Bloat in Ruminants

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BLOAT, a digestive disorder of ruminants, is the distention of the stomach with gas. The swelling is limited mainly to the first two compartments of the stomach—the rumen (or paunch) and reticulum (or honeycomb).

The occurrence of bloat has increased remarkably since 1930, perhaps a reflection of changes in management and feeding practices, a great increase in acreage of legumes, and other factors.

Bloat is a major disease of cattle and sheep. It is hard to assess the actual numerical or monetary losses for two reasons. Postmortem gaseous distention of the full ruminant stomach usually occurs following death from other causes and sometimes the death may be attributed wrongly to bloat. The most serious loss from bloat to many dairymen and cattlemen is the loss in milk production and the slower gains in weight that usually follow recovery from severe bloat, but such losses are not easily estimated. Nevertheless we have some estimates that in the United States bloat costs dairymen and producers of beef cattle and sheep about 40 to 45 million dollars a year.

One must also take into account the great losses that occur because of sudden changes that have to be made in management practices, such as the abrupt cessation of the pasturing of lush and productive legume pastures after the loss of a few animals.

GENERAL CLASSIFICATIONS of bloat describe it as acute (of short duration) and chronic (of long duration); as mild, moderate, and severe; as frothy or foamy and nonfrothy; and in other ways. Those classifications are inadequate in one way or another. Some animals that never have had serious trouble may suddenly bloat and die. Others may bloat mildly; that is, after no more than a mild distention of the rumen and with no apparent distress or aftereffects, they may bloat severely and die. Some cattle in Mississippi bloated mildly more than 100 times before serious or fatal bloat occurred; they were grazing Ladino clover pastures off and on and showed mild distention of the rumen almost every day.

The classification of bloat into mild, moderate, and severe forms reflects a person's own variable and inexact interpretations. Sometimes an animal may not appear to be greatly distended and yet may actually be close to death. Other animals may seem to be greatly distended but in no particular distress. Body conformation, thickness of the body wall, and muscle tone may have a pronounced influence on the apparent distention of the rumen and even the feel of the distended left side of bloated animals.

We have little data on the actual pressures in the paunches of severely bloated cattle or sheep. Investigators in California devised an instrument that, pressed against the area at the top part of the left flank where the distention is usually most evident, can measure indirectly the pressures in the rumen. Differences in the ways in which the instrument is applied make the data of only relative value.

The most accurate and direct methods of obtaining existing pressures in the paunch available in 1956 were rather hard on the animal and were of practical use on only a few animals for experimental purposes.

Critical pressures vary in different animals of the same breed and species. In man, accurate, indirect methods of measuring blood pressure are in use, but it is impossible to set up definite pressure standards for differentiating between high or low blood pressure and the normal values that can be applied for all individuals.

The classification of bloat into "frothy" and "nonfrothy," or free-gas types, is probably a matter of degree. Some cases may have a large pocket or a number of pockets of gas in various parts of the rumen; in other cases most of the material in the paunch may be a frothy or foamy mass. It is unlikely that there is an absolute absence of free gas (gas pockets) in any case of bloat. The amount of gas so retained may be relatively small, however.

The extent of frothing becomes serious because of its possible effects on eructation, or belching. The rumen gases are formed from bacterial fermentation of food material in the paunch. The retention of the gases largely in millions of small bubbles throughout the feed in the paunch probably would lower the efficiency of the animal's belching mechanism.

Bloat generally is believed to be due to some dysfunction of the eructating mechanism. If the belching mechanism is working normally, the animal can eructate more gas than can be expected to form in the rumen under normal feeding conditions. Because our knowledge of the physiology of normal eructation is incomplete, we can list the causes of bloat only as theories.

Theories for the cause of bloat may be classified in general as physical, biochemical, and hereditary and as connected with soil fertility and the climate.

The physical theories suggest there is too much dense feed, or excessive formation of gas, altered surface tension, or physical deficiency. The biochemical theories have to do with the presence of hydrogen cyanide, flavones, saponins, and allergies.

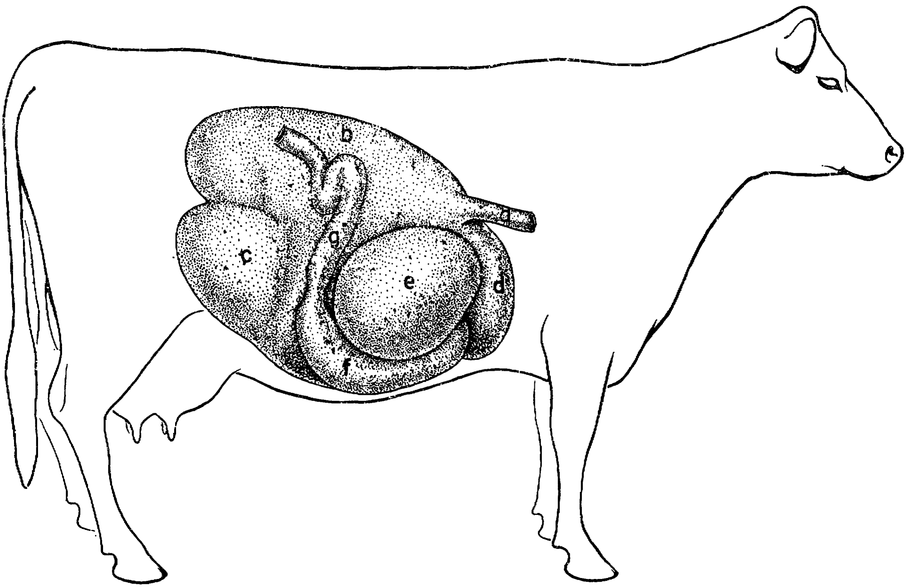
Scientists at Iowa State College noted that alfalfa forms a more compact mass than bluegrass when treated in the same way. They also observed that grazing cows may eat 50 to 100 pounds of succulent feed before resting. This material, remaining in a compact mass, would weight the stomach down and make the cardia (the esophageal opening into the stomach) less capable of opening. The fermenting mass of freshly eaten food would be buoyed up by the gas of fermentation and would also make belching more difficult. As the pressure increases, the tendency for the cardia to be blocked would be still greater.

Excessive gas formation once was a widely accepted theory. It is true that, pound for pound, there may be considerable difference in the rate of gas formation from different feeds. But investigators generally have come to believe that an animal that can belch normally has no difficulty in eructating all the gas formed in its stomach.

The surface tension theory holds that bloat is caused by any material that will alter surface tension so that the gas of fermentation will be entrapped in countless bubbles throughout the feed mass in the rumen.

Saponins—substances found in highest concentrations in some of the legumes—are most apt to cause bloat. Eight saponins have been isolated from alfalfa. We have no good quantitative method for determining the amounts of saponins in various plants. Saponins do have an effect on surface tension, but in this respect the part they have in causing bloat is moot. Either saponins or something else does influence surface tension so that the gas of fermentation does not rise freely to the top of the rumen.

Research in the Animal and Poultry Husbandry Research Branch at Beltsville, Md., the Western Utilization Research Branch at Albany, Calif., and at Cornell University has thrown new light on the saponins. The saponins were found to be extremely toxic. The investigators induced bloating and death by feeding or by injecting relatively large amounts of alfalfa saponins into the blood stream. When the internal organs were examined after death, lesions were found that are not usually seen in animals dying from ordinary bloat. This could be a matter



The approximate position of the stomach of the cow: (a) Esophagus; (b) dorsal sac of rumen; (c) ventral sac of rumen; (d) reticulum; (e) omasum; (f) abdomasum; (g) duodenum.

of dosage or lack of purification of the alfalfa saponin extracts. The findings may eventually be of great importance, but so far they must be regarded as tentative. Alfalfa probably contains no more of the saponins than other legumes. It was the first plant to undergo such extraction. There may be marked differences between what happens to legumes in the extraction processes and the changes that occur in the digestive tract of ruminants.

The amount and kind of saliva may have an influence on surface tension and foam formation. Succulent leafy feed, such as that of legume pastures, stimulates a minimum secretion of saliva. The presence of coarse feed in the rumen reflexly stimulates the salivary glands to increase greatly their output. Copious amounts of saliva apparently prevent the gas of fermentation from accumulating as foam in the food mass, and therefore it rises to the top where it can be easily eructated. Cattle on lush legume pastures spend little time ruminating; it is assumed that most of the total amount of saliva is secreted during rumination.

Research workers at the University of California investigated aspects of physical deficiency and came to the belief that the belching mechanism is stimulated in the same manner as the rumination mechanism—that is, by the scratching of the wall of the rumen and reticulum by coarse material in the feed. Thus they agree with scientists in South Africa that coarse material in the feed has a direct or indirect influence on belching. The two groups of investigators differ as to whether coarse feed stimulates belching by directly stimulating the mechanism or whether the feed affects belching indirectly by stimulating an increased rate of salivary secretion.

Hydrogen cyanide, a highly toxic poison that occurs in certain plants, was thought by some to be a primary cause of bloat. Experimental work has disproved that theory. Experimental feeding of hydrogen cyanide does not inhibit belching, at least when gas is pumped into the rumen of the animals. Some varieties of birdsfoot trefoil may contain 19 times as much cyanide as Ladino clover; trefoil causes little or no bloat, but Ladino clover has probably caused as much bloat as any other legume.

Flavones in legume juice are active substances that have a paralyzing effect on rabbit gut (a smooth muscle similar in structure to the muscle of the rumen wall), according to investigators in England. They theorized that flavones might influence the belching mechanism, but we have no direct evidence. Safe grass juice contains small amounts of flavones.

THE THEORY that an allergy might be responsible for bloat was offered by veterinarians in Ireland, who noted a high incidence of bloat following the second dose of trichomonal antigen, a vaccine. The first, or sensitizing, dose had been received 7 to 10 days previously, about the proper spacing for an allergic response. This is an interesting theory and may eventually open up new fields for the study of allergic reactions originating from the digestive tract. It is, however, no more than a theory.

SOME THEORIES are chiefly biochemical in nature. One is that certain toxins that might inhibit belching are absorbed from the rumen. Another, developed in Germany, is that the high phosphatase content of rumen ingesta and the rich phosphate content of bloat-producing plants are responsible for an increased rate of gas production in the bloating animals.

The theories are interesting to research workers but of little practical value to farmers in 1956, but some of them may eventually prove to be very important in the prevention and treatment of bloat.

Heredity is listed as a possible cause of bloat only on limited experimental evidence. A number of bloating steers were sired by one bull. In a limited number of experiments with identical twins, members of the same set showed a tendency to bloat. The importance of heredity as a factor in bloat cannot be ignored. Even if the tendency is inherited, however, it is unlikely that bloating will occur unless aggravated by other factors.

There is some indication that bloat rarely occurs on certain types of soil. Climatic and weather conditions must be involved also, but until the definite substances are found in plants that are responsible for bloat, little can be definitely said regarding the effect of soil fertility and weather.

HOW DOES BLOAT CAUSE DEATH? We do not know exactly. Some researchers assign a physical basis—that is, the increased pressure in the rumen interferes with blood flow and respiration and the animal actually dies of suffocation. Others think that absorption of certain gases from the rumen and possibly other toxic substances might be responsible. It is possible that increased pressure may increase the rate of absorption of certain substances that ordinarily might be detoxified or excreted as fast as they were absorbed. Investigations at the New York State Veterinary College at Cornell University indicate that the effects of increased pressures in the rumen may be responsible for a complex set of symptoms.

TREATMENT with turpentine and phenol preparations or coal tar derivatives, commonly used in the treatment of bloat, did not reduce the amount of gas formed. The benefits of such treatments were due to their surface tension—defoaming—action. A number of American scientists have reported on methyl silicone, another defoaming agent, as an effective treatment in bloat. Such defoaming agents appear to act by changing the surface tension of liquids. Studies in New Zealand indicated that antifoaming agents never failed to protect animals from bloat and to relieve the bloated ones. This should not be interpreted as meaning that all bloat is due to frothing and that antifoaming agents are the complete solution to the bloat problem.

The New Zealand research workers discovered that paraffin, silicones, peanut oil, soybean oil, and turpentine, all of which are surface-active agents, would successfully relieve and prevent bloat. Here, again, it must be remembered that conditions may be different in different parts of the world and that further experimental work will be necessary under the existing conditions in various parts of this country.

It is doubtful even in "frothy" bloat that defoaming agents would be effective in the critical stages of bloat.

In the acute cases, time is of utmost importance so that an emergency rumenotomy would probably be the only effective method of treatment.

In cases that are not critical, the stomach tube method of relieving gas pressure is always worth a trial. In the "frothy" type, however, it may be disappointing, because it is difficult to locate the possible existing gas pockets before the tube, or trocar, becomes clogged.

Extensive work is being done on more effective and efficient defoaming agents. It will be necessary to study the effect of these agents on the rumen bacteria and protozoa and their direct effect on the treated animals. There is little experimental evidence that physical methods or drugs now in use are effective in stimulating belching. It is difficult to evaluate clinical data, as a high percentage of bloated animals recover without treatment.

PREVENTION OF BLOAT should be the primary aim of investigations. When enough basic knowledge is available as to the cause of bloat, it should be possible through feeding and management practices and animal and plant breeding programs to reduce the incidence greatly. If plants are the primary cause and if their chemical and physical characteristics that cause bloat are known, it may be possible to change those characteristics.

Certain feeding practices may offer considerable relief in areas where bloat is a serious problem. There is some evidence that pure legume pastures are more dangerous than pastures that are 50 percent legume plants or less. Weather and other conditions may make it difficult to maintain such ratios.

Bloat occurs occasionally in the feed lot; with the use of fresh, field-chopped legumes, the number of cases may increase. Some feeders control this type of bloat by mixing coarse, nonlegume feed or straw with the roughage. One large feeder puts a bale of straw to every 3 or 4 bales of alfalfa hay through the chopper (dry hay) and believes that it greatly reduces bloat.

Technicians in California reduced the incidence of bloat by feeding Sudangrass to animals before they were turned on the pastures each day.

Experimental work has started in England on the spraying of harmless defoaming agents on bloat-producing pastures.

Investigators in Wisconsin found some evidence that common household detergents may be effective in preventing bloat.

FEW DEFINITE recommendations can be made other than the use of mixed pastures and the feeding of coarse nonlegume roughages daily before turning on pastures or supplying it to animals on legume pastures. In dry-lot feeding, the inclusion of straw or other nonlegume hay with legume roughage may help to prevent bloat.

Studies of the physical, chemical, and pharmacological characteristics of saponins have been undertaken by scientists of the Department of Agriculture at Beltsville, Md., and Albany, Calif.

The innervation of anatomical structures involved in belching is being studied at the University of Minnesota. Men at the University of Wisconsin began studies of the effect of detergents on foaming and other physical characteristics involved as possible causes of bloat.

The physiology of belching and the place of rumen bacteria in bloat are studied at Cornell University and the University of Maryland.

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Chemical Poisoning

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ARSENIC poisoning in livestock may be caused by arsenic trioxide (white arsenic), paris green, sodium arsenite, and sodium arsenate. Arsenic has been a common cause of accidental and criminal poisoning of animals because it often is used to kill insects, parasites, weeds, and rodents and as a tonic for animals.

Arsenic compounds usually are palatable to animals, especially when they are hungry for salt. Many cattle and sheep have died from eating arsenic-treated plants, grasshopper bait, or discarded arsenic residues. The toxic dose of arsenic depends on the species of animals, the type of arsenical compound, its physical state, and the method of administration.

ARSENIC POISONING may be acute or chronic, depending on the amount consumed.

In acute poisoning, a form frequently encountered, the symptoms may include intense abdominal pain, salivation, a diffuse diarrhea, depression, weakness, incoordination, and posterior paralysis, and a subnormal temperature. These symptoms terminate in convulsions and death within a few hours, or the animals may linger for 3 or 4 days. Some eventually recover.

The chronic form of arsenic poisoning in animals is hard to diagnose because the symptoms may be obscure and much like the symptoms of other diseases. Some of the common symptoms are loss of flesh; a bright-red coloration of the mucous membranes; digestive disturbance, with slight to marked diarrhea, irregular pulse, and depression.

Animals poisoned with arsenic usually have taken such large amounts that treatment is of no value.

FLUORINE is an active chemical element. It is widely distributed in the soil, rocks, water, and plants. It combines with other elements to form fluorides.

The main naturally occurring fluorine compounds, which are used for commercial purposes, are fluorspar, cryolite, and apatite (rock phosphate).

Chronic fluorosis results from the ingestion of small amounts of fluoride for a long time. It occurs in livestock from the use of mineral mixtures containing rock phosphate, water high in fluorine, and from contaminated forage grown near industrial plants that emit fluorides into the atmosphere. It is possible that surface contamination of growing plants with dust from soil high in fluorides may cause chronic fluorosis in animals subsisting entirely on such forage.

All classes of livestock may be affected by excess amounts of fluorides. Considerable variation exists among

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