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6-1944

Bloat in Dairy Cattle

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Olson, T. M., "Bloat in Dairy Cattle" (1944). *Agricultural Experiment Station Circulars*. Paper 49.
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Circular 52
June, 1944

File copy

BLOAT **in** **Dairy Cattle**



South Dakota
Agricultural Experiment Station
South Dakota State College, Brookings

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Bloat in Dairy Cattle

Results of Recent Investigations

By T. M. OLSON, Dairy Husbandman

For many years bloat has been causing death among cattle. This loss of animals has been a severe tax on the livestock industry. Moreover, good pasture has been wasted because farmers feared that their cattle would bloat if they were turned out on legume crops, many of which are well adapted for grazing.

In recent years organized experimental work has been conducted to determine the cause or causes of this trouble and to suggest practices that may prevent bloat.

To date no remedy to prevent bloat under all conditions has been found. Until it is determined, farmers will do well to pasture legumes with caution. The South Dakota Station and several other experiment stations throughout the country are trying to find out what causes bloat and how to prevent it. This circular gives the latest information obtained from experiments with bloat at these stations.

Livestock men have suggested many practices that they claim will prevent or inhibit bloat. These practices seem to work for some farmers. But for others they either fail completely or cannot be depended upon under all conditions. Therefore even when they are used, the risk of pasturing legume crops is as great as ever.

Many of these suggested practices have been tried in recent years under controlled experimental conditions. They have failed. They are, however, good herd-management practices that should be followed.

They are (1) have salt and lime always available in the pasture, (2) feed grain to cows on legume pasture, (3) have dry roughage available in the pasture or yard, (4) have water available for the cows at all times during the day, (5) keep cattle off wet pastures, (6) keep cows on pasture day and night after they have once been started on the pasture.

Although these are good practices, they will not prevent bloat. For instance, giving cows access to salt, lime, water, and roughage, and feeding grain on pasture can be recommended under all pasture conditions but cannot be depended upon to prevent bloat.

If cows can be induced to eat enough dry roughage, they cannot eat as much succulent legumes, and thus the danger of bloat is lessened. But the cows usually will not eat dry roughages if the pasture grasses are palatable.

Perhaps something should be said about medicinal preparations which are sold as preventive remedies for bloat. To date no one has

found anything that will prevent bloat. If salesmen who make these claims would post authentic bonds against loss of livestock from bloat

on legume pastures when their medicinal mixtures are fed, they would have no trouble in selling their product.

What is Bloat?

Bloat is an excessive accumulation of gases and distension of the rumen or paunch. Non-ruminants may also bloat.

All researchers agree that the reason for an excessive accumulation of gases under certain feeding conditions is that the animal cannot belch. The reason why bloated

animals cannot belch is not known (see page 6).

The gases found in bloated animals are also formed in the rumen of normal animals under normal feeding conditions but are either belched or are given off through the excretory organs. If the animal can belch freely, the gas is given off as it forms.

Ruminal Pressures

In experimental trials at the South Dakota Agricultural Experiment Station, a motor-driven compressor pump which developed 75 pounds of pressure was used to insufflate (inflate) the rumen through a stomach tube and also through a canula inserted in the upper posterior part of the rumen.

The trials indicated that insufflated ruminal pressures even higher than the pressure of bloated animals were reduced to normal by one belch. However, when an animal was prevented from belching, the ruminal pressure soon exceeded the limits of the animals endurance.

The ruminal pressures of insuff-

lated animals (both animals which died from bloat and animals that survived) were obtained at this Station (Table 1).

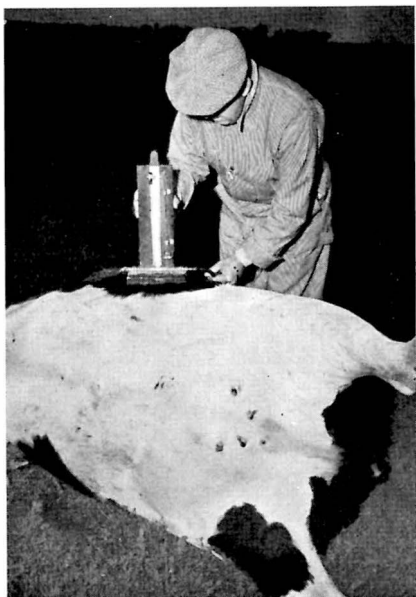
An effort to determine the pressure necessary to rupture the diaphragm was undertaken on one dead cow. A compressor pump was used to insufflate the rumen through the esophagus. A mercury manometer inserted through a horse trocar canula was used to determine the pressure. The thorax was not opened until there was no increased pressure registered on the manometer.

When the pressure attained 140 millimeters of mercury, the air seemed to spread under the skin to

all parts of the body and a lower pressure was registered. The legs, udder, neck, and head rounded out, indicating considerable air between the skin and tissue.

When the thorax was opened, the pressure in the rumen subsided from 140 to 80 millimeters and the abdominal viscera of the inflated animal were forced into the thoracic cavity. The diaphragm was found to be ruptured. It cannot be stated definitely that the diaphragm burst before the thorax was opened.

A second attempt to find what pressure will burst the diaphragm was made with the animal shown below.



Bloated heifer with 125 millimeters of pressure about 3 hours after death



Inflated abdominal viscera and ruptured diaphragm of heifer shown below

This 2-year-old heifer was grazing with the herd of milk cows on an alfalfa pasture. The herd also had access to sudan grass pasture. A light rain was falling the day the heifer bloated. The heifer had been on this same pasture for several months and had access to alfalfa hay in a feed rack in the yard as well as salt, water, and bone meal.

She was found dead at 11 a.m. At 1 p.m. the ruminal pressure was found to be 125 millimeters of mercury. She was still warm and was posted immediately by a practicing veterinarian. The thorax was opened and the diaphragm was found to be torn and separated from the thoracic wall. (See picture above. The attendant is holding the torn diaphragm in his left hand.) When the thorax was opened, the abdominal viscera were forced forward so

TABLE 1. RUMINAL PRESSURES IN CATTLE TESTED

Conditions	Number of cases	Pressures		
		Average	Range	Average (per square inch)
		<i>mm. of mercury</i>	<i>mm. of mercury</i>	<i>lb.</i>
Insufflated animals	16	83	50—120	1.6044
Dead bloated animals*	15	66	40—125	1.2764
Live bloated animals	8	58	50—70	1.0211
Pressures which burst diaphragms of dead animals	2	133	125—140	2.5709

* The dead animals were not tested for several hours after death, so pressures given are higher than they would have been immediately after death. However only one dead animal had a pressure more than 100 millimeters of mercury.

that the diaphragm could not be photographed to show its position even when the thoracic viscera were removed.

Similar trials were performed on sheep anesthetized with nembutal. It was found that when the pressure approached 80 millimeters of mercury, the sheep died very suddenly. On posting, the diaphragm was found to be ruptured, evidently by excessive ruminal pressure.

If the diaphragm were ruptured by ruminal pressure, these trials

seem to corroborate the theory of some workers that the cause of death from bloat may be due to the bursting of the diaphragm or to great enough pressure on the diaphragm to inhibit the normal functioning of the heart and lungs.

However, in these trials the ruminal pressures of all of the animals which died from bloat except one (page 5) were not so high as the maximum insufflated pressures which were necessary to burst the diaphragm (Table 1).

Why Can't Bloated Animals Belch?

Four theories have been expressed by different workers as to the reason for bloat in ruminants. None of these theories have been entirely substantiated by experimental evidence, yet they are all based on research data.

This fact emphasizes the difficulty in determining the cause of

bloat even when the best known techniques are used.

Ingesta Obstruction

As was previously stated, all research workers agree that when an animal cannot belch it bloats very quickly. An obstruction in the esophagus, such as a small potato or

apple, will cause the animal to bloat. When a sheep is placed on its back and the cardiac orifice is closed off by the ingesta, the sheep bloats.

These observations in addition to experimental work on this phase of bloat has lead to the theory that when ruminants eat legumes, the anterior portion of the rumen fills up with a heavy mass of the ingesta and shuts off the opening of the esophagus into the stomach, preventing the animal from belching.

Roughage Needed

A second theory is based on the fact that an animal rarely bloats on dry fibrous hays, such as alfalfa. Carefully controlled experimental work has demonstrated that tickling the anterior portion of the rumen with a wisp of hay induces belching.

Experimental trials have also indicated that if animals can be induced to eat enough coarse roughage before pasturing on legumes, there is less danger from bloat.

Froth and Foam in Rumen

The third theory is that plants on which animals are known to

bloat most frequently contain saponins (carbohydrate compound) that cause froth and foam in the rumen. This froth and foam is a deterrent to belching and thus induces bloat.

Legume Plants

A fourth theory is that legume plants, which most often cause bloat, contain relatively high percents of protein which produce an excess of toxic gases in the rumen. These gases, single or combined, partly paralyze the rumen and so prevent belching.

It has been demonstrated by several workers that the contraction of the rumen is a necessary function to belching. When the animal cannot belch, the pressure is increased and the toxic gases are absorbed into the systemic blood.

It has long been known that small amounts of such gases as carbon monoxide (CO) and hydrogen sulfide (H₂S), both present in ruminal gas, are highly toxic and result in instant death when present in the blood in even low percentages.

Ruminal Gases

Research work at the South Dakota Station has shown that both carbon monoxide and hydrogen sulfide are present in the rumen of

normal animals, and that hydrogen sulfide is greatly increased in bloated animals (Table 2). Similar analyses are available from other

TABLE 2. PERCENT BY VOLUME OF RUMINAL GASES IN NORMAL AND BLOATED COWS

Cows	Number of animals tested	C ₂ H ₆	CO	CH ₄	H ₂ S*	O	N	H ₂
Normal	59	53.73	0.0 to 0.102	29.31	Trace to 0.04	1.80	20.46	0.51
Bloated	23	60.04	0.0 to 0.34	15.25	0.8 to 1.0	3.82	20.09	0.26

* Hydrogen sulfide determined with H₂S detector.

agricultural experiment stations.

The percent of gases except sulfide and methane remain about the same in normal and bloated animals. The assumption therefore is that hydrogen sulfide, a highly toxic gas, paralyzes the rumen and is then absorbed. When a small percent of hydrogen-sulfide gas enters the systemic blood, immediate death results.

Believers in this theory of bloat presume that plants which are known to cause bloat, such as the legumes, produce more hydrogen sulfide than plants which rarely if ever produce bloat.

Legumes are higher in protein than non-legumes. Analyses¹ of legumes at other stations indicate that the protein of legumes is higher in sulfur than the protein of non-legumes. Analyses also indicate that the leaves and finer stems of legumes, the part eaten by grazing cattle, are relatively higher in sulfur than the stems of the same plants. Alfalfa leaves contained more than twice as much sulfur as did the stems.

Tests were made with four cows to find the amount of hydrogen sulfide present under different feeding conditions. Results are shown in Table 3.

The hydrogen-sulfide gas in these cows on dry feed was tested with the hydrogen-sulfide detector. A horse trocar was inserted in the upper, posterior part of the rumen.

These cows were each given 30 pounds of green alfalfa, cut during a light rain and fed immediately. The canula was allowed to remain in the rumen of the cows while they were eating the alfalfa but was closed with a rubber cap. The alfalfa was eaten in about half an hour. Four hours later the rumen gas was again tested for hydrogen sulfide.

The following morning the cows were allowed to graze in an alfalfa field with the capped canula still left in the rumen. It was misting and the alfalfa was quite wet. The cows roamed around considerably and seemed to graze the dandelions and grasses more than

¹ *Detection of Sulfur Deficiency of Soils By Means of Plants*. Reprint of First International Congress of Soil Science (June 13 to 22, 1927). Vol. 3. *North Dakota Bimonthly Bulletin*, Vol. 5, p. 20.

TABLE 3. PERCENTAGE OF HYDROGEN SULFIDE IN RUMINAL GAS UNDER VARIOUS FEEDING CONDITIONS

Number of cow	Percent of hydrogen sulfide* by volume in gas when cows were allowed—		
	dry feed	30 pounds of fresh green alfalfa	grazing on alfalfa starting to blossom†
	<i>perct.</i>	<i>perct.</i>	<i>perct.</i>
17E.....	0.040	0.050	0.005
25E.....	0.005	0.025	0.005
26E.....	0.0015	0.060	0.020
27E.....	0.005	0.030	0.010

* Hydrogen sulfide determined with H₂S detector.

† The cows were allowed to graze until full.

the alfalfa. After 2 hours of grazing, they were taken to the barn and the rumen gas again tested for hydrogen sulfide.

These trials showed a higher percent of hydrogen sulfide when the cows were stable-fed freshly cut green alfalfa than when they were on dry feed or on pasture (Table 3).

The only explanation that is of-

fered for a lower hydrogen-sulfide content in the ruminal gas of cow 17E when the cows were allowed to graze alfalfa as compared to dry feed, is that while grazing the cows ate considerable weeds and non-legumes. They also roamed around a great deal, which may have resulted in the belching of the gases as they were formed.

Hydrogen Sulfide From Fermentation

The fermentation of legumes and non-legumes in an incubator at 37°C. for 24 to 48 hours showed a somewhat higher percent of hydrogen sulfide in the tops and finer parts of the plants than in the stems.

This indicates that the sulfur content of the plant is closely correlated with the hydrogen-sulfide gas produced in the rumen when the plant is eaten. It has been demonstrated by other stations² that

plants vary widely in their sulfur content, depending on the sulfur content of the soil on which the plants are grown.

British workers have found the highest sulfur in young rapidly growing plants. Bloat also occurs most frequently when cattle are grazing on young, rapidly growing plants. After the plants become more mature and fibrous, the danger from bloat is appreciably lessened or entirely absent.

² See footnote on page 8.

Rapidly growing plants are necessarily higher in protein. The increase in protein is found in the growing parts of the plants, which are the leaves and finer stems. Therefore the higher sulfur content prevails in the rapidly growing parts of the plant. When these parts are eaten, the organic sulfur may be converted to hydrogen sulfide.

Bloat Problems

It is difficult to explain why cows can pasture legumes on one farm without any apparent danger from bloat while on an adjoining farm there is considerable difficulty with bloat when legumes are pastured under the same conditions.

Another problem is why legumes can be safely pastured on a certain farm some years but will cause bloat other years.

However, experiments conducted at this station point to answers to both of these questions.

During a period of abnormally low rainfall, milk cows at this station were pastured on both alfalfa and sweet-clover experimental plots for 7 consecutive years without a single case of bloat. But in a period of normal rainfall, cows bloated to the extent that grazing on these same plots had to be discontinued and the plots plowed and reseeded to non-legumes.

That cows bloat some years and not others on the same legume pasture perhaps can be explained by variation in rainfall. With heavier rainfall the plants will grow more rapidly and contain more sulfur.

If hydrogen sulfide is produced in the rumen from the sulfur content of high-protein plants, and if these plants depend upon the sulfur content of the soil, it is possible to explain why cows may bloat on some legume pastures and not on others. They will bloat on plants from soil containing the larger amount of sulfur.

“Boiling” Type of Bloat

In some cases of bloat the fermentation in the rumen is considerably more vigorous than in others. Local veterinarians call this type the “boiling” type of bloat. In these cases a trocar is not adequate to relieve the animal.

An incision in the rumen must be made large enough for the insertion of a hand, and the fermenting ingesta manually removed. Unless this is done there is little chance of saving the life of the animal. This type of bloat is mentioned because it appears to be affected by other causative factors than the more moderate accumulation of gas which prevails in the ordinary type of bloat.

Preventive Measures

Until the cause or causes of bloat have been definitely established and a dependable remedy found that will prevent it under all conditions, livestock farmers will do well to guard their herds against loss by following a few suggestions that will tend to keep it at a minimum.

1. Mix legumes with grasses such as brome, timothy, and red top.
2. Have good grass pastures available to the cows.
3. Pasture sudan grass. It provides excellent grazing for the summer months and will supplement the legume pasture.
4. For early spring grazing, use rye and other cereal grains. They make good supplemental pasture.
5. Feed grain and silage to cows on pasture.

If the cows on pasture can be induced to eat wilted legumes, two other practices would be helpful in preventing bloat. They are cutting several swaths around a legume pasture each day and allowing cut legumes to wilt, and keeping palatable dry roughage in a feed rack in the yard or pasture.