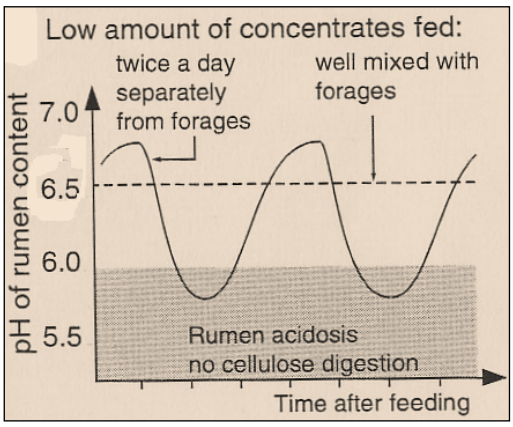
The bodies of the micro-organisms contain proteins; more proteins are formed when they multiply; the proteins are made of amino acids - both essential and non-essential)

The micro-organisms also produce (synthesize) vitamins of the "B" group, which are absorbed and utilized by ruminants)

The most important features of the ruminant digestive process are:

- The ease with which roughages are converted into VFAs, which are then absorbed and utilized by the animals as a source of energy (and production of fat);
- The formation of essential amino acids (or proteins containing them, which are broken down into the respective amino acids in the abomasum) from non-protein nitrogen sources e.g. urea and proteins which do not contain any essential amino acids. The amino acids are subsequently absorbed and utilized to form proteins or as a source of energy.

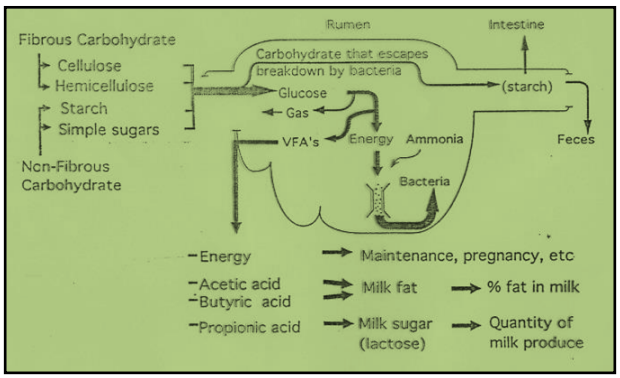
To prevent reduction in intake and digestion of cellulose, rumen pH should not fall below 6 for long periods of time. The problem is less severe at low level of concentrate feeding than at high levels.



Rumen microbes synthesize vitamins of the B complex, vitamin C and K

Energy Metabolism

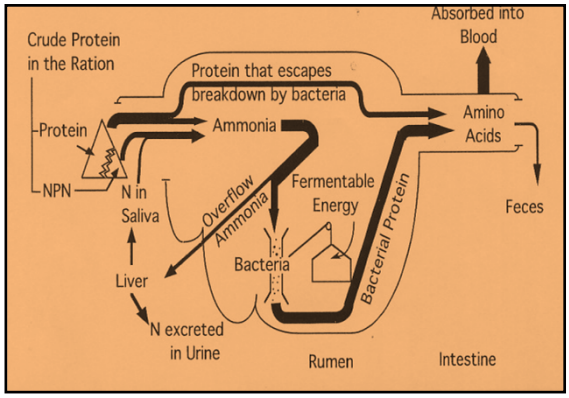
Ruminants derive about 70% of their energy from the VFAs produced in the rumen. VFAs comprise of more than 95% of the acids produced in the rumen. In general, 65% is acetic, 20% propionic and 15% butyric.



Fibrous carbohydrates → Increased acetate → increased milk fat and decreased milk yield.

Non-fibrous carbohydrates → more VFAs → Increased propionate → Increased milk yield (increased glucose synthesis) and decreased milk fat.

Protein metabolism



Proteins are largely broken down in the rumen.

Non-Protein Nitrogen (eg urea in Urea-Molasses Blocks) is degraded into ammonia, which is used by bacteria to produce bacterial protein. This process requires easily available carbohydrates (eg. Molasses in Urea-Molasses Blocks).

Bacterial protein is digested in the intestine.