BABY DOLL NUTRITION NEWS

Nutrition Series Number 1 **Single Issue Price $4.00**

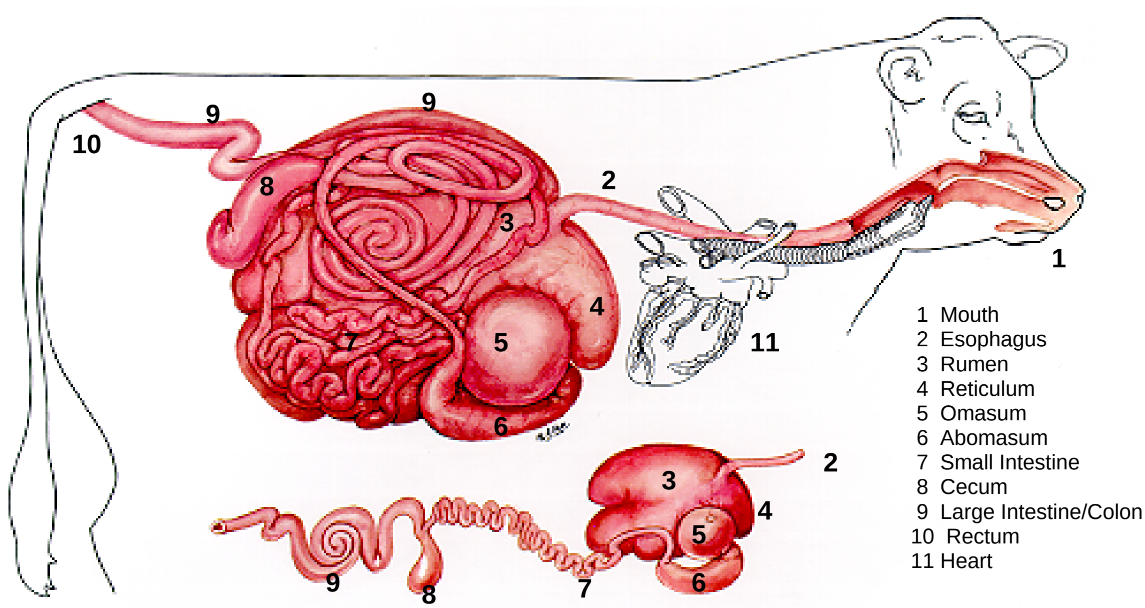
UNDERSTANDING THE RUMINANT DIGESTIVE SYSTEM

Fermentation System on the Hoof

The dynamic and amazing ruminant digestive system provides cattle and other ruminants with some unique advantages. It also provides livestock producers with opportunities for feeding economies. Ruminants can utilize feedstuffs which are otherwise unusable by man and would create disposal problems, were it not for cattle. The unique feature of all true ruminants is a large pre-gastric fermentation in the rumen and reticulum which allows the ruminant to utilize fibrous feeds. Understanding how the ruminant digestive system works helps us develop management and nutritional programs to maximize performance of beef cattle with minimum cost of production.

What is Digestion?

Digestion is the breakdown of feed to its component nutrients, making them small or soluble enough to be absorbed into the bloodstream. Digestion includes mechanical forces such as chewing and muscle contractions that physically break feed into particles, and chemical action such as stomach acid and attack by enzymes that are produced either by the digestive tract or by microorganisms.



The first step in the process of digestion involves the mouth where tremendous amounts of saliva are secreted daily by cattle, depending on quantity and type of diet. Saliva contains water, mucin, protein, salts and bicarbonate to lubricate and begin the breakdown of ingested feed particles. Bicarbonate helps maintain rumen pH in the range of 5.8 - 7.0. Cattle fed diets which are high in roughage produce up to 200 quarts of saliva per day, while cattle fed high concentrate diets may produce only 30-80 quarts.

Do Cattle Have Four Stomachs?

Contrary to popular belief, cattle don't really have four stomachs. They have a series of four compartments: **Rumen, Reticulum, Omasum and Abomasum**. Each compartment has specific functions. The rumen and reticulum are the site of fermentation, while the omasum is thought to masticate feed and absorb water. The abomasum, or "true stomach", initiates protein digestion using hydrochloric acid and enzymes.

From the code of the old west:

Always take a good look at what you're about to eat.
It's not so important to know what it is, but it's critical to know what it was.

BABY DOLL® NUTRITION LTD. • 21 NORMANDY DRIVE • LAKE ST. LOUIS, MO 63367 • PH (314) 625-1884 FAX (314) 625-1747

Rumen Fermentation & Rumination

First, no enzymes or other digestive secretions are produced by the rumen. The warmth, moisture, slightly acidic pH (5.8-7.0) and lack of oxygen inside the rumen are ideal for the growth of bacteria and protozoa, commonly called the "rumen microbes". Feed is fermented by these microbes. The animal uses many of the fermentation by-products, such as volatile fatty acids (VFAs), as sources of nutrients. Other fermentation by-products, such as carbon dioxide and methane, are lost when the cattle eructate (belch).

Ingesta can flow freely between the two compartments of the rumen and reticulum which have a combined capacity of about 33 gallons in a 1250 lb cow. Heavy, dense particles, such as whole corn, sink to the bottom of the rumen. Light, fluffy feeds, such as hay, float on the top of the rumen forming a “mat” or “raft”. Particles which have specific gravity close to 1.0 leave the rumen with the fluid which passes into the omasum. Some rumen microbes attach to particles in the rumen, while others are free in the fluid. There are hundreds of species of microorganisms in the rumen and the species which predominate are dependant on the diet being fed. Starch-digesting microbes predominate when a high-concentrate diet is fed, while cellulytic bacteria predominate when a roughage-based diet is fed. A change in diet disrupts the microbes and it takes 2 - 3 weeks for the microbes to adapt to the new diet.

The ruminant regurgitates and rechews feed for greater physical/mechanical breakdown. This process is called “rumination” or “chewing the cud”. Additional chewing provides more surface area for the microbes to attack, the next time it reaches the rumen.

Results of Rumen Fermentation:

- Digestion of fiber and starch.
- Production, absorption and utilization of volatile fatty acids (VFA's) to satisfy approximately 70% of the animal's energy needs.
- Amino acid degration and nonprotein nitrogen utilization.
- Microbial synthesis of water soluble vitamins.
- Production and loss of rumen gases, primarily carbon dioxide and methane. Large volumes of these gases are produced by microbial metabolism and lost by belching.

Omasum - 5 Gallon Capacity

From the rumen-reticulum, rumen contents flow to the omasum which is thought to aid in reducing the size of food particles that were not completely fermented, and water is absorbed.

Abomasum - 4 Gallon Capacity

The fourth compartment is often referred to as the "true stomach" since its function is similar to non-ruminant animals such as humans, swine, dogs and cats. From this point on, digestion is similar for ruminants and non-ruminants. The abomasum secretes hydrochloric acid (pH 1-3) and pepsin - an enzyme which breaks

Small Intestine - 17 Gallon Capacity

Digesta is now referred to as “chyme”. Bile salts, secreted by the liver, raise pH and emulsify fats in the small intestine. Many enzymes break down proteins, fats, and carbohydrates for absorption. Vitamins and minerals are absorbed here as well. Rumen microbes are digested and absorbed in the abomasum and small intestine along with other feedstuffs.

Large Intestine - 9.2 Gallon Capacity

The large intestine includes the cecum, colon and rectum. An active bacterial fermentation occurs in both the cecum and colon and produces VFAs which are then absorbed. A major function of the colon is reabsorption of water. Remaining undigested feed, microbial cells, secretions and abraded tissue are passed through the rectum and excreted.

Ruminants vs Non-ruminants

Digestion in the ruminant animal is similar to that of most nonruminants, with the exception that feeds are subjected to a pre-gastric fermentation by bacteria and protozoa in the rumen and reticulum. Pre-gastric fermentation gives the ruminant animal the capability of using feedstuffs which nonruminants cannot use, such as forages and nonprotein nitrogen. The ability of the ruminant to utilize forages provides man the opportunity to harvest meat, milk, and fiber from marginal land areas. Energy-dense feeds, such as corn, can be utilized by ruminants when it is economically feasible to feed grains to ruminants. Human food by-products such as food processing wastes, milling by-products, distillery by-products, oil seed by-products, brewing by-products and bakery by-products can be fermented and absorbed as nutrient sources by ruminants.

Pre-ruminants and Ruminants

At birth, ruminants have a digestive system resembling the non-ruminant species. As the neonatal calf nurses the cow, a specialized structure called the “esophageal groove” closes and bypasses the rumen as it directs milk from the esophagus directly into the omasum and abomasum. The calf uses milk more efficiently by digesting it in the abomasm and small intestine. Once the calf begins consuming dry feed, however, bacteria fermentation causes the rumen to grow and develop. It grows in size and the lining develops projections called “papillae” which greatly increase absorptive area.

Getting More From the Rumen Fermentation

Like other fermentation systems, the rumen operates at peak efficiency when frequent, small doses of feed are provided. Big doses can cause acidosis and/ or bloat. Consistency is important to maintaining proper pH and maintaining a healthy rumen. Changes in feed composition should be gradual - preferably 2-3 weeks. Feed should be provided at the same time each day and the amount should be changed in small increments over