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Short communication

Individual mineral supplement intake by ewes swath grazing or confinement fed pea-barley forage

Devon L. Ragen[a], Erin E. Nix[a], Rachel L. Endecott[a], Patrick G. Hatfield[a], Mark K. Petersen[b], Janice G.P. Bowman[a,*]

[a] Department of Animal and Range Sciences, Montana State University, Bozeman, MT 59718, United States
[b] USDA-ARS Fort Keogh Livestock and Range Research Laboratory, Miles City, MT 59301, United States

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ABSTRACT

Previous research has reported high variation in intake of self-fed protein and/or energy supplements by individual animals, however little is known about variation in consumption of mineral supplements. Sixty mature range ewes (non-pregnant, non-lactating) were used in a completely randomized design repeated 2 years to determine if feeding method of intercropped field pea (*Pisum sativum* L.) and spring barley (*Hordeum vulgare* L.) forage (swath grazed or fed as hay in confinement) affected individual ewe mineral consumption. Thirty ewes were allocated to 3 confinement pens (10 ewes/pen) and 30 ewes were allocated to 3 grazing plots (10 ewes/plot). Ewes had ad libitum access to feed, water, and a mineral supplement containing 1% titanium dioxide as an external marker. Forage dry matter intake (DMI) was calculated using estimates of fecal output, and in vitro 48-h forage DM digestibility. Ewe supplement intake was determined from fecal and supplement Ti concentrations, and fecal output. Forage and mineral intakes were analyzed using ewe as the experimental unit, and plot or pen as the experimental unit for intake variation. A year×treatment interaction ($P<0.01$) existed for DM forage and mineral intake. Ewes in confinement consumed more forage DM than grazing ewes in 2010, but less than grazing ewes in 2011. Mean mineral intake was highest ($P<0.01$) by grazing ewes in 2011 and 2010 (average 69 g/day), intermediate by confinement ewes in 2010 (57 g/day), and lowest by confinement ewes in 2011 (31 g/day). A year×treatment interaction ($P=0.05$) existed for mineral intake CV which was higher ($P=0.04$) for confinement ewes in 2011 (67 *vs.* 34%), but was not different ($P>0.05$) between treatments in 2010. In this study, variation in individual ewe intake of mineral supplement was large in both grazing ewes and ewes fed hay in confinement.

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1. Introduction

A major limitation to providing appropriate mineral nutrients to sheep is a lack of understanding factors affecting individual animal supplement consumption. Bowman and Sowell (1997) reported that some animals refuse supplements altogether,

Abbreviations: ADF, acid detergent fiber; ADG, average daily gain; BW, body weight; CP, crude protein; CV, coefficient of variation; DM, dry matter; DMI, dry matter intake; DMD, dry matter digestibility; FO, daily fecal output; NDF, neutral detergent fiber.

* Corresponding author. Tel.: +1 406 994 5563; fax: +1 406 994 5589.
E-mail address: jbowman@montana.edu (J.G.P. Bowman).

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while others consume excessive amounts. Deviation from the targeted supplement intake can negatively impact animal production. Interpretation of data from grazing trials with supplementary feeding is difficult due to the lack of information concerning the quantity of supplement consumed by each animal in a group-feeding situation (Nolan et al., 1975). Researchers have looked at individual intake of protein and energy supplements (Curtis et al., 1994), but few studies have evaluated variation in individual consumption of mineral. Lobato and Pearce (1980) reported that confinement of sheep that had not licked molasses-urea blocks under grazing conditions increased the proportion of animals licking the blocks. In a study with cows, Stiles et al. (1967) obtained higher consumption of molasses-salt blocks when the animals were confined compared with free grazing. The objective of this study was to determine if feeding method of pea–barley forage (swath grazing or hay fed in confinement) affected individual ewe mineral consumption.

2. Materials and methods

2.1. Experimental design

All animal procedures were approved by the Montana State University Agricultural Animal Care and Use Committee (Protocol #2009-AA04). The study was conducted at the Montana State University's Fort Ellis Research Station in Bozeman, MT during fall 2010 and fall 2011. The experiment was a completely randomized design testing the effects of treatment (swath grazing pea-barley forage *vs.* pea–barley hay fed in confinement), year (2010 *vs.* 2011), and the treatment×year interaction.

2.2. Experimental protocol

Sixty mature western whiteface range ewes were selected from the Bair Ranch in Martinsdale, MT to be used in 2010. The ewes (65.4 ± 5.84 kg body weight; BW) were non-pregnant, and non-lactating. For the second year, 60 mature western whiteface range ewes (61.9 ± 6.28 kg BW, non-pregnant, non-lactating) were selected from the Red Bluff Research Ranch near Norris, MT. Previously, ewes from the Bair Ranch only had access to a mineral supplement 2 weeks prior to breeding and during the lambing season. Ewes from Red Bluff Research Ranch had ad libitum access to a salt/mineral mixture prior to the study.

The same feeding and sampling protocol was used in 2010 and 2011. Each year upon arrival, 30 ewes were assigned to the swath grazing treatment and 30 ewes were assigned to the confinement feeding treatment. The swath grazing treatment consisted of 3 pastures (10 ewes/pasture) where pea–barley forage had been mechanically swathed and left in the field. Each pasture was 91 m × 15 m, and was divided into 2 equal sections each measuring 0.07 ha. The confinement feeding treatment consisted of 3 pens (10 ewes/pen) where pea-barley hay (harvested from the same field where the swath grazing pastures were located) was fed. Each pen measured 465 m^2. The experiment consisted of 7 days for diet adaptation, followed by 7 days of data collection. Ewes were restricted to grazing one half of the swathed pastures during the adaptation period, and the other half was grazed during the collection period. Ewes in the confinement feeding treatment were fed their respective hay during both the adaptation and collection periods.

Throughout the experiment, ewes had ad libitum access to forage, water, and a commercial mineral supplement (Payback – Sheep Range Mineral 16-8, Cenex Harvest States, Inc., Great Falls, MT; Content: min. 120 g/kg Ca from $CaCO_3$, max. 140 g/kg Ca, 120 g/kg P from $CaHPO_4$, min 110 g/kg salt, max. 125 g/kg salt, 30 g/kg Mg from MgO, 4 mg/kg Co from $CoCO_3$, 7 mg/kg Cu from $CuSO_4$, 100 mg/kg I from $C_2H_{10}I_2N_2$, 1.8 g/kg Mn from $MnSO_4$, 19 mg/kg Se from Na_2 SeO_3, 2.0 g/kg Zn from $ZnSO_4$, 550,000 IU/kg vit. A, 55,000 IU/kg vit. D, 1100 IU/kg vit.E, remainder of supplement consisted of distillers dried grains with solubles, molasses products, and soybean oil) with 10 g/kg TiO_2 mechanically mixed into the supplement as an external marker to estimate supplement intake. A Hobart mixer was used to combine 22,473 g of commercial mineral with 227 g TiO_2. A new batch of mineral and TiO_2 was mixed and used the second year.

One mineral feeder was placed in each confinement pen and grazing pasture. Only 1 ewe could consume mineral at a time. Mineral feeders were checked daily and kept full of mineral. Throughout the entire experiment, ewes on both treatments were moved into handling facilities daily and dosed with gelatin capsules filled with 2 g Cr_2O_3 as an external marker to estimate fecal output (FO). Following the adaptation period, swath grazing ewes were moved into the remaining 0.07 ha of their pasture with fresh forage for data collection. Mineral feeders were also moved and placed in the middle of the grazing area. During the data collection, all ewes were gathered daily, and fecal grab samples were collected via rectum. Just prior to the collection period, hay and swath forage samples were taken for forage composition analysis (Table 1). Hay forage samples were taken by core sampling random bales, and compositing the cores. Swath forage samples were collected by randomly taking three 10-cm profile sections of an un-grazed swath per pasture, and compositing.

Forage samples were dried at 60 °C and ground in a Wiley mill through a 1-mm screen. Forage samples were analyzed for DM (930.15) and OM (9442.05) via AOAC (2000); NDF (inclusive of residual ash without amylase; Mertens, 2002) and ADF (973.18 via AOAC (2000), ANKOM^{200} Fiber Analyzer, ANKOM Technology Corp., Macedon, NY; and crude protein using Leco, total combustion method, 968.06 (AOAC, 2000). Individual fecal samples were composited by ewe within year, dried at 60 °C, ground through a 1-mm screen in a Wiley mill, and analyzed for DM (930.15; AOAC, 2000); Ti (Myers et al., 2004); and Cr by atomic absorption spectrometry (Ellis et al., 1982). Forage in vitro digestibility (Table 1) was measured each year on the composited sample of hay and swathed forage used for composition analysis. Triplicate samples of each forage were used in