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Bloat – A new approach to an old problem

Ruminal tympany, commonly known as bloat, is a digestive disorder of ruminants that occurs when the gas produced during normal rumination is trapped in the rumen and can not be expelled by belching. Consequently, increased pressure in the rumen can compress the cardiovascular system so that when untreated the condition can be fatal.

Bloat can be caused by lack of ruminal contractions, an obstruction in the oesophagus or the presence of a stable and persistent foam in the rumen. This latter cause is commonly seen in animals grazing specific types of forages and is a source of major financial loss to the livestock industry in many countries. Blowey concisely describes the condition, termed frothy bloat:

‘Normally free gas collects as a single bubble in the upper part of the rumen until it is expelled. However, under certain conditions, as the gas is released from the semi-solid fermenting food in the bottom of the rumen it forms a froth or foam. This foam can be very stable, so much so that the gas it contains cannot be expelled by the normal method of rumen contraction, so although the rumen is contracting and there is no obstruction in the oesophagus, a severe and often fatal bloat develops.’

The foam is caused by a reaction in the rumen involving large quantities of a specific plant protein called leaf fraction 1 protein. This protein occurs naturally in green plants, including forage legumes, clovers and lush leys. Since the concentration of this protein in plant material can vary with stage of growth, bloat may be particularly problematic at certain times of the year. At present, the treatment for frothy bloat involves the prompt administration of oral detergent drenches to disperse the foam and, in severe cases, the use of stomach tubing or canulation to relieve the pressure in the rumen.

It has long been recognised that tympany never occurs with certain bloat-safe fodder legumes, such as sainfoin and birdsfoot trefoil. The constituents in these forages that prevent bloat were identified as condensed tannins. There is still some debate as to why these tannins exist in plants. They may have evolved as a defence mechanism against herbivores or as a reponse to plant stress. The condensed tannins bind with dietary protein to form a stable complex that does not foam in the rumen. The tannin-protein complex is generally stable between pH 5.6 and 7.0, and therefore is stable in the conditions in the rumen (pH 6.5) It is not until the food exits the rumen and is exposed to gastric (pH 2.5-

3.5) and pancreatic (pH 8.0) juices in the lower gastrointestinal tract, that the complex will dissociate and the protein becomes available for metabolism. Research has indicated that low concentrations of tannins can prevent bloat.

However, the use of tannin-containing diets to prevent bloat is not as clear-cut as it may first appear, since there are many other consequences of their inclusion in ruminant diets. This has been the subject of several recent reviews and the main points are outlined below.

Many foods contain condensed tannins, including red wine and tea, but humans and other animals such as rats and deer, produce a specific protein in saliva that binds to condensed tannins and renders them largely ineffectual during the digestive process. These proteins contain a high proportion of proline, which suggests that they evolved to bind dietary tannins in order to preserve other more valuable amino acids. However, sheep and cattle produce little, if any, of this protein and are therefore more susceptible to the effects of tannins in the diet. These effects can be classified as either beneficial or detrimental to ruminant production depending on the quantities and characteristics of the tannins.

Beneficial

Condensed tannins prevent the incidence of bloat by binding the protein responsible for the condition in the rumen.

- When proteins are bound to tannins less protein is degraded and subsequently lost as ammonia from the rumen.
- Since the tannin-protein complex breaks down when the pH changes in the lower gastrointestinal tract, more essential amino acids are available for uptake from the small intestine. This may be of particular importance where the supply of essential amino acids is limiting some aspect of production (e.g. wool production).
- There is also evidence that condensed tannins can increase both the ovulation rate and lambing percentages in sheep. This may be related to a reduced level of ammonia in the blood plasma (since less ammonia formed in the rumen), but further research is necessary to confirm this theory.
- Condensed tannins may confer better tolerance of internal parasite infections in sheep.
- An improved carcass composition in lambs has been attributed to tannins in the diet.

Detrimental

- High concentrations of condensed tannins can decrease feed intake (usually at concentrations in excess of 60g/kg DM), probably through reduced palatability.
- Harmful effects, such as negative protein balance, tend to be associated with some monogastrics and ruminants on sole feeds high in tannins.

- Condensed tannins may also bind to dietary carbohydrates, though to a much lesser extent than that of dietary proteins. This has been shown to reduce the digestibility of the carbohydrate fractions, such as starch and fibre, in the diet.

It has been reported that concentrations of about 20-30 g/kg DM are probably optimal for maximising the nutritive value of forages. Interestingly McMahon et al. (1999) reported that co-feeding sainfoin with fresh alfalfa can markedly reduce the incidence of bloat in ruminants. They found that the incidence of bloat was reduced by 45 to 93% in three out of four years. It would be interesting to investigate if co-feeding sainfoin with clover would also reduce bloat. As an aside, on a recent visit to Zimbabwe a farmer reported that she had been advised to give some local brewers' grain (made from sorghum and contains tannins) to her cattle and has no case of bloat for years.

It is likely that interest in the use of the tannin-containing fodder legumes, such as sainfoin, in ruminant production will increase in the future for three reasons:

- The beneficial effects on ruminant production outlined above,
- The partitioning of nitrogen from urine to faecal N leads to beneficial environmental implications and
- To reduce chemical inputs into livestock systems (e.g. anthelminthic drugs and bloat drenches)

It can be concluded that forages containing low levels of condensed tannins have an important role in the development of strategies to control bloat in ruminant livestock systems. It is also clear that continued developments in plant breeding will be needed to improve the agronomic performance of bloat-safe fodder legumes and to meet future needs of the livestock industry.

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