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Nutrition and Feeding of the Cow-Calf Herd:
Digestive System of the Cow

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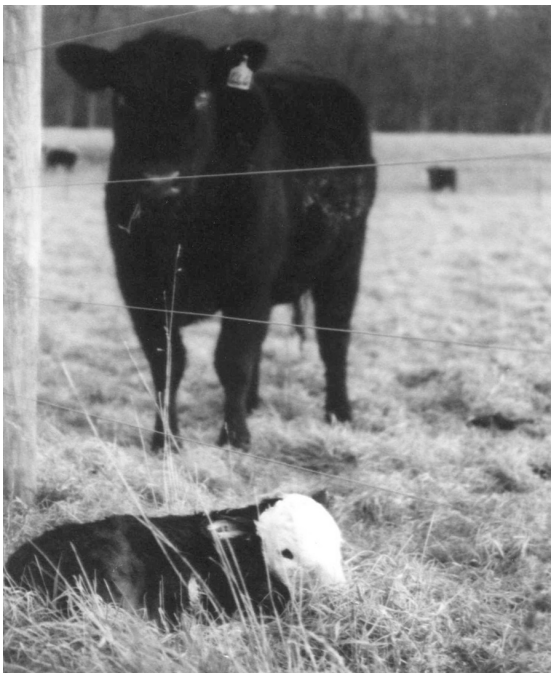
Proper nutrition is the foundation for a productive and profitable cow-calf herd. Without good nutrition, cattle cannot express their full genetic potential nor will they be reproductively efficient. Often low reproductive rates, poor growth, and increased illness are a result of a nutritional imbalance or deficiency rather than a disease or genetics. In addition, pasture and feed represent the single largest cost associated with the cowherd.

Cow-calf producers need to understand basic digestive physiology, types of nutrients, and requirements of the cow in order to be competent on-farm nutritionists. By understanding feeds and ration balancing, producers can meet the nutritional needs of their animals in a more cost efficient manner. In addition, a fundamental understanding of feeds and rations will assist producers in evaluating new products, alternative feeds, and supplements. The Nutrition and Feeding of the Cow-Calf Herd series provides the information necessary to become a better nutritional manager.



Proper nutrition is essential for good reproduction.

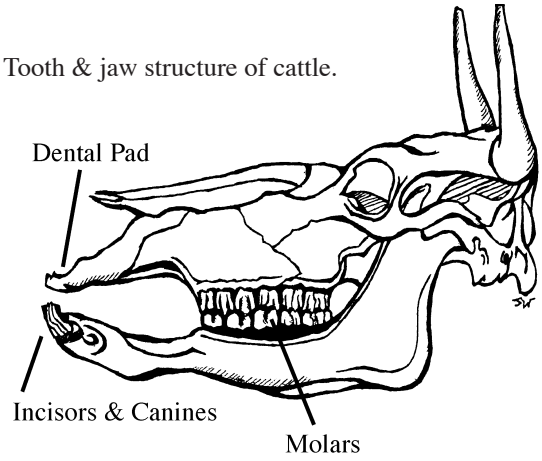
Cattle Have A Unique Digestive System

Mouth and Teeth

Cattle belong to a class of animals known as ruminants. Ruminants are cloven hooved animals that have four compartments to their stomach and chew their cud. In addition, ruminants have an unusual configuration of teeth. Their small and large intestine are designed to handle large volumes of material. Cattle evolved to exist on large amounts of fiber. They do not do well on all grain or high fat diets.

The mouths of cattle are very different from most non-ruminant animals (Figure 1). Cattle have 32 teeth. They have 6 incisors and 2 canines in the front on the bot-

Figure 1. Tooth & jaw structure of cattle.



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tom. The canines are not pointed but look like incisors. There are no incisors on the top; instead cattle have a **dental pad**. Cattle have 6 premolars and 6 molars on both top and bottom jaws for a total of 24 molars. In addition, there is a large gap between the incisors and molars. This configuration allows cattle to harvest and chew a large amount of fibrous feed.

Because their teeth are primarily for grinding, cattle use their tongues to grasp or gather grass and then pinch it off between their incisors and dental pad. Since they lack upper incisors, cattle cannot bite off grass very well, and they are inefficient at grazing closely. The inside of the cheeks and palate are rough which helps hold feed in while cattle chew with a side to side motion.

In addition to reducing the size of feed particles, the mouth aids in digestion by adding saliva to the feed. Cows will produce 20-35 gallons of saliva a day. The saliva helps moisten the feed. Saliva also contains sodium bicarbonate to keep the rumen at the proper neutral pH (6.5-7.2) for good microbial growth. Much of the water contained in saliva is recycled by the cow.

Stomach

The four compartments of the cattle stomach are the rumen, reticulum, omasum, and abomasum (Figure 2). The **rumen** is the largest compartment, and it contains billions of bacteria, protozoa, molds, and yeasts. These microorganisms live in a symbiotic manner with the cow, and they are the reason cattle can eat and digest large amounts of roughage. The rumen microorganisms are adaptable enough that cattle can digest a large variety of feeds from grass, hay, and corn to brewer's grains, corn stalks, silage, and even urea.

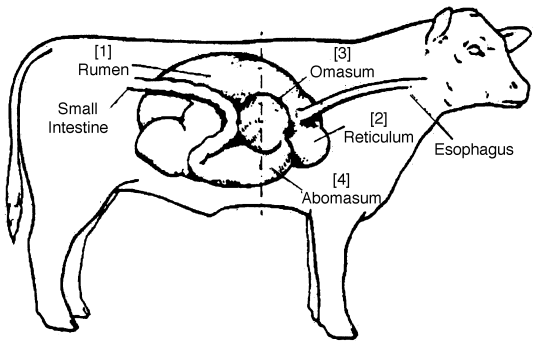

Figure 2. Compartments of the stomach of cattle.

The bacteria and protozoa do most of the digestion of feeds for the cow. This is a tremendous factory. There are 25 to 50 billion bacteria and 200 to 500 thousand protozoa in every milliliter of rumen fluid (about 0.06 ounces). The microorganisms digest the plant fiber and produce volatile fatty acids. These fatty acids are absorbed directly through the rumen wall and supply 60 to 80 % of the energy needed by the cow. In addition to energy, the microorganisms produce protein including essential amino acids from the protein and nitrogen the cow ingests. Because the microbes can use nitrogen to make protein, cows can eat urea and other sources of non-protein nitrogen that would kill non-ruminants. The microbes also make vitamins B and C.

The **reticulum**, with its honeycomb like lining, is a compartment of the stomach that is involved with rumination. It also acts as a trap for foreign objects ingested by the cow. It is not unusual to find rocks, nails, and pieces of wire and metal in the reticulum of cattle. If wire or metal punctures the side of the reticulum, it can cause "hardware disease." Hardware disease is actually an irritation or infection of the diaphragm, heart or lungs. It is hard to treat, but can be prevented by keeping metal trash out of pastures. Specially shaped magnets can be administered to cows to decrease the possibility that ingested metal will pierce the digestive tract. These magnets stay in the reticulum for the life of the animal.

When cattle ruminate, or chew their cud, they are regurgitating a bolus of incompletely chewed feed. In order for the microbes to digest fiber rapidly and efficiently it must be in small pieces, so cattle re-chew their food several times. Cows also eructate or belch giving off carbon dioxide and methane. When cows "lose their cud" or stop ruminating, it is an indication that they have a digestive upset, and their rumen is not functioning properly.

Bloat is another condition that occurs when cows can't eructate. It is caused by a rapid change in feed or overeating grain (gaseous bloat) or grazing pure stands of clover or alfalfa (frothy bloat). Gaseous bloat is a result of improper digestion or fermentation of grain. It is treated by passing a tube into the rumen or using a trocar and cannula to make an external opening in the rumen to release the gas pressure. The procedure may have to be repeated. Frothy bloat is a result of surfactants in legumes causing gas to be trapped in a bubbly foam. Large amounts of mineral oil must be forced into the rumen via a tube to break up the bubbles as a treatment for frothy bloat. Bloat must be treated quickly as

the increased rumen size and pressure interferes with normal breathing.

The incidence of bloat in cattle grazing legumes can be reduced by maintaining at least 50% of the stand as grass. Also, cattle should not be turned out onto a pasture with a high percentage of legumes when cattle are hungry or the pasture is wet. Once cattle are adapted to legume/grass pastures, they can graze it even when wet. A final option is to use "bloat guard" blocks which contain poloxolene.

Although rumen microbes can digest a great variety of different feeds, they are very sensitive to drastic changes in feeds. Some groups of microbes are better at digesting fiber (forages), whereas others are better at digesting starch (grains). Changing rapidly from a forage-based diet to a grain-based diet causes millions of fiber-digesting microbes to die-off as they cannot digest the starch, and there are too few starch-digesting microbes to use the grain so the grain sours in the rumen. As a result, rumen pH decreases, the rumen stops working, and the animal becomes ill. In severe cases, cattle can develop acidosis and founder or die.

The **omasum** is also known as "the book" or many piles because of its many leaf-like folds. It functions as the gateway to the abomasum, filtering large particles back to the reticulorumen and allowing fine particles and fluid to be passed to the abomasum. Though the complete function of this compartment is unknown, it does aid in water resorption and recycling of buffers for the saliva. The omasum may also absorb some volatile fatty acids.

The **abomasum** is also known as the "true stomach." It functions much like the human stomach producing acid and some enzymes to start protein digestion. Animals that go off feed or have acidosis can develop a displaced abomasum or "twisted stomach." The abomasum will actually float out of place and become torsioned stopping the flow of digesta. Surgery is the only cure for a displaced abomasum. Although displaced abomasum is more common in dairy cattle than beef cattle, producers should be aware of the possibility of this problem in cattle that have had severe digestive upsets.

Lower Digestive Tract

The rest of digestion is performed in the **small intestine** and large intestine much as it is in humans and other mammals. Digesta that leaves the rumen and enters the lower digestive tract includes some microbes and undigested fiber, as well as protein and some sugars produced by the microbes. By-pass protein, fat, and carbohydrates also enter the lower digestive tract. By-pass protein, fat, and carbohydrates are nutrients that cannot be digested in the rumen but may be digested in the abomasum and small intestine.

Enzymes to digest proteins, sugars, and starch flow into the small intestine from the pancreas, while the gall bladder produces bile to help digest fats. The small intestine also produces some enzymes to aid in digestion, but its major function is absorption of digested nutrients. Except for the volatile fatty acids, most of the nutrients are absorbed in the small intestine including protein, starch, fats, minerals and vitamins.

Water is primarily absorbed in the **large intestine**. Undigested feed, some excess water, and some metabolic wastes leave the large intestine as fecal material. The consistency of manure is an indicator of animal health and is dependent on water, fiber, and protein content of the feed. For example, cattle on lush spring forage will have profuse watery, greenish colored manure, whereas animals on a hay diet will have firm manure that is dark in color. Animals should produce manure that is indicative of the diet they are receiving. If not, it may indicate a digestive upset or disease. Light colored manure, manure tinged with blood, and watery manure (when on a dry diet) are not normal situations. Manure should not smell putrid or rancid. Producers should recognize changes in manure that indicate problems.

Grazing should provide a majority of nutrients.

Feeding Management

Healthy rumen = healthy cattle

Although proper nutrition and cattle health goes beyond taking care of the rumen microbes, reducing digestive problems and promoting a rumen with a healthy microbe population can prevent many serious problems in cattle. The following are some rules for maintaining rumen health:

- Provide a diet that meets the energy, protein and mineral requirements of the animal.
- Make sure water is clean and available.
- Pay attention to fiber levels in diets; a fiber level between 30% and 70% is preferred.
- Switch from high fiber diets to high grain diets slowly; change should occur gradually over days or weeks.
- Diets should contain 5% or less fat.
- Changing from a high grain diet to a high fiber diet will generally NOT cause digestive upsets, but will reduce performance.
- Do not move hungry or newly received cattle into pastures containing a high percentage (>25%) of legumes.
- Do not introduce cattle to high percentage legume pastures when pastures are wet.
- Supply cattle grazing pasture containing >50% legumes with ionophores or poloxolene.
- Monitor rumination and fecal output to aid in early detection of digestive problems.

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