



## **Legume-Associated Frothy Bloat in Cattle**

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Bloat is defined as a severe enlargement of the abdomen due to an over-accumulation of gasses trapped within the rumenoreticulum. This condition can affect both sheep and cattle, although it is most common in the later. Bloat can be classified based on its etiology as either frothy bloat, or the less frequent free-gas bloat. The most common cause of frothy bloat in cattle is the consumption of bloat-causing legumes (Merck Veterinary Manual, 2006). In order to prevent legume-associated frothy bloat in cattle it is important to understand the main characteristics of the disorder, the causes, treatments and preventative strategies that can be implemented for on-farm use.

In healthy cattle approximately 30 to 50 liters of gas are produced every hour (Bowen, 1996). Gas is produced as a result of microbial fermentation of ingested feeds and it accumulates at the top of the rumen (see figure 1). Animals rid their bodies of this gas through eructation, or belching. Eructation is initiated when receptors in the dorsal sac of the rumen and those in the area surrounding the cardia, the junction between the rumen and the esophagus, are exposed to free gas. The cardia remains tightly closed if exposed to anything other than gas, preventing liquid and particulate matter from entering the lungs. A complex series of rumenoreticular muscle contractions then forces liquid material away from the cardia, creating an empty space for the dorsal sac to push gas forward (Findlay, 1998). Once surrounded by gas the cardia will relax, which triggers the animal to breathe deeply, drawing gas upwards into the esophagus and lungs, ultimately being expelled through the mouth. This sequence of events should occur approximately once every minute if normal fermentation processes are occurring inside of the rumen (Majak et al., 2003).

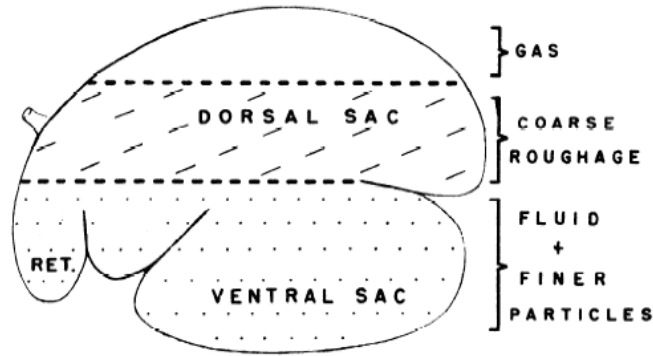


Figure 1: Layers of ingested material inside of the rumen. Figure also shows basic anatomy of the rumenoreticulum, including the dorsal and ventral sacs, and the reticulum (designated “RET”) (Stevens and Sellers, 1960).

In frothy bloat the eructation mechanism fails to occur because gas becomes trapped in small bubbles. These bubbles form a frothy or foamy mass inside the rumen (see picture 1) (Howarth, 1975). Since gas is no longer in the free form, receptors inside the rumen fail to recognize it. Gas now has no means of escaping, which causes the rumen to inflate. The condition can first be spotted as a swelling on the left flank of the animal. Other early symptoms include standing up and lying back down repetitively, kicking at the belly, frequent defecation and urination, grunting, and extension of the neck and head. As bloat severity worsens animals have difficulty breathing because of pressure that is exerted on the diaphragm by the gas-filled rumen. Also, in severe cases rumen contractions can halt completely, and a distinct drum sound can be heard when the rumen is tapped or flicked. This characteristic sound is the reason why bloat is commonly referred to as ruminal tympany (Majak et al., 2003).



Picture 1: Foam production seen in a cow with frothy bloat (Cheng et al., 1998).

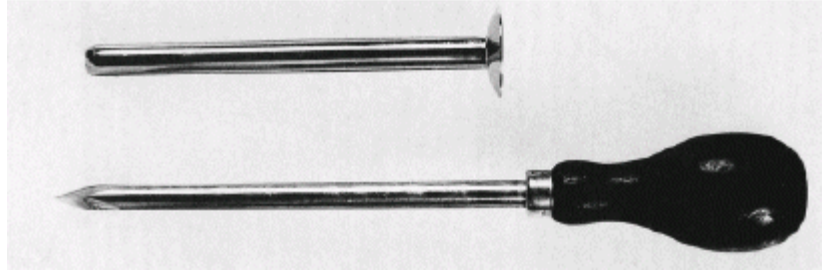
Consumption of legume forages in large quantities is one of the primary causes of frothy bloat; however, not all legumes cause frothy bloat. Legumes can be classified as either bloat-causing, or bloat-safe. Bloat-causing legumes include alfalfa, sweetclover, red clover, ladino clover, white clover, and alsike clover (Merck Veterinary Manual, 2006 and Majak et al., 2003).

Bloat-safe legumes include sainfoin, birdsfoot trefoil, cicer milkvetch, and lespedeza. There are many hypothesized reasons why some legumes cause bloat and others do not. It seems that a combination of factors, both plant, animal and microbial ultimately contribute to the condition (Austin, 1981). First, bloat-safe legumes have thick cell walls which prevents mechanical disruption while animals are chewing. This means that when bloat-safe legumes enter the rumen it will take longer for rumen microorganisms to invade plant tissues, and consequently are they digested very slowly (Howarth, 1979). In contrast, bloat-causing legumes are more vulnerable to being broken down during chewing because of weaker cell walls, allowing rumen microorganisms easier access to cellular constituents. One constituent released upon degradation of the mesophyll cell wall is chlorophyll. It is hypothesized that heightened chlorophyll concentrations within the rumen is the main cause of legume-associated bloat (Majak et al., 1986). Once chloroplasts are released into the rumen they are subject to digestion themselves. Digestion results in disruption of the lamellar membranes of chloroplasts releasing soluble proteins, namely fractions I and II, which are believed to be the major foaming agents in the rumen (Howarth, 1975).

There are also microbial factors which contribute to the stability of foam inside the rumen. In bloated animals it has been noted that rumen bacteria produce an overabundance of mucopolysaccharides that form into a slime in the rumen. This slime increases the viscosity of rumen contents, in addition to stabilizing the gaseous foam (Cheng et al., 1998 and Majak et al., 2003). According to Coulmen et al. (2000) it is the increase in viscosity which leads to formation of gas into the characteristic bubbles.

In addition to mechanical strength of cell walls, bloat-safe legumes have large amounts of condensed tannins which inhibit frothy bloat. Condensed tannins are plant polyphenols capable of binding soluble proteins responsible for foam production. Condensed tannins have also been shown to reduce digestive activity of rumen microorganisms, slowing clearance of feed particles from the rumen. This can be beneficial since rapid passage of legume particles from the rumen has been linked with a higher incidence of bloat; however, tannins are only advantageous to a certain degree. It has been shown that if tannins reach concentrations in excess of 20 to 30 g/kg of DM intake, digestion can be negatively affected (Coulman et al., 2000).

Frothy bloat can often be detected in as little as 30 minutes to 1 hour after animals have grazed on bloat-causing legumes. In order to properly treat animals the severity of the condition has to be accurately assessed. If the condition is severe, pressure inside of the rumen should be alleviated immediately. The easiest way to do this is by puncturing the rumen with a trocar and cannula (see picture 2). First, a small 1 centimeter incision needs to be made in the middle of the left flank of the animal. The trocar, which fits inside the cannula, can then be inserted through the abdominal wall and into the rumen. Once inside the rumen, the trocar can then be removed, leaving the cannula behind. Gas and foam can then escape through the opening in the cannula. If necessary, the cannula can be left in place until the condition has subsided. In cases where the condition is so severe that the animal's life is in immediate danger an emergency rumenectomy can be performed. This procedure is similar to the trocar and cannula method; however a sharp knife is used to cut down to the rumen yielding a larger incision and a more immediate release of pressure and rumen contents (Majak et al., 2003).



Picture 2: Trocar (bottom) and cannula (Majak et al., 2003).

Animals exhibiting less severe symptoms can be treated with less invasive procedures. The most effective way to treat and prevent frothy bloat is to administer an antifoaming agent. Ideally animals should be able to produce enough saliva, a natural antifoaming agent, to keep rumen froth to a minimum; however, decreased salivation is one of the key characteristics of the condition (Howarth, 1975). Producers can choose from a variety of other sources for antifoaming agents, the most common of which are oils, fats, synthetic non-ionic surfactants, and ionophore antibiotics. Depending on the product, treatments can be drenched into the rumen, sprayed onto pasture, added to feed, feed blocks, water troughs, and can also be applied to the flanks of animals. Dosages also vary depending on the product. The recommended dosage for oils and fats is between 60 and 120 ml/head/day. Animal fats, vegetable oil, and mineral oil are all work equally well in the rumen (Austin, 1981). The most common non-ionic surfactant used on the market is poloxalene, with a recommended dosage of approximately 10 to 20 mg/head/day (Merck Veterinary Manual, 2006). Surfactants can be applied in smaller quantities compared to oils and fats, which is an advantage for producers. It is hypothesized that non-ionic surfactants work by reallocating dietary lipids in the rumen, allowing them to become more successful anti-foaming agents (Howarth, 1975).

Ionophore antibiotics, like monensin and lasalocid have both been used for treatment of frothy bloat (Majak et al., 2003). It is thought that these products reduce bloat by inhibiting the growth of bloat-causing microbes, namely Gram-positive *Streptococci* and protozoa, and also possibly by altering ruminal volatile fatty acid (VFA) production (Coulman et al., 2000, and Stanford et al., 2001). They are able to convert acetic acid to propionic acid, thereby reducing the amount of methane and CO<sub>2</sub> gas produced in the rumen (Stanford et al., 2001).

There are many preventative management strategies that can be used on-farm to lessen the incidence of bloat when feeding legume forages. First, the stage of plant growth should be monitored since, the likelihood of bloat decreases with advancing maturity. Plants in the pre-bud stage are the most bloat-prone, so grazing should be kept to a minimum at this time point. One of the most beneficial management strategies is seeding a mixed sward, with at least 50% of the total plant population being grass. Animals grazing a 50:50 ratio of legumes to grass are able to consume equal quantities of both forages, thus preventing bloat; however, this technique assumes that animals are not displaying selective feeding behavior in the field. Other preventative strategies include feeding a course hay prior to grazing bloat-prone legumes, cutting and wilting prior to grazing, and avoiding discontinuous grazing (Coulmen et al., 2000 and Majak et al., 2003).

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