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RED GUT IN LAMB LUCERNE GRAZING TRIALS AT LINCOLN

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SUMMARY

Red gut is a disease of weaned lambs grazing lucerne characterized by sudden death. Affected animals show intense reddening of the intestines in the region drained by the anterior mesenteric vein and in many cases the intestines are displaced. Healthy lambs grazing lucerne often have displaced intestines. Red gut and visceral displacement do not occur when lambs graze ryegrass pastures.

Epidemiology data from lamb grazing trials showed that early and late weaned animals, lambs vaccinated against clostridial diseases, lambs supplemented with lucerne hay, and whether lambs grazed stands sprayed with paraquat or not were susceptible to red gut. The incidence of the disease was reduced when lambs grazed very weedy stands, when lambs were supplemented with good quality meadow hay, and when lambs were suckled.

Experiments using caecal cannulated and slaughtered lambs showed that the volatile fatty acid content of digesta from the caecum-proximal colon was markedly higher in lucerne-fed lambs compared with those given ryegrass pastures, indicating increased large intestinal fermentation. Such fermentation may predispose lambs to the disease red gut.

INTRODUCTION

A "red gut" syndrome associated with sporadic and sudden deaths of young sheep grazing lucerne has been reported by Gumbrell (1972) and major features of the condition based largely on post-mortem findings have been discussed by Gumbrell and Jagusch (1973) and Gumbrell (1974). The intense red colour of the intestines found on autopsy is due to distension of the blood vessels supplying these organs (hyperaemia).

The present paper discusses the epidemiology of red gut in lamb grazing trials at Lincoln, and gives results obtained from analyses made on the rumen and caecal digesta of slaughtered lambs. Data were also obtained from caecal cannulated sheep.

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EPIDEMIOLOGY OF RED GUT IN LAMB GRAZING TRIALS

The incidence of sudden deaths from red gut in lamb grazing trials at Lincoln during 1971-73 is summarized in Table 1. Most lucerne stands were pure either through spraying with paraquat in August or by good grazing management.

TABLE 1: LAMB LOSSES IN GRAZING TRIALS (1971-73)

<i>Trial Period and Treatment</i>	<i>No. at Risk</i>	<i>Deaths</i>
Spring 1971:		
Suckled lucerne	68	0
Suckled ryegrass	18	0
Weaned lucerne	111	3
Spring 1972:		
Weaned weedy lucerne	51	0
Weaned lucerne	51	3
Weaned lucerne + LH*	49	5
Weaned lucerne + salt	50	0
Weaned weedy clover	147	0
Suckled weedy clover	21	0
Suckled ryegrass	18	0
Spring-summer 1972-3:		
Weaned weedy lucerne	53	1
Weaned lucerne	90	16
Weaned lucerne + LH	49	10
Weaned lucerne + salt	50	5
Spring 1973:		
Weaned weedy lucerne	43	2
Weaned lucerne	44	6
Weaned lucerne + LH	45	4
Weaned lucerne + salt	40	5

* LH = lucerne hay

The results showed that the incidence of red gut was nil or at least markedly reduced when lambs were suckling and when grazing very weedy pastures. The disease has never occurred with lambs weaned on to ryegrass pastures at the College research farm. In these trials losses on the pure lucerne stands, and including lambs supplemented with lucerne hay, ranged from 3 to 20% of the animals at risk.

At autopsy the dominant lesion was the intense reddening of the intestine commencing 100 to 200 cm posterior to the pylorus and continuing through to the terminal colon. The reddened intestines were usually displaced. When viewed from the ventral surface many showed a clockwise torsion of 90 to 270°. Sometimes the displacement was ventral.

Histologically the affected intestine showed marked capillary and venous engorgement, consistent with venous obstruction. The discoloured part of the intestine was the area drained by the anterior mesenteric vein suggesting that this vessel was obstructed by torsion or other means, causing death by shock.

An identical lesion was seen in two live lambs euthanased and autopsied when showing abdominal discomfort, characteristic of severe colic, whilst grazing lucerne in the course of these experiments.

In trials conducted during 1973-75 attempts were made to control the disease by feeding meadow hay and ryegrass straw both in the paddock and also when lambs were run-off every 9 to 16 hours on to ryegrass each day. Lambs were vaccinated against clostridial diseases. The incidence of red gut in these trials is summarized in Table 2. It appeared that meadow hay supplementation controlled the disease in contrast to that of lucerne hay and ryegrass straw. However, lambs ate only the leaves of lucerne and they refused the ryegrass straw completely. On the other hand, the leaf sheath and a significant portion of the stem of the meadow hay was eaten. In all other treatments, deaths from red gut reached epidemic proportions, suckled lambs excepted.

TABLE 2: LAMB LOSSES IN GRAZING TRIALS (1973-75)

<i>Trial Period and Treatment</i>	<i>No. at Risk</i>	<i>Deaths</i>
Summer 1973:		
Weaned lucerne	45	4
Weaned lucerne + salt	45	5
Weaned lucerne + LH (on-off)	92	9
Summer 1974:		
Weaned lucerne	41	5
Weaned lucerne + MH (on-off)	41	0
Autumn 1974:		
Weaned lucerne	46	2
Weaned lucerne + MH	46	0
Weaned lucerne + MH (on-off)	46	0
Spring 1974:		
Weaned lucerne	120	6
Weaned lucerne + RGS	59	6
Spring 1975:		
Suckled ryegrass	136	0
Suckled lucerne	104	0

MH = meadow hay: RGS = ryegrass straw

TRIAL WITH SLAUGHTERED LAMBS

Twenty-six weaned lambs grazing lucerne during the spring/early summer period 1974, when animals were dying of red gut, and 12 lambs from ryegrass pasture were slaughtered directly off feed so that the anatomical positioning of the abdominal viscera, digestive parameters and some blood metabolites could be contrasted according to diet. Blood samples were collected when their throats were cut, then each lamb was splayed, the abdominal cavity opened, and the position of the organs noted and photographed. The gastro-intestinal tract was separated into rumen-reticulum, omasum-abomasum, small intestine, caecum-proximal colon and distal colon. These were weighed full and

TABLE 3: RESULTS FROM THE SLAUGHTER EXPERIMENTS

	<i>Lucerne Grazed</i>	<i>Grass Grazed</i>	<i>Signif.</i>
Body weight (kg)	28.3 ± 1.12	26.9 ± 1.28	ns
Rumen:			
pH	5.9 ± 0.06	6.4 ± 0.10	**
contents (kg)	1.63 ± 0.11	2.30 ± 0.26	*
contents (DM %)	12.1 ± 0.26	10.3 ± 0.45	**
VFAs (mM/100 ml)	19.6 ± 0.53	8.9 ± 0.48	**
ash (%)	12.83 ± 0.15	13.64 ± 0.45	*
nitrogen (%)	6.22 ± 0.16	3.53 ± 0.11	**
pectin (%)	2.09 ± 0.27	0.78 ± 0.11	**
hemicellulose (%)	4.87 ± 0.33	14.94 ± 1.15	**
cellulose (%)	11.07 ± 0.62	19.46 ± 0.73	**
lignin (%)	5.30 ± 0.32	6.29 ± 0.49	ns
Caecum-proximal colon:			
pH	6.5 ± 0.03	6.6 ± 0.06	ns
contents (kg)	0.33 ± 0.02	0.29 ± 0.04	ns
contents (DM %)	11.02 ± 0.62	13.06 ± 0.59	*
VFAs (mM/100 ml)	13.5 ± 0.52	9.7 ± 0.62	**
ash (%)	18.76 ± 0.63	24.92 ± 1.29	**
nitrogen (%)	4.00 ± 0.10	2.67 ± 0.05	**
pectin (%)	1.21 ± 0.06	1.03 ± 0.05	ns
hemicellulose (%)	3.87 ± 0.21	9.02 ± 0.59	**
cellulose (%)	9.19 ± 0.39	11.56 ± 0.84	**
lignin (%)	7.28 ± 0.20	7.94 ± 0.53	ns
Serum sodium (mg/100 ml)	346 ± 4.8	363 ± 4.0	*
potassium (mg/100 ml)	22.9 ± 0.44	23.4 ± 0.80	ns
calcium (mg/10 ml)	11.2 ± 0.13	11.5 ± 0.20	ns
magnesium (mg/100 ml)	2.53 ± 0.06	2.35 ± 0.06	*
phosphorus (mg/100 ml)	7.9 ± 0.32	9.2 ± 0.46	*
urea nitrogen (mg/100 ml)	29.7 ± 3.01	13.00 ± 2.51	**

empty. Samples of the rumen-reticulum and caecum-proximal colon contents were taken, their pH measured, and then frozen for further analysis.

In contrast to the ryegrass-fed lambs, 50% of the lucerne-grazed lambs showed abnormalities in size and/or anterior displacement of the large intestine and in particular the caecum.

Table 3 gives the results for the weight and composition of the rumen and caecum-proximal colon digesta and also some serum metabolites. An analysis of variance showed there were no significant differences in the body weights of the lambs selected for slaughter so differences between treatments were considered due to the type of pasture grazed. There were also no significant differences in the lignin content of either the rumen or caecal digesta. However, ash, N, pectin, hemicellulose, and cellulose differed according to diet. The weight of rumen contents in lucerne-fed animals was less than those given ryegrass and the volatile fatty acid concentration in both the rumen and caecum-proximal colon digesta was very much higher in the former group.

TRIAL WITH CAECAL CANNULATED SHEEP

In September 1974 six yearling ewes were surgically prepared with a perspex cannula placed in the proximal colon. Five of these animals were in suitable condition for sampling during the period December 6, 1974-January 8, 1965. Three were fed on lucerne which had slowly matured over this period, and two were given ryegrass pasture. Animals were sampled daily, but variable amounts of caecal contents were obtained. The results from this trial (Table 4) for the composition and volatile fatty acid concentration of the caecal digesta were similar to those obtained in the slaughter trial (Table 3).

TABLE 4: RESULTS FROM THE CAECAL CANNULATION EXPERIMENT

	<i>Lucerne Grazed</i>	<i>Grass Grazed</i>	<i>Signif.</i>
Dry matter (%)	11.6 \pm 0.19	13.2 \pm 0.32	**
VFAs (mM/100 ml)	11.8 \pm 0.52	7.0 \pm 0.24	**
Ash (%)	21.8 \pm 0.28	29.0 \pm 1.10	**
Nitrogen (%)	3.6 \pm 0.06	2.4 \pm 0.07	**
Pectin (%)	1.18 \pm 0.04	1.41 \pm 0.07	**
Hemicellulose (%)	4.71 \pm 0.19	9.99 \pm 0.53	**
Cellulose (%)	10.48 \pm 0.51	12.78 \pm 0.81	*
Lignin (%)	8.67 \pm 0.46	7.61 \pm 0.23	ns

DISCUSSION

The epidemiology of "red gut" in ten lamb grazing trials at Lincoln College over a five-year period suggests that the risk of disease was diminished when the greater proportion of digestion occurred in proximal regions of the gut. Thus the diet of lambs consuming ryegrass, meadow hay and weeds would be considered more fibrous than the apices and axial leaves selected by lambs grazing lucerne (Jagusch *et al.*, 1970). The fact that lambs refused to eat ryegrass straw and the stems of lucerne hay yet still recorded a high incidence of red gut, whilst suckled lambs, which digest a significant proportion of their total intake in the proximal gut, did not get the disease supports the contention that risk of red gut increases when the digestion shifts more towards the large intestine. In this respect it is interesting to note that the lesion has not been recorded in trials with grain finishing of lambs at Lincoln (Jagusch and Gumbrell — unpublished).

Eleven cases of red gut occurred during the slaughter and caecal cannulation trials showing that the lucerne was in a "dangerous" state. No cases of red gut occurred with lambs fed ryegrass pasture from which slaughtered animals were taken. The results from these trials therefore represent the realistic pathological situation and, since there was no difference in mean body weight between lucerne- and grass-fed lambs, differences in measured parameters were considered to be due to diet.

Volatile fatty acid (VFA) levels in the rumen of the lucerne grazed lambs were similar to those obtained from lambs grazing white clover (Ulyatt, 1969). However, the grass-grazed lambs showed a lower rumen VFA level than the ryegrass-fed lambs of Ulyatt (1969) which might be a reflection of the more mature grass grazed at Lincoln.

Increases in VFA levels in the rumen are an indication of greater VFA production (Leng, 1970). The increased VFA production in the rumens of the lucerne-grazed sheep compared with those on grass reflected the composition of lucerne (Bailey *et al.*, 1971) compared with that of grass (Ulyatt and McRae, 1974) — *i.e.*, lucerne contains less structural carbohydrate, and is thus more readily fermented. This is similar to ruminal fermentation of clover compared with grass (Ulyatt and McRae, 1971). The lower pH of the rumen contents of the lucerne-fed sheep was due to the increased VFA level. Ulyatt (1969) also reported clover had a shorter retention time in the rumen than ryegrass, again because of its higher ratio of readily fermentable

carbohydrate to structural carbohydrate. Lucerne has a similar ratio and would therefore be expected to have a shorter rumen retention time. This, together with the high intake of lambs grazing lucerne and their smaller rumens (McLean *et al.*, 1962), would provide a rapid rate of passage of digesta to the large intestine.

Differences between lucerne- and grass-grazed sheep in dry matter content, ash, nitrogen, pectin, hemicellulose and cellulose levels in both rumen and caecum-proximal colon contents reflect the different composition of lucerne (Bailey *et al.*, 1971) and grass (Ulyatt and McRae, 1974).

The most significant difference between the lucerne and the grass groups in both experiments was the increased VFA levels in the caecum-proximal colon of the lucerne group. Williams (1965) reported a similar difference in animals fed lucerne hay compared with a wheat plus lucerne hay diet. This indicated that there was a greater rate of VFA production in these sheep, and therefore that more substrate must be reaching the caecum-proximal colon, possibly because of the higher rate of passage of the ingesta. As the caecum-proximal colon contents of these sheep have more nitrogen and less cellulose and hemicellulose than the grass-grazed sheep, the fermentation substrate must include increased quantities of non-structural carbohydrates.

The increased size and malposition of the large intestine observed in healthy lambs grazing lucerne is hypothesized as being due to increased large intestinal fermentation.

The role that a larger misplaced large intestine plays in the pathogenesis of red gut is not known. Such a large intestine may be less stable in position and this, combined with the smaller rumen size, may allow more extreme intestinal displacement, such as torsion, to occur. However, not all lambs that die from the disease have such a displacement.

Svendsen (1972) reported that VFA inhibited caecal motility in sheep. This work was part of a study on gastro-intestinal atony in ruminants. It is not possible to compare directly the levels of VFA that he used with the levels measured in this experiment. The smallest amount that he introduced into the caecums of his experimental sheep and obtained inhibition of motility was about one-fifth of those measured in caecum-proximal colon of the lucerne-grazing lambs in this experiment. Thus caecal atony due to high VFA levels in the caecum-proximal colon may be involved in the pathogenesis of red gut.

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