Small Ruminant Research 144 (2016) 28–34

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Effects of pen flooring type and bedding on lamb growth and carcass characteristics☆

J.R. Jaborek, G.D. Lowe, F.L. Fluharty*

Department of Animal Sciences, The Ohio State University, Wooster 44691, United States

ARTICLE INFO

Article history:
Received 27 September 2015
Received in revised form 27 May 2016
Accepted 15 July 2016
Available online 20 July 2016

Keywords:
Flooring type
Feedlot
Bedding
Lambs
Growth

ABSTRACT

Two studies were conducted to determine the effects of floor or bedding type on lamb performance, carcass characteristics, and visceral organ mass. In Exp. 1, seventy-two early weaned Targhee × Hampshire ram lambs (initial BW = 35.2 kg) were used in a randomized complete block design experiment to determine the effects of floor type and bedding with lambs fed an 80% concentrate diet. The types of flooring investigated were expanded metal, dirt with a sand top-dress, and dirt with straw bedding. Flooring type affected DMI ($P < 0.001$), with lambs on expanded metal consuming the least (1.23 kg/day), lambs on straw consuming the most (1.28 kg/day), and lambs on sand being intermediate (1.25 kg/day). The differences in DMI resulted in lambs on expanded metal having a lower ($P < 0.05$) ADG than lambs on straw (0.26 vs. 0.28 kg/day, respectively). Lambs bedded with straw had greater ($P < 0.05$) total digestive tract mass compared to lambs on expanded metal flooring. No significant differences were found for lamb carcass characteristics due to flooring type. In Exp. 2, ninety-two Dorset × Hampshire lambs (initial BW = 31 kg) were used in a randomized complete block design experiment to determine the effects of bedding, dirt with a sand top-dress, and dirt with straw bedding, on animal performance with alfalfa silage and corn-based growing and finishing diets, respectively. Lambs were allotted to pens based on sex (wethers = 46 and ewes = 46) and initial BW (small or large), with 11 or 12 lambs per pen. Lambs bedded with straw had significantly greater ($P < 0.05$) ADG, DMI, and G:F compared with lambs bedded with sand during the growing period. However, lambs bedded with sand had significantly greater G:F ($P < 0.05$) compared to lambs bedded with straw during the finishing period.

Published by Elsevier B.V.

1. Introduction

In many parts of the world, where extreme heat, cold, rain, or snow occur, lambs are fed in enclosed feedlots. Animals can be housed using a variety of floor surfaces along with different types of bedding. Slatted floors are commonly used in intensive feeding operations and research settings to minimize the labor and costs associated with bedding and manure removal from animal pens. Slatted floors also allow for higher stocking densities which can reduce the additional space needed to house and feed lambs. However, concerns of animal welfare have led into the investigation of using bedding substrates on solid surfaced floors (Faerevik et al., 2005). Bedding substrates, many being feed residues such as straw; can also be used to provide animals with adequate comfort while lying down. However, not all bedding sources are the same. While there may be differences associated with cost (Teixeira et al., 2015), different bedding substrates may provide varying levels of absorbency, thermoregulatory properties, and comfort to the animal (Panivivat et al., 2004).

Flooring type may affect animal behavior and growth performance if the flooring material causes stress to the animal. Bedding substrates can help animals adapt to a new environment by providing animals with environmental enrichment, such as straw (Aguayo-Ulloa et al., 2014; Teixeira et al., 2015). Environmental enrichment in pens can reduce stereotypical behaviors (Teixeira et al., 2012), such as wool picking and other oral manipulations. Flooring preferences of lambs appear to change between unshorn and shorn sheep due to comfort and surrounding ambient temperature (Faerevik et al., 2005). Thus, preference changes to different bedding types can make it difficult to observe performance differences occurring over long periods of time.

As previously mentioned, many feed residues are used as a bedding source for livestock and may alter feed intake. The use of straw

☆ Salaries support provided by state and federal funds appropriated to the Ohio Agricultural Research and Development Center, The Ohio State University.

* Corresponding author at: Department of Animal Sciences, The Ohio State University, Wooster, Ohio, USA.
E-mail address: fluharty.1@osu.edu (F.L. Fluharty).

http://dx.doi.org/10.1016/j.smallrumres.2016.07.013
0921-4488/Published by Elsevier B.V.

bedding may potentially provide a source of feed which results in inefficient utilization of high-concentrate diets, if the straw intake increases the rate of passage of grain out of the rumen prior to bacterial degradation. However, other studies have not reported differences regarding the performance of lambs on different flooring surfaces when fed to lighter end weights (Crosby et al., 2004; Day et al., 2006; Teixeira et al., 2012, 2015; Wolf et al., 2010). In the United States, the majority of lambs are marketed at a heavier body weight (BW) (>50 kg) than those previously mentioned (<40 kg). For this reason, this study intends to investigate if different flooring surfaces effect lamb performance when fed to heavier market weights.

A balance must exist between animal comfort and well-being, cleanliness, and feed digestibility and efficiency. The objectives of this study was to determine if flooring surface affected the growth performance of lambs, visceral organ mass, and carcass characteristics of growing and finishing lambs. We hypothesize that the consumption of straw bedding by lambs will reduced the performance and increase visceral organ mass of lambs bedded on straw compared to other flooring surfaces.

2. Materials and methods

In experiment 1, research protocols concerning animal care followed guidelines recommended in the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (Consortium, 1988). In experiment 2, animal research procedures were approved by the Institutional Animal Care and Use Committee Protocol No. 2014A00000098.

2.1. Experiment 1

2.1.1. Animals and treatments

Seventy-two early-weaned Targhee × Hampshire ram lambs (initial BW = 36.1 ± 0.5 kg) were used in a randomized complete block design experiment to determine the effects of floor type on lamb performance, visceral organ mass, and carcass characteristics. The experiment began in April of 1998 and ended in July 1998. Lambs were housed at the Ohio Agriculture Research and Development Center's sheep research feedlot inside covered barns in Wooster, Ohio. Three pen floor types were tested: expanded metal flooring, sand covering a dirt floor, and straw bedding on a dirt floor. Lambs were allotted to pens based on initial BW size, with three weight blocks (small, medium, and large; weighing 26.8–29.0 kg, 29.5–33.1 kg, and 33.6–38.1 kg respectively), with four lambs per pen. Pen was the experimental unit and a total of 18 pens were used in the experiment. Pen dimensions with expanded metal floors were 1.52 × 4.88 m, allowing 1.85 m^2 per lamb. Pens were constructed with metal gates on three sides and a 1.52 m long wooden fence line feed bunk on the fourth side. The pens containing sand or straw bedding were 2.59 × 4.69 m, allowing 3.04 m^2 per lamb and also had a wooden fence line feed bunk 1.52 m long. Sand bedding was kept at a minimum depth of 7.5 cm and raked to remove manure on an as-need basis. Straw bedding was applied twice a week and pack depth was kept to a minimum of 5 cm. All pens were equipped with automatic nipple waterers, so water was available to lambs at all times.

Diets fed to lambs were formulated to meet the dietary nutrient requirements of lambs (NRC, 1985; Table 1). Feed samples were collected weekly throughout the experiment and used to determine weekly dry matter intake (DMI) by drying the samples at 100 °C (AOAC, 1984). The remainder was dried in a forced air oven at 55 °C, ground to pass through a 2-mm screen, and analyzed for dry matter (DM) (AOAC, 1984).

Table 1
Nutrient and Diet Composition used in Exp. 1.

Item	%, Dry Matter Basis
Whole corn	55.00
Ground corn	11.47
Alfalfa pellets	10.00
Soybean hulls	10.00
Soybean meal	11.00
Urea	0.40
Limestone	0.60
Dicalcium phosphate	0.50
Trace mineral salt[a]	0.45
Vitamin A, 30,000 IU/g	0.01
Vitamin D, 3000 IU/g	0.01
Vitamin E, 44 IU/g	0.05
Selenium, 201 ppm	0.09
Ammonium chloride	0.40
Lasalocid, 150 g/kg	0.022
Calculated composition	
Crude protein, %	15.31
Calcium, %	0.52
Phosphorus, %	0.43
NEm, Mcal/kg	1.91
NEg, Mcal/kg	1.28

[a] Contained > 93% NaCl, 0.35% Zn, 0.28% Mn, 0.175% Fe, 0.035% Cu, 0.007% I, and 0.007% Co.

Lambs were fed on a pen basis. Feed offered and feed refused was weighed daily for each pen prior to feeding at 0800 to record feed intake. Since sorting was expected, feed was not allowed to remain in the feed bunk for more than one day before being discarded. The diet consisted of 80% concentrate, 20% forage, with whole-shelled corn fed at 55% of the diet, and the remaining ingredients fed in a pelleted supplement. Alfalfa pellets and soybean hulls were each fed at 10% of the diet (Table 1). Lambs were offered feed at 3.0–3.5% of BW throughout the trial. During week 1, 3.0% of BW was fed, during weeks 2 and 3, 3.5% of BW was fed, during weeks 4 and 5, 3.25% of BW was fed, during weeks 6, 7, and 8, 3.0% of BW was fed, and during the remaining weeks 3.25% of BW was fed. This feeding schedule was expected to result in a gain of approximately 270 g/day based on the energy content of the diet. Seven day intermediate weights were used to calculate the upcoming weeks feed intake, based on live BW. An attempt was made to measure the amount of straw consumed by lambs in the straw bedding treatment. However, the nipple waterers in the pens dripped excessively, which made the straw in the vicinity of the waterers very wet. Therefore, we were unable to correct for moisture content of the straw accurately enough to measure the amount of straw consumed by these lambs.

Initial and final BW was determined by using the average BW taken on two consecutive days before feeding occurred at 0800 at the start and end of the trial, with interim BW measurements taken every seven days. Average daily gain (ADG), daily DMI, G:F (kg of BW gain/kg of feed consumed), days required to reach harvest weight, and total DMI were determined for all lambs. Lambs were removed from the trial for commercial slaughter, on a pen basis, as each pen reached the predetermined BW for market of 54.4–59.0 kg.

Lambs from the large weight blocks were used to collect visceral organ mass for lambs on expanded metal flooring and sand bedding. A pen of large and medium weight lambs were used to collect visceral organ mass for lambs bedded on straw. As lambs were taken to a similar final weight, the use of large and medium weight block lambs was not expected to be a significant source of variation. Visceral organs (heart, kidney, liver, rumen/reticulum, omasum, abomasum, small intestine, cecum, and large intestine) were removed from the carcasses during slaughter and any adhering adipose tissue was stripped from these organs. The visceral organs were then flushed with water, stripped of contents, and