3:15

THE EFFECTS OF SHORT PERIODS OF WATER AND/OR FEED DEPRIVATION, AND REALIMENTATION, ON THE LIPID CONTENT OF THE M.longissimus dorsi AND THE LIVER OF SHEEP.

W.R. SHORTHOSE

CSIRO, Division of Food Research, Meat Research Laboratory, P.O. Box 12, Cannon Hill, Queensland 4170, Australia.

SUMMARY

Sheep deprived of feed for 74 hours before slaughter had greater muscle (M. longissimus dorsi) and liver dry matter and lipid (ether-extract) contents than sheep deprived of feed for 26 hours or those deprived of feed for 46 hours, refed, and slaughtered 26 hours later. The accumulation of lipid in muscle as a result of feed deprivation was unexpected.

INTRODUCTION

Sheep sent to slaughter in Australia may be without feed, and sometimes water, for a period of days. They will invariably be given access to water before slaughter but may not be fed. The influence of feed and water deprivation on liveweight and carcass weight (Callaghan and Thompson, 1940; Kirton et al, 1967) and carbohydrate metabolism (Ford, 1962) have been investigated but there have been few studies on the effects on muscle lipid content. In the study reported here the influence of water and feed deprivation and realimentation on the lipid contents of muscles and liver of mature sheep not transported to slaughter were examined.

MATERIALS AND METHODS

Animals

Sixteen Merino-cross wethers (mean initial liveweight 36.5±(S.E.)0.5 kg) were housed outside, on concrete, in individual pens with water always available for 10 weeks (mean final liveweight 42.9±0.5 kg). They were fed, daily at 0800 hrs, a ration of 50% lucerne chaff and 50% oats, with appropriate mineral additives, at the rate of $80g/kg^{0.7}$ of initial liveweight, throughout this period and feed intakes were recorded daily.

Water and/or feed deprivation and realimentation

After 10 weeks on feed, the animals were divided into four groups, each of four animals, in a random stratified manner such that the mean liveweights of the groups were similar. At random, the groups were assigned to the preslaughter feeding and watering treatments shows in Table 1.

Table 1. Preslaughter feeding and watering regimes

Days		Day 1	Day 2	Day 3	Day 4	Day 5
Group A	Feed	+	+	+	+	-
	Water	+	+	+	+	+
Group B	Feed	+	-	-	-	-
	Water	+	+	+	+	+
Group C	Feed	+	-	-	+	-
	Water	+	-	-	+	+
Group D	Feed	+	-	-	-	-
	Water	+	-	-	+	+

Group A were offered their normal feed, with water available, on days 2, 3, and 4 and were killed on day 5. Group B animals were not fed on days 2, 3 and 4 but had water available and were killed on day 5. Group C animals received no feed and water on days 2 and 3 but were fed and watered on day 4. Group D also received no feed or water on days 2 and 3 and only water on day 4. Groups A and C were last fed 26 h and groups B and D 74 h before slaughter (on day 5) and all groups had access to water in the 24-28 h before slaughter.

Slaughter procedure and sampling

Four animals were killed per day, one from each treatment group. Order of slaughter was in a latin-square design over the four slaughter days. Six animals (four to be slaughtered and two, trained, 'Judas' sheep) were walked into an holding pen at 0800 hours on each slaughter day and slaughter commenced at 0900 hours. Samples of the M.longissimus dorsi (LD) (6.9±0.3 min post-stunning) and liver (33.4±1.0 min post-stunning) were removed for dry matter and ether extract (lipid) determinations.

Analyses

The muscle and liver samples were dissected free of any extraneous fat and analysed for dry matter and ether extract by the A.O.A.C. method.

Table 2. Mean liver weight (as % carcass weight), and mean percentage dry matter (DM) and lipid contents (as % of DM) of the liver and M.longissimus dorsi (LD) of sheep subject to various periods of water and/or feed deprivation, with or without realimentation, before slaughter.

Group	Treatment	Liver Wt (% of carcass weight)	Liver % DM	Liver %lipid	LD %DM	LD %lipid
A	F+W	2.60	32.53[a]	15.9[a]	27.93	17.5
C	NF,NW:F+W	2.88	31.80[a]	22.8[a]	28.48	18.7
	Mean of A + C	2.74	32.19	19.38	28.20	18.08
B	NF,W; W	2.68	36.28[b]	38.0[b]	29.50	23.6
D	NF,NW: W	2.43	36.90[b]	35.0[b]	29.48	23.2
	Mean of B + D	2.56	36.60*	36.50*	29.62*	23.38*

a, b: individual group means with different superscripts differ significantly ($P<0.05$)

*: mean of groups B and D combined differs significantly from that of groups A and C combined ($P<0.05$).

F = feed; W = water; NF = no feed; NW = no water.

RESULTS AND DISCUSSION

Liver weights expressed as a percentage of carcass weights did not differ between groups (Table 2). The mean percentage dry matter and the mean lipid

content of the livers (as a percentage of dry matter) of both the groups fed until the day before slaughter, day 4, (Group A) and the group deprived of feed, but with access to water, and realimented on day 4 (Group C), were significantly greater than those of the groups that were not fed after day 1 (Groups B and D). The extra 48 hours of feed deprivation of groups B and D, relative to groups A and C (which were without feed for 26 h before slaughter), thus resulted in increased liver lipid and dry matter content. This effect was expected as it has been reported previously in healthy ruminants deprived of feed (Ford, 1962; Carr et al., 1973) and in ketotic ruminants (Reid et al., 1979).

The mean dry matter and lipid contents of the LD did not differ significantly between the individual groups. The results for these variables within groups A and C and within Groups B and D were homogeneous and were combined. Analysis showed that groups A and C combined had lesser mean LD dry matter and mean LD lipid content (as percentage of dry matter) than groups B and D combined. The extra 48 hours of feed deprivation increased LD lipid and dry matter contents. Access to water within the period of feed deprivation did not appear to influence this effect. This increase in muscle lipid content with feed deprivation was unexpected and, as far as I am aware, has not been previously reported. Reid et al., (1979) have suggested that the increase in liver lipid content of fasted cows results from both an increased hepatic uptake of circulating free fatty acids and a reduced secretion of triacylglycerol. A similar situation appears to pertain in the muscles of fasted sheep. This is despite the fact that carcass fat content decreases during periods of feed deprivation of similar duration to those in the present study (Kirton et al., 1967). Differences in muscle lipid accumulation could influence the reaction of feed-deprived animals to other preslaughter stresses.

REFERENCES

Callaghan, A.R. and Thompson, D.S. (1940). Journal of the Dept. of Agriculture South Australia 44 : 3-18.

Carr, T.R., Allen, D.M. and Phar, P.A. (1973). J. Anim. Sci. 36 : 923-926.

Ford, E.J.H. (1962). J. Agric. Sci. (Camb.) 59 : 67-75.

Kirton, A.H., Clarke, J.N. and Carter, A.H. (1967). N.Z. J. Agric. Res. 10 : 43-55.

Reid, I.M., Collins, R.A., Baird, G.D., Roberts, C.J. and Symonds, H.W. (1979). J. Agric. Sci. (Camb.). 93 : 253-256.