final report

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Dehydration in lambs at the time of slaughter

Experiment 1

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Contents

1 Aims

The aim of this experiment was to determine if the addition of either salt or betaine to the diet will reduce the loss of water from muscle during a water deprivation period.

2 Methods

Experimental Design

Table 1 Description of the treatments

Treatment	Diet	Water availability during fasting
Control,	Low salt and no betaine	Yes
Low salt no betaine	Low salt and no betaine	No
Salt	High salt	No
Betaine	Betaine	No
Salt plus betaine	High salt and betaine	No

There were 5 treatments (Table 1). Each cell contained 3 sheep and was replicated 8 times (N=120).

Animals

One hundred and twenty Poll Dorset merino cross lambs with a mean liveweight of 45.9±0.170kg (mean±sem) were used for the experiment.

Diet

Prior to the experiment, the lambs were housed in individual pens for approximately 14 days. During this time the lambs were fed a diet in the form of a 9 millimetre diameter pellet, that consisted of steam cut oaten chaff (40%), barley (39.5%), lupins (*Lupinus angustifolius* 15%), extruded canola meal (4%), limestone (0.5%), potassium chloride (0.06%), calcium hydroxide (0.05%), sodium chloride (0.3%), sulphur flake (0.1%) and a commercial mineral vitamin premix (Advanced feeds premix™ 0.6%).
Salt and betaine were added to the diet for each of the appropriate treatment groups for 7 days prior to the commencement of the water deprivation period. Salt was added at the rate 50 g/kg and betaine at the rate of 6.3 g/kg. The pellet was fed at the rate of 1.5 kg/lamb/day.

3 Results

Table 2 Water intake prior to the water deprivation period (litres/lamb/day)

Treatment				P Salt	P Betaine	P interaction
No salt No betaine	No salt Betaine	Salt No Betaine	Salt Betaine			
5.42±0.339[a]	5.72±0.365[a]	8.33±0.696[b]	9.1±0.0.928[b]	<0.001	0.39	0.71

Values within rows with different superscripts a, b are different.

There was a significant effect of salt ($P<0.01$) but not of betaine ($P>0.05$) on water intake (Table 2).

Table 3 The effect of water deprivation on live weight loss during fasting and carcass parameters

Parameter	Treatment		P value
	No water	Water	
LW loss (kg)	4.60±0.419 [a]	2.71±0.289 [b]	0.0005
HCW (kg)	20.93±0.179[a]	21.59±0.222[b]	0.03
GR (mm)	12.35±0.415	12.85±0.717	0.09
Dressing percentage (%)	45.2±0.5[a]	47.1±0.5[b]	0.0051
SM weight (grams)	301±4.5	314±5.6	0.08
ST weight (grams)	105.43±2.1	109.2±1.8	0.17
Weight of water in SM (grams)	227.6±4.4	217.5±3.5	0.07
Weight of water in ST (grams)	79.6±1.4	76.3±1.5	0.11

Values within rows with different superscripts a, b are different.

Water deprivation caused a significant ($P<0.05$) increase in liveweight loss and a significant decrease in hot carcass weight and dressing percentage (Table 3).

Table 4 The effect of salt and betaine on liveweight loss and carcass parameters

Parameter	Treatment				P Salt	P Betaine	P interaction
	No salt, Betaine	No salt, No betaine	Salt, Betaine	Salt, No betaine			
LW loss (kg)	4.58±0.383	4.60±0.419	4.90±0.223	4.98±0.187	0.31	0.14	0.52
HCW (kg)	20.98±0.223	20.93±0.179	21.14±0.160	20.56±0.203	0.87	0.61	0.87
GR (mm)	12.71±0.674	12.15±0.410	13.29±0.491	12.21±0.602	0.56	0.04	0.03
Dressing percentage (%)	45.6±0.6	46±0.4	45.2±0.5	45.5±0.5	0.66	0.86	0.91
SM weight (grams)	302.7±4.13	301.04±4.54	305.94±3.72	305.11±4.82	0.20	0.58	0.29
ST weight (grams)	105.74±1.86	105.43±2.08	107.24±1.69	105.23±2.08	0.82	0.74	0.29
Water in SM (grams)	218.8±3.2	217.5±1.5	219.9±3.0	220.0±3.6	0.55	0.92	0.90
Water in ST (grams)	76.3±1.3	76.3±1.5	77.6±1.2	75.5±1.5	0.84	0.45	0.45

There was no primary effect of either salt or betaine on LW loss, HCW, SM weight, ST weight or dressing percentage (Table 4). However, when liveweight was included in the model there was a significant effect of betaine on GR and a significant interaction (P<0.05) between salt and betaine for GR. When betaine had been included in the diet prior to the period of water deprivation the GR was higher and particularly when salt was also included in the diet.

Table 5 The effects of salt and betaine inclusion on urine specific gravity

Time (hours)	Treatment				Repeated measures statistics		
	No salt, Betaine	No salt, No betaine	Salt, Betaine	Salt, No betaine	P Salt	P Betaine	P interact
0	1.021±0.003[a]	1.025±0.004[a]	1.013±0.002[b]	1.013±0.004[b]			
24	1.046±0.001[a]	1.049±0.002[a]	1.04±0.003[b]	1.043±0.004[b]	0.0017	0.55	0.76
48	1.054±0.001[a]	1.052±0.003[a]	1.050±0.001[b]	1.050±0.002[b]			
P value	<0.001	<0.001	<0.001	<0.001			

Values within rows with different superscripts a, b are different.

There was a significant effect of salt (P<0.01) but no effect of betaine (P>0.05) on urine specific gravity (Table 5, Figure 1). There was a significant effect of high salt inclusion on the fractional excretion rate of sodium (P<0.01) and an interaction between time and the rate of salt inclusion in the diet (Figure 2).

Figure 1 The specific gravity of urine

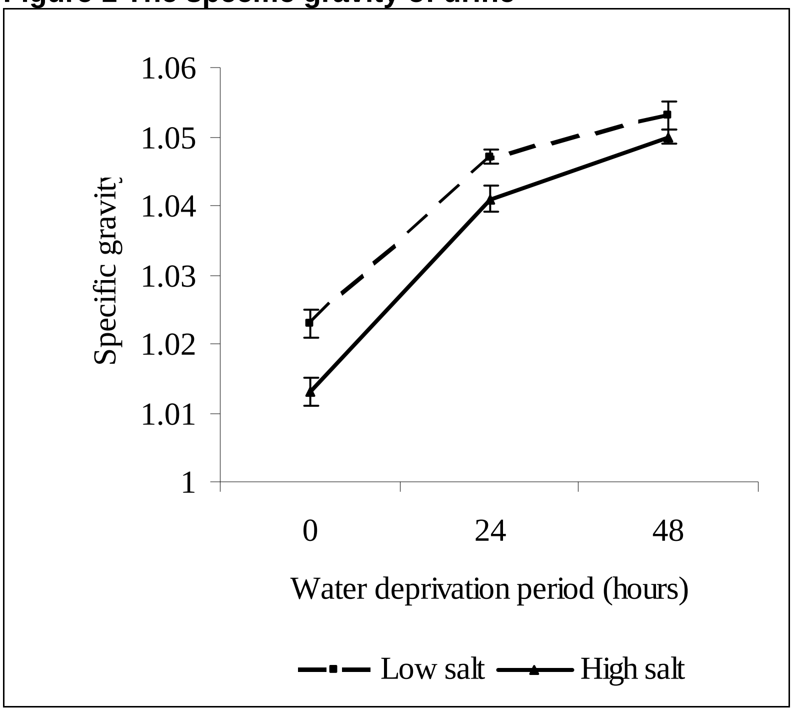
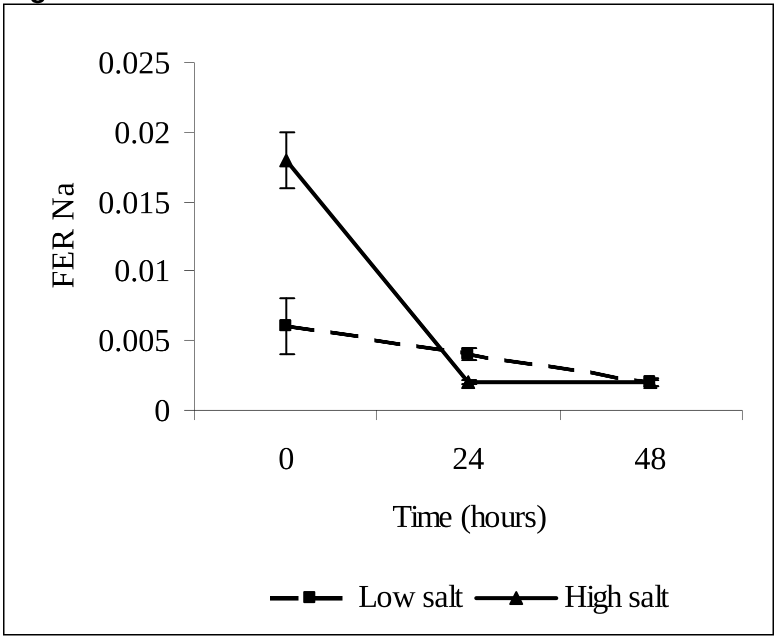


Figure 2 The fractional excretion rate of sodium



4 Discussion

The results confirmed that dehydration at the time of slaughter reduces both the dressing percentage and the carcass weight of lambs (Table 3). Prevention of dehydration at the time of slaughter should therefore result in higher carcass weights.

As was expected, the inclusion of salt in the diet at the rate of 5% significantly ($P<0.01$) increased water intake (Table 2) and this resulted in a reduction in urine specific gravity compared to lambs fed the control diet prior to water deprivation. This and the increase in the fractional excretion rate of sodium (Figure 2) would have allowed the lambs to maintain blood sodium homeostasis whilst ingesting the relatively high levels of salt.

Evidence of these effects of high salt inclusion in the diet on the hydration status of the lambs had disappeared by the end of the 48 hour period of water deprivation. For the lambs fed the high salt diet, the fractional excretion rate of sodium had returned to normal levels 24 hours after the commencement of water deprivation (Figure 2). This may have been the reason for high salt inclusion having neither beneficial nor detrimental effects on the hydration status of lambs after a 48 hour period of water deprivation.

Interestingly the difference in urine specific gravity associated with salt ingestion was still present 24 hours after the commencement of the water deprivation period. Notwithstanding this finding, the urine specific gravity of the lambs fed salt at a high rate rose between 0 and 24 hours, and 97% of the lambs in this treatment had hypersthenuric urine 24 hours after the commencement of water deprivation. Therefore in renal function terms urine specific gravity of lambs fed salt at a high level was similar to that for lambs fed the diet with a normal rate of salt at this time.

In a previous experiment it was found that lambs grazing saltbush produced urine with a lower specific gravity and meat with a lower dry matter concentration than lambs grazing stubble, when slaughtered commercially after a 24 hour transport and lairage period. The results from this current experiment suggest that ingestion of diets containing a high level of salt will not cause lambs to produce urine with a low specific gravity when the lambs have been denied access to water at the time of urine collection. While feeding high levels of salt had no beneficial effect on lamb hydration status after a period of water deprivation, the results of the saltbush experiment suggests that the outcome may be different when lambs have access to water. Further work to investigate this aspect is therefore warranted.

The effect of betaine on water intake (Table 2) was small and not significant ($P>0.05$). The only significant finding for betaine was an increase in tissue depth (GR measurement, Table 4), and this occurred particularly when salt was included in the diet at a high level. This is difficult to explain in the absence of any associated changes in urine, blood or carcass parameters. If betaine was to change cell volume then presumably it would lead to a change in muscle and carcass weight unless tissue density was changed as well.

5 Conclusions

Access to water was the only treatment, of those tested, that influenced the hydration status of lambs at the time of slaughter. Feeding lambs either high levels of salt or betaine on farm prior to consignment is therefore unlikely to prevent dehydration in lambs at slaughter, when the lambs fail or are unable to drink water in lairage prior to slaughter. However further work is warranted to determine if the prior inclusion of salt or betaine in the diet will encourage sheep to drink whilst in lairage.