BRIEF COMMUNICATION: The effect of fasting on live weight in hogget wethers and pregnant mature ewes.

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INTRODUCTION

Withholding of food and water, or fasting, of sheep for up to 24 hours is a practice commonly employed in the agricultural industry and research sectors. Farmers routinely fast sheep before shearing, pregnancy scanning and transport. Further, with relatively large numbers of animals involved in some experiments, duration of weighing and manipulation time can vary, which may interfere with a comparison of live weight measurements. The determination of the rate of liveweight loss will allow live weights to be corrected to a specific length of fast. Little research has been conducted investigating liveweight loss in mature ewes during fasting over short-term periods up to 24 hours. Research to date has tended to investigate the effects of transport and yarding in young sheep through to slaughter (Kirton *et al.* 1971; Thompson *et al.* 1987). No literature was found on the effect of fasting on pregnant ewes. The aim of the present study was to investigate the effect of fasting on live weights recorded firstly, on mature ewes in mid to late pregnancy and secondly, on hogget wethers.

MATERIAL AND METHODS

Twenty-nine single-bearing and 32 twin-bearing mature ewes at approximately day 70 (D70) of pregnancy on 7 July 2008, were housed indoors for 24 hours, without access to feed or water. The ewes were weighed in groups of approximately 20, in the same sequence, immediately at housing and 0.5, 1, 2, 3, 6, 12, 18 and 24 hours after housing. This procedure was repeated at approximately D130 on 23 August 2008.

Additionally, 37 ten month-old wether hoggets were housed indoors for 24 hours, without access to feed or water on July 2008. The hoggets were weighed in two groups, in the same sequence, at the same intervals as the ewes. The fasting period began at midday on each occasion. The ewes and hoggets were offered *ad libitum* ryegrass / white clover pasture for at least 24 hours before, and after, the fasting periods on each occasion.

A linear model with a third grade Polynomial regression equation, with a random sheep effect was fitted to the liveweight loss data using PROC GLM in SAS (SAS, 2008). For the D70 vs. D130 ewes, litter size, a fixed group effect (D70 vs. D130), and the interactions between the polynomial coefficients and the group effect were also fitted.

RESULTS AND DISCUSSION

Both hoggets and pregnant mature ewes lost live weight over the 24 hour period with the relationship between weight loss and time exhibiting a curvilinear response. Initial live weights at the start of fasting (housing), for the hoggets, and mature ewes at D70 and D130 were 42.5 ± 1.1 kg (mean ± standard error), 64.9 ± 0.8 kg and 63.2 ± 0.8 kg with losses after 24 hours fasting being equal to 15.1, 9.8 and 7.5% of the initial live weight, respectively.

The D70 ewe polynomial equation for liveweight loss over time was

$$Y = 1.0185 - 0.01172\ T + 0.00060\ T^2 - 0.0000113\ T^3\ (R^2 = 0.72)$$

where Y = proportion of full live weight (%) and T = time fasted (hours).

The equation for the D130 ewes was

$$Y = 1.0185 - 0.00651\ T + 0.000250\ T^2 - 0.000004245\ T^3\ (R^2 = 0.72)$$

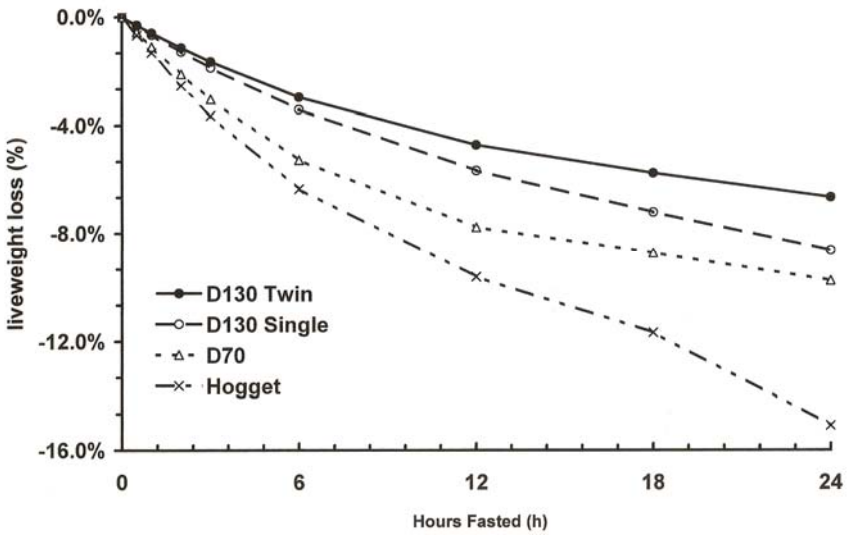
The equation for weight loss over time in 10 month old hoggets was

$$Y = 0.9956 - 0.0137\ T + 0.000727\ T^2 - 0.00001595\ T^3\ (R^2 = 0.94, P < 0.0001)$$

The equations for the mature ewes at D70 and D130 were significantly different ($P < 0.05$). The percentage liveweight losses calculated from the above models for D70 with combined litter sizes, and D130 single-bearing (D130 Single) and twin-bearing (D130 Twin) mature ewes at 0, 0.5, 1, 2, 3, 6, 12, 18 and 24 hours fasting are shown in Figure 1.

No previous studies were found examining the loss of live weight in pregnant ewes during fasting, nor in fact, non-pregnant ewes. That the liveweight loss at D70 of pregnancy was larger than at D130 (9.8 vs. 7.5%) may be due to a smaller uterus volume at D70 of pregnancy compared to D130, resulting in less restriction on the rumen volume, and therefore the clearance of a larger rumen at D70 having a greater effect in overall liveweight loss due to 'gutfill'. Forbes (1969) reported a negative

FIGURE 1: The percentage decrease in live weight post-fasting, of twin- and single-bearing ewes at day 130 (D130) of pregnancy, ewes at day 70 (D70) of pregnancy and 10 month old wether hoggets, as calculated using polynomial equations.



relationship between rumen volume and uterus volume in pregnant ewes slaughtered between D72 and D144 of gestation. At D72 the uterus and rumen volumes were 4.1 ± 0.7 litres and 6.6 ± 0.9 litres respectively, however by D144 they were 7.7 ± 0.4 litres and 3.8 ± 0.4 litres respectively. In contrast, non-pregnant ewes had rumen volumes of 9.2 ± 0.6 litres throughout the same period.

Litter size of the D70 ewes had no significant effect on liveweight loss. However, at D130 there was a time by litter size interaction ($P < 0.0001$).

The polynomial equation for D130 Single ewes was

$$Y = 1.0064 - 0.006887\ T + 0.00025\ T^2 - 0.00000425\ T^3\ (R^2 = 0.82)$$

while for the D130 Twin ewes, it was

$$Y = 1.0064 - 0.00617\ T + 0.00025\ T^2 - 0.00000425\ T^3\ (R^2 = 0.82)$$

indicating that twin-bearing ewes exhibited a lower proportional liveweight change at D130 than single-bearing ewes. Grazul-Bilska *et al.* (2006) found that gravid uterus weight was 24% heavier in twin-bearing ewes vs. single-bearing ewes at D140 of pregnancy, and that the weight of amniotic fluids was 37% heaver. This indicates that the volume of the gravid uterus is significantly greater in twin-bearing ewes and therefore rumen volume and rumen weight is a lesser percentage of total live weight, and thus its clearance would have a lesser effect.

The equation for weight change over time in 10 month old hogget wethers was

$$Y = 0.9956 - 0.0137\ T + 0.000727\ T^2 - 0.00001595\ T^3\ (R^2 = 0.94, P < 0.0001)$$

The equations for hoggets and ewes pregnant at days 70 and 130 were all significantly different ($P < 0.05$). Liveweight losses calculated from the above models are shown in Figure 1.

The hoggets lost 15.1% over 24 hours of food and water deprivation. Knowles *et al.* (1995), Kirton *et al.* (1968) and Thompson *et al.* (1987) found liveweight losses of 8%, 10% and 12% respectively, occurring after 24 hours fasting in lambs. The lower percentage liveweight loss in these earlier studies is likely due to these studies allowing access to water. Hogan *et al.* (2007) reported that wether sheep will excrete 3 to 6 litres of urine per day. This would suggest some liveweight loss due to deprivation of water and therefore non-replacement of excreted urine.

The hoggets lost a higher proportion of live weight after 24 hours than pregnant ewes (Figure 1). This cannot be explained conclusively, as this study was comparing pregnant ewes with non-pregnant hoggets, and concepta weight may have had an influence. However, it is interesting to note that previous work by Weston *et al.* (1989) had found the reticulo-rumen accounting for a higher proportion of live weight in younger animals. They found reticulo-rumen digesta weights of 7,710 g and 7,140 g for 35 kg lambs and 52.7 kg adult ewes (22.0% and 13.5% respectively) grazing *ad libitum* pasture respectively. This suggests that a decrease in rumen volume over 24 hours fasting may lead to a larger proportional live weight loss in hoggets than in mature ewes.

Interestingly in the hoggets, steady weight loss was still occurring at 24 hours, while in the mature ewes the rate of loss appeared to be slowing. Several studies have examined fasting up to and beyond 48 hours in lambs (Kirton *et al.* 1968; Thompson *et al.* 1987), and they found that the decline in live weight flattened out after 24 hours. Kirton *et al.* (1968) found reductions in the weights of stomach and

intestines, and their contents, of 33% and 25% respectively for the first 24 hours, and 6% and 7% respectively during the second 24 hours of fasting. Kirton *et al.* (1968) also found an 11% reduction in liver weight after 24 hours fasting. This suggests that further studies should examine the effects of fasting on metabolic profiles. Additional studies should also consider monitoring animal behaviour, liveweight regain and changes in metabolic profiles in animals returned to herbage to accurately determine short term effects of fasting.

The present study identified weight loss profiles of hoggets and pregnant ewes during a 24 hour fasting and water deprivation. Following validation with unrelated data, these equations could be used to calculate predicted live weight after a fasting period or conversely, non-fasted live weight in a fasted animal. Further studies should validate these equations and consider measuring metabolic profiles in fasted animals to provide information of potential health and welfare considerations of fasting and water deprivation.

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REFERENCES

Forbes, J.M. 1969: The effect of pregnancy and fatness on the volume of rumen contents in the ewe. *Journal of agricultural science, Cambridge* **72**:119-121.

Grazul-Bilska, A.T.; Pant, D.; Luther, J.S.; Borowicz, P.P.; Navanukraw, C.; Caton, J.S.; Ward, M.A.; Redmer, M.A.; Reynolds, L.P. 2006: Pregnancy rates and gravid uterus parameters in single, twin and triplet pregnancies in naturally bred ewes and ewes after transfer of in vitro produced embryos. *Animal reproduction science* **92**: 268-283.

Hogan, J.P.; Petherick, C.; Phillips, C.J.C. 2007: The physiological and metabolic impacts on sheep and cattle of feed and water deprivation before and during transport. *Nutrition research review* **20**: 17-28.

Kirton, A.H.; Quartermain, A.R.; Uijee, A.E.; Carter, W.A.; Pickering, F.S. 1968. Effect of 1 and 2 days' ante-mortem fasting on liveweight and carcass losses in lambs. *New Zealand journal of agricultural research* **11**: 891-902.

Knowles, T.G.; Brown, S.N.; Warriss, P.D.; Phillips, A.J.; Dolan, S.K.; Hunt, P.; Ford, J.E.; Edwards, J.E.; Watkins, P.E. 1995: Effects on sheep of transport by road for up to 24 hours. *Veterinary record* **136**: 431-438.

SAS, 2008: SAS/STAT Software. Release 9.13. SAS Institute, Cary, North Carolina, USA.

Thompson, J.M.; O'Halloran, W.J.; McNeill, D.M.J.; Jackson-Hope, N.J.; May, T.J. 1987: The effect of fasting on liveweight and carcass characteristics in lambs. *Meat science* **20**: 293-309.

Weston, R.H.; Lindsay, J.R.; Peter, D.W.; Buscall, D.J. 1989: Factors limiting the intake of feed by sheep. XIV. Comparisons of voluntary feed consumption and various transactions in the alimentary tract between lambs and sheep fed roughage diets. *Australian journal of agricultural research* **40**: 625-642.