

THE IMPACT OF SUPPLEMENTAL SALT FORM, DIET, AND FEEDING LOCATION ON SALT INTAKE IN WEANED LAMBS

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Impact Statement

Previous research has reported high variation in intake of self-fed protein and/or energy supplements by livestock, however little is known about variation in consumption of salt. Sheep that are salt deprived will consume less feed and water. However, the overconsumption of salt by sheep can have detrimental effects including reduced feed intake and a decline in body weight. This project investigates the impact of form of salt, location of feeding, and type of feed on salt intake in weaned lambs. The results of this study will aid feed companies in formulating salt, mineral, and feed rations that help meet sheep nutritional requirements.

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SUMMARY

The objective of this study was to determine the effect of finishing diet (alfalfa based vs barley based), feeding location (sheltered confinement vs open stubble ground) and salt form (loose vs block) on salt intake in weaned lambs. No two- or three-way interactions were detected ($P > 0.05$). Therefore results are presented as the main effects of feeding location, diet, and salt form over the two year study period. Sheep housed in pens consumed $0.007 \text{ oz} \cdot \text{lamb}^{-1} \cdot \text{d}^{-1}$ more ($P < 0.01$) salt than sheep fed on wheat stubble fields. In addition, sheep feed loose salt consumed, $0.006 \text{ oz} \cdot \text{lamb}^{-1} \cdot \text{d}^{-1}$ more ($P < 0.01$) salt than sheep offered block salt. The type of diet did not impact ($P = 0.91$) salt consumption.

INTRODUCTION

Previous research has reported high variation in intake of self-fed mineral supplements by sheep (Ragen et al. 2014). However little is known about the differences in the intake of plain salt by sheep. All livestock have an innate attraction to salt and this behavior is used to supplement animals with trace minerals (Burghardi, 1982). Sheep that are salt deprived will consume less feed and water. However, the overconsumption of salt by sheep can result in reduced feed intake and a decline in body weight (Peirce, 1957).

In a review of salt appetite, Denton (1967) noted that all mammals have the

ability to taste salt, and there is a universal liking for it. Burghardi et al. (1982) concluded that the palatability of minerals and the hardness of supplement blocks were among the main factors accounting for differences in the amount consumed by lambs.

Rocks et al. (1982) found that the intake of granulated salt by individual grazing sheep was consistently greater, and appeared more uniform, than the intake of the same material compressed into blocks. The use of loose instead of compressed salt has a substantial advantage in cost per unit. Providing a supplement in block form has the advantages of convenience, much greater resistance to rain and dew, and assured uniformity of any additives in the salt mixture. The control of excessive intakes by the use of blocks may be a significant advantage (Rocks et al., 1982). Hagsten et al. (1975) reported the optimal dietary feeding level of salt for growing lambs to be 0.39% of the ration. However, no research has addressed intake of salt and as impacted by the interaction of form of salt, type of diet, and location of feeding.

PROCEDURES

Sheep Selection and Management. All animal procedures were approved by the Montana State University Agricultural Animal Care and Use Committee (Protocol #2013-AA04). Ninety crossbred lambs (ewes and wethers; Blackface x Western whiteface; 6-mo-old; BW = 76.8 ± 12.7 lb) and 18 Targhee lambs (ewes; 6-mo-old; BW = 85.4 ± 6.9 lb) were used in yr 1 (September

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25 to November 25, 2013) of the study. Targhee ewe lambs were used because of insufficient number of crossbred lambs in yr 1. One hundred and eight crossbred lambs (ewes and wethers; Blackface x Western whiteface; 5-mo-old; BW = 70.0 ± 10.3 lb) were used in yr 2 (September 3 to November 3, 2014) of the study. On d 0 all lambs were placed in a dry lot pen and held off of feed and water overnight. On d 1 lambs were weighed, and paint-branded for identification purposes. Lambs were then stratified by BW and allocated to treatments. Treatments were 1) feed location (confinement pens vs wheat stubble fields) 2) Finishing diet (alfalfa based pelleted diet vs a barley based pelleted diet) and 3) form of salt (loose vs block) (Table 1). Electronic ID tags (Allflex USA, Inc., Dallas-Ft. Worth, TX) were attached to the exterior of the left ear on lambs allocated to confinement pens for the measurement of individual feed and salt intake with the GrowSafe feed intake system (GrowSafe Systems Ltd., Airdrie, AB, Canada). Weaned lambs fed the barley based pelleted diet were stepped up to the high grain ration over a period of 20 days. For lambs fed the finishing diets on wheat stubble fields, diet and salt consumption was measured by the amount offered of each minus amount refused at the end of the study period.

All lambs had ad libitum access to their finishing diet (alfalfa or barley pellets), salt supplement (block or loose), and water. The GrowSafe feed intake system was used in the confinement pens (23 ft × 37 ft). Elevated platforms and false bottoms were constructed to modify GrowSafe beef cattle stanchions and feed bunks (2.6 ft × 3.3 ft), respectively, for sheep. Finishing rations and salt were offered in separate GrowSafe bunks in each confinement pen so that individual feed and salt intake could be recorded for each lamb. Feed allowances were checked and more feed offered daily at 0800 and 1700 h. Daily feed and salt intake was computed using the

Process Intakes and Export Behavior Data routine of the GrowSafe Data Acquisition software.

In the wheat stubble fields (50 ft × 145 ft), pellet feeders, salt feeders and water troughs were placed in the fields and moved twice during the study to allow for more even manure distribution addressed in a companion study. There was one pellet feeder and salt feeder/six lambs. The salt feeders were raised off the ground and protected from rain and wind so the salt was not lost or wasted. The pellet feeders were also raised off the ground and mostly protected from rain and wind; however, in inclement weather some of the pellets in the bunk became wet but were still consumed by the lambs.

Salt. The salt offered in this study was American Stockman brand with a guaranteed analysis of 98.0% to 99.9% Sodium Chloride. For yr 1, salt was weighed on d 0, d 19, d 33, d 46 and d 53. For yr 2, salt was weighed on d 0, d 31, d 45, and d 60. All lambs had access to a salt/mineral mixture prior to the study. At the end of the study, the remaining salt was removed from the feeders, weighed, and salt disappearance was recorded.

Statistical Analyses. All statistical analyses were performed in R statistical software (ver. 2.4; R Development Core Team 2011, Vienna, Austria). All lambs on a particular treatment were housed in one pen but were stratified by BW and randomly assigned to one of the experimental units within the pen. The model included the effect of treatment. The response variable was salt intake. A two-way ANOVA model was originally fit, including a three-way interaction for the location the sheep were housed (pen or field), the form the salt was provided (loose or block), and the type of feed (alfalfa or barley) the sheep were consuming. Also included were all two-way interactions for average feed intake (feed intake by location, feed intake by salt form,

and feed intake by type of feed). The full model was reduced sequentially, where the term with the largest P -value ($P > 0.05$) was removed at each step. This process was continued until all terms had $P < 0.05$. The final model was a two-way additive ANOVA model containing effects for the location the sheep were housed and for the form the salt was offered.

RESULTS AND DISCUSSION

Salt Intake. There were no two- or three-way interactions detected; therefore main effects are presented in Table 2. Sheep housed in pens consumed 88% more ($P < 0.01$) salt on a daily basis than sheep located on fields. In addition, sheep feed loose salt consumed, 76% more ($P < 0.01$) salt per day than sheep offered block salt. The type of finishing diet had no impact on salt intake. Salt intake by lambs in our study ranged from 0.006 to 0.016% of the diet and therefore lambs did not consume recommended levels of salt (Hagsten et al., 1975).

Feed companies may use these results in formulating salt, mineral, and feed rations that help meet nutritional requirements for sheep based on producers' specific enterprises.

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Table 1. Treatment

Location	Feed	Salt Form
Pen	Barley	Loose
Pen	Barley	Block
Pen	Alfalfa	Loose
Pen	Alfalfa	Block
Field	Barley	Loose
Field	Barley	Block
Field	Alfalfa	Loose
Field	Alfalfa	Block

Table 2. Salt intake by weaned lambs¹

Item	Treatment						SE	<i>P</i> -value		
	Location		Feed		Salt Form			Pen vs. Field	ALF vs. BAR	Loose vs. Block
Average Salt Intake, oz•lamb ⁻¹ •d ⁻¹	Pen ²	Field ³	ALF ⁴	BAR ⁵	Loose ⁶	Block ⁷	0.04	< 0.01	0.91	< 0.01

¹No two- or three-way interactions were detected for location, feed or salt form.

²Pen = Sheltered confinement.

³Field = Wheat stubble field.

⁴ALF = pellet containing 71% alfalfa, 18% barley, 5% molasses, 0.013% Bovatec, and 6.1% vitamin/mineral package (no salt).

⁵BAR = pellet containing 60% barley, 26% alfalfa, 4% molasses, 4% bentonite, 2.5% soybean-hi pro, 0.016% Bovatec, and 7.4% vitamin/mineral package (no salt).

⁶Loose = Plain white granulated salt. American Stockman brand with a guaranteed analysis of 98.0% to 99.9% Sodium Chloride.

⁷Block = Plain white 22.7-kg block salt. American Stockman brand with a guaranteed analysis of 98.0% to 99.9% Sodium Chloride.