EFFECTS OF PRESLAUGHTER FASTING ON RUMINAL CONTENTS

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INTRODUCTION

The quality of meat can be affected by the preslaughter treatment of the animals from which it is derived. One such important preslaughter factor is the length of time animals are in lairage at a meat works before being processed. In recommending the optimum time of such holding periods there are many considerations. These include factors influencing levels of muscle glycogen, prevention of traumatic injuries, spread of infection, time for adequate ante-mortem inspection, prevention and alleviation of hide or fleece contamination and factors affecting the physical nature and amount of the gastro-intestinal contents which might in turn influence the hygiene quality of the final product.

These considerations can affect the way in which different classes of stock are treated. In many countries pigs are slaughtered as soon as possible in order to avoid problems of glycogen depletion and cross infection. Conversely ruminants are often held in lairage for at least 24 hours because this period will allow adequate time for ante-mortem inspection and washing of dirty stock.

In New Zealand it is mandatory for adult sheep and cattle to be received at the abattoir at least 24 hours before slaughter. Lambs can be received up to midnight on the day before slaughter but the majority would be held in lairage for at least 18 hours. It must be appreciated that more than 10,000 sheep may be slaughtered each day at an average New Zealand abattoir, and in certain areas the fleeces of such animals may contain pumice or other soil dusts which have to be removed by washing. It is also widely believed that a holding period will allow repletion of muscle glycogen and a period without food and water is likely to reduce the volume of the gastro-intestinal contents which will lessen the chance of carcase contamination during subsequent evisceration.

The work reported in this contribution was designed to investigate only one of these factors; the effects of withholding food and water on the nature of ruminal contents of sheep.

MATERIALS AND METHODS

The sheep and lambs studied in this investigation were two separate groups of animals sent to a local abattoir for slaughter from farms within a radius of 40km. The sheep were a single group of 95 Romney ewes discarded as breeding stock and the lambs were an individual group of 96 Romneys approximately six months of age. After arrival at the works the animals were divided into five approximately equal treatment groups as shown below.

Group I	Slaughtered the same day (approximately 6-10 hours without food and water)
Group II	Held for a further 24 hours without food and water
Group III	Held for a further 24 hours without food, with access to water
Group IV	Held for a further 48 hours without food and water
Group V	Held for a further 48 hours without food, with access to water

The sheep were slaughtered and processed in the abattoir at the times indicated. Each carcase was individually identified and final carcase weights recorded. Paunches were opened by a 10-15cm incision in the ventral aspect of the rumen and a smaller one in the reticulum, and the contents were emptied into buckets of known weight. The contents were well mixed and weighed and a 125ml sample taken from at least 10 animals from each group for subsequent estimation of dry matter content.

The nature of the ruminal contents were assessed using the following scoring system adapted from that used by Ross (1934) :-

I	Solid	= moulded to the shape of the rumen
II	Semisolid	= not moulded but not flowing out of the rumen
III	Semifluid	= slowly flowing out of the rumen
IV	Fluid	= freely flowing containing a mixture of finely divided solids
V	Watery	= practically no solid material.

In the laboratory, the samples were transferred to dry 500ml beakers of known weight. The beakers and contents were reweighed and placed in an oven for drying overnight (135^{o}C). After reweighing, the dry matter was calculated and expressed in grams per 100g ruminal contents.

Analysis for significance of difference between mean groups was by the method described by Sokal and Rohlf(1969).

RESULTS

Table 1A and 1B show the mean weights of ruminal contents and carcases of the five groups of sheep and lambs in each experiment. Although there are only minor differences between the mean weights of ruminal contents of different groups, these differences are significant ($P < 0.01$) for both sheep and lambs.

The mean carcase weights of all five groups of adult sheep were similar but in lambs there was a significant ($P < 0.05$) trend towards a decreasing carcase weight with time held before slaughter.

Tables 2A and 2B indicate differences in the physical nature and dry matter content of the ruminal contents in each group of animals. The relationship between these two parameters is shown in Figure 1. It will be noted that there is a good correlation between the subjective assessment of the physical nature of the ruminal contents and the objective dry matter estimations.

Figure 2 summarises the effects of these experiments by showing changes in dry matter of ruminal content in relation to the time the animals were held in yards before slaughter. The fluidity of the ruminal contents of all groups of animals increased in relation to the time they were kept without food before slaughter. All groups showed a highly significant($P < 0.01$) decrease in dry matter content during the first 24 hours without food. This trend continued for the second 24 hours of the experiment but was only statistically significant in the lambs ($P < 0.01$). Although the access to water during the holding period had no detectable effect on the nature or dry matter content of the ruminal contents in lambs, in sheep it had a significant effect ($P < 0.05$) on reducing the dry matter content during the first 24 hours.

DISCUSSION

Abattoirs can provide a valuable and inexpensive source of information on many problems but it is often not feasible to record all the data that is possible in a laboratory investigation. In these studies, it was not possible to record the weights of sheep and lambs on arrival at the abattoir, or to calculate the initial weight of their ruminal contents. Therefore no definite statements can be made concerning the effects of fasting and water deprivation on these two parameters. There is an indication of a slight decrease in the weight of the ruminal contents during this period, but subjective observations suggest that such a decrease would be of little practical importance in relation to subsequent evisceration and dressing procedures. It would also appear that any possible loss of carcase weight during a 48 hour holding period is small and it was only possible to demonstrate a statistically significant effect in lambs.

Previous work on cattle (Reid and Blackmore, unpublished) has shown that decreases in both body weight and weight of ruminal contents, occur when they are held without food for 72 hours. In these experiments two pairs of identical twin Holstein cows were deprived of food for 72 hours, and one of each twin had access to water. Every 12 hours the animals were weighed, and the total contents of their rumens removed via a fistula, weighed and replaced. The surgically induced fistulae had been prepared several years prior to this experiment. The results showed that water consumption had little effect on the weight of ruminal contents but water deprivation increased the loss of body weight.

The objective of the present study was to investigate the effects of fasting and water deprivation on the nature of the ruminal contents of sheep and lambs, and it is believed that the observations recorded are of practical importance. Although only two mobs of animals were studied in detail, further experiments are being carried out on other groups of sheep and lambs held in lairage with and without water for 24 to 48 hours. Initial analysis of data indicates that the results recorded in this contribution are representative of animals held in lairage.

It has been clearly demonstrated that, in both sheep and lambs, holding in lairage without food and water causes a marked increase in the fluidity of the ruminal content. These changes are most rapid in the first 24 hours, and are exacerbated only in adult sheep by making water available. This difference between sheep and lambs is probably due to differences in the amount of water drunk. A subsequent trial showed that during a 24 hour period in lairage, 20 lambs only drank three litres of water or an average of only 150ml per lamb. Such an addition of water to a mean ruminal content of 2.74kg would have an almost undetectable effect on the dry matter content. The adult sheep were discarded breeding ewes which would have previously been in lactation when they would have drunk more water than non-lactating animals. They may have thus continued to drink more than required for their physiological needs. Such learnt behaviour of water consumption above physiological requirements has been observed in cattle (pers. comm. R.E.Munford).

The dry matter estimations were found to be an accurate indicator of the nature of the ruminal contents. This made it possible to use more objective figures which were more appropriate for statistical analysis than the previous scoring system devised by Ross (1934).

During the slaughter process, it is common practice to ligate the oesophagus to prevent reflux of ruminal contents and subsequent contamination of the carcase. When ruminal contents are very fluid, seepage past an oesophageal clip or ligature is more likely to occur, and such a problem was the reason for the present investigation. Although care is taken not to incise the gastro-intestinal tract during evisceration, such accidents inevitably occur. If the contents of the tract, including the rumen, are of a fluid nature there is a much greater chance of gross carcase contamination. It is therefore believed that the increase in fluidity of ruminal contents, which has been demonstrated to occur while sheep and lambs are in lairage, is undesirable in relation to hygienic dressing. However, it is important that all the reasons for holding animals before slaughter, referred to in the introduction of this contribution, are also considered. It would be irresponsible to recommend any major changes before all these factors have been properly investigated and evaluated.

ACKNOWLEDGEMENTS

We wish to thank Dr. C.Reid of the D.S.I.R. Animal Physiology Unit for his cooperation with the studies of cattle. We also wish to acknowledge the cooperation and the enthusiastic support by the staff of Borthwick - CWS Ltd.

REFERENCES

Ross, I.C. (1934) : The Passage of Fluids Through The Ruminant Stomach, II. Aust.Vet.J., 10, 11-23.
Sokal, R.R. and Rohlf, F.J. (1969) : Biometry, The Principles and Practice of Statistics in Biological Research. W.H.Freeman and Co. San Fransisco.

TABLE 1A : WEIGHTS (kg) OF RUMINAL CONTENTS AND CARCASES OF SHEEP

		Slaughtered on day of arrival	In Yards 24 hours		In Yards 48 hours	
			No water	Water available	No water	Water available
Ruminal Content	Mean	4.49	4.03	4.81	4.15	3.79
	Range	1.75-6.08	2.50-5.64	2.47-6.15	1.62-5.99	1.57-6.30
Carcases	Mean	16.48	17.39	18.08	16.76	16.68
	Range	11.5-21.0	11.5-32.5	12.0-29.0	12.5-24.0	13.0-31.0

TABLE 1B : WEIGHTS (kg) OF RUMINAL CONTENTS AND CARCASES OF LAMBS

		Slaughtered on day of arrival	In Yards 24 hours		In Yards 48 hours	
			No water	Water available	No water	Water Available
Ruminal Content	Mean	2.74	2.80	2.50	2.53	2.38
	Range	1.88-3.52	2.10-4.18	1.57-3.40	1.74-3.15	1.74-3.04
Carcases	Mean	16.53	16.53	16.03	15.89	15.55
	Range	13.0-18.5	15.5-21.5	13.5-20.0	12.5-18.5	12.5-20.0

TABLE 2A : PHYSICAL NATURE AND DRY MATTER ESTIMATIONS OF RUMINAL CONTENTS OF SHEEP.

Description of contents	Slaughtered on day of arrival	In Yards 24 hours		In Yards 48 hours	
		No water	Water available	No water	Water available
I Solid	2	1			
II Semisolid	15	4		2	
III Semifluid	3	7	8	6	3
IV Fluid		6	11	7	7
V Watery				4	10
Mean Dry Matter estimation g/100g	10.32	7.73	5.95	6.47	5.10

TABLE 2B : PHYSICAL NATURE AND DRY MATTER ESTIMATION OF RUMINAL CONTENTS OF LAMBS

Description of contents	Slaughtered on day of arrival	In Yards 24 hours		In Yards 48 hours	
		No water	Water available	No water	Water available
I Solid					
II Semisolid	12				
III Semifluid	5	1	1		
IV Fluid	1	12	14		
V Watery		6	5	19	20
Mean Dry Matter estimation g/100g	8.30	3.77	3.73	2.48	2.58

FIGURE 1 : RELATIONSHIP BETWEEN SCORING OF THE NATURE OF RUMINAL CONTENTS AND ESTIMATION OF DRY MATTER

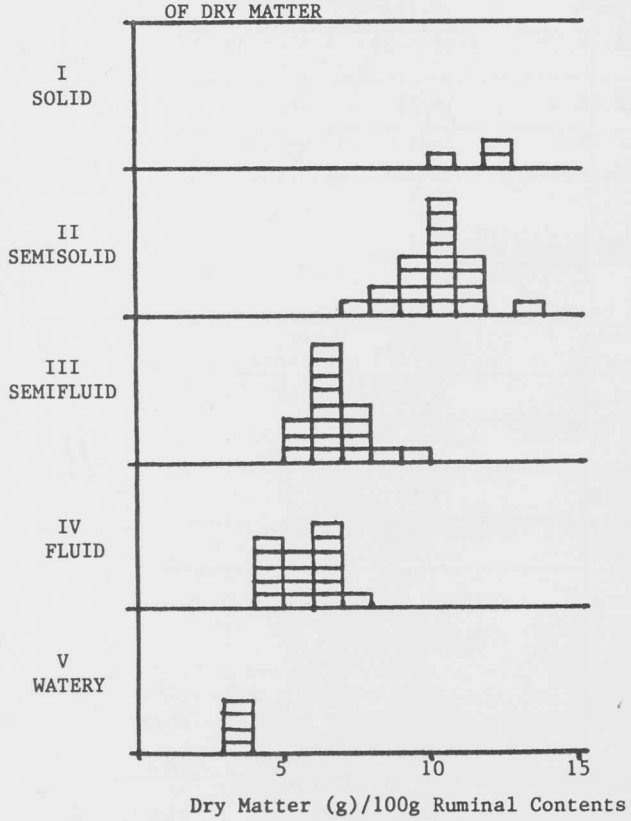

FIGURE 2 : EFFECT OF HOLDING PERIOD AND ACCESS TO WATER ON DRY MATTER OF RUMINAL CONTENTS