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Effects of exercise and roughage source on the health and performance of receiving beef calves

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ABSTRACT

Consumer interest regarding cattle welfare has increased. This experiment evaluated exercise and roughage source on calf performance and health during a 56-d receiving period. Steers (n = 94; BW = 250 ± 12 kg) were assigned in a randomized complete block design with a 2 × 2 factorial arrangement of treatments. Factors included (1) roughage source [30% (DM basis) hay (HY) or 15% cottonseed hulls and 15% soybean hulls (HLS)] and (2) exercise [529 m of exercise (EX) 3 d/wk or no exercise (NEX)]. No differences in BW or ADG existed among treatments ($P \geq 0.24$). However, HLS calves had reduced DMI from d 29 to 42, 43 to 56, and 0 to 56 ($P \leq 0.04$) compared with HY calves. Overall, HLS and EX calves were more efficient than HY and NEX calves ($P < 0.001$ and $P = 0.02$, respectively). On d 56, there was an interaction for both fecal score ($P < 0.01$) and fecal pH ($P = 0.05$) with HY + NEX having reduced fecal score and fecal pH compared with all other treatments. The number of calves that required a second antimicrobial treatment for bovine respiratory disease tended ($P = 0.08$) to be reduced for HY and NEX calves compared with HLS and EX calves. Calves that were fed HLS or exercised had greater feed conversion efficiency than calves that were fed HY or not exercised. Further investigation is needed to determine the effects of exercise on fecal characteristics and clinical bovine respiratory disease incidence.

Key words: calf, exercise, hulls, receiving health, roughage source

INTRODUCTION

Consumers are becoming more concerned about quality of life for animals (Lyles and Calvo-Lorenzo, 2014). These concerns can be defined by 3 parameters: health, natural behavior, and positive affective state (Fraser, 2008). A positive affective state can be thought of as an animal's ability to positively respond to changes that are not brought about by a single stimulus. Additional consumer concerns include access to the outdoors, exercise, and the use of antibiotics, even when used for treating, preventing, and controlling diseases (McEwen and Fedorka-Cray, 2002; Czycholl et al., 2015).

The majority of cattle's lives are spent consuming forage. However, cattle do not grow as efficiently on forage-based diets compared with concentrate-based diets due to a lack of metabolizable energy. In feedlots, cattle are fed concentrate-based diets to facilitate efficient growth and weight gain. Roughages aid in the transition to these concentrate-based diets and also help optimize DMI to improve performance while reducing digestive problems, such as acidosis. Roughage consumption also improves muscular development within the rumen due to the bulk and particle size of forage (Tamate et al., 1962).

In feedlot receiving diets, a roughage source constituting 30% of the DM or greater is commonly included (Samuelson et al., 2016). Cottonseed hulls (NDF = 81% and ADF = 65%) and soybean hulls (NDF = 65% and ADF = 46%) can be used as roughage sources due to high fiber content (NASEM, 2016). In addition, cottonseed hulls are palatable and can stimulate intake in calves fed grain-based diets (Blasi and Drouillard, 2002).

Producers are seeking alternative methods to improve cattle health and well-being. Although exercise could potentially be an alternative method and ease consumer concerns, care must be taken to ensure the exercise does not cause increased stress on the pulmonary system, because cattle have unique lungs that are small in relation to body size with little reserve, no collateral ventilation, and little interlobular interdependence (Robinson et al., 1983). Limited research has been completed evaluating exercise in feedlot settings. The objectives for this experiment were to determine the effects of exercise and roughage source on receiving calf health and performance during a 56-d receiving period.

MATERIALS AND METHODS

All procedures were approved by Oklahoma State University's Institutional Animal Care and Use Committee (Animal Care and Use Protocol AG-16–1).

The authors declare no conflict of interest.

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Cattle Description, Initial Processing, and BW

In mid-August, 94 crossbred steers (BW at arrival = 250 ± 12 kg) were purchased at a livestock market in Holden, Missouri, and transported (approximately 568 km) to the Willard Sparks Beef Research Center at Oklahoma State University in Stillwater. Calves arrived on d −8 and were commingled in two 24.4 × 30.5 m holding pens (47 calves per pen), with ad libitum access to water and prairie hay for approximately 4 h. Due to high temperatures, cattle were moved to 15 small pens (4.57 × 15.24 m) with access to shade and sprinkled with water. In these pens, calves were still provided ad libitum access to water and prairie hay.

The following morning, on d −7, calves were individually weighed, verified for sex, and administered a uniquely numbered ear tag in the left ear. Calves were administered a clostridial bacterium/toxoid (Vision 7; Merck Animal Health, De Soto, KS) s.c. at 2 mL/steer and a viral vaccine for infectious bovine rhinotracheitis virus, bovine viral diarrhea virus types 1 and 2, parainfluenza 3 virus, and bovine respiratory syncytial virus (Titanium 5; Elanco Animal Health, Greenfield, IN) s.c. at 2 mL/steer; treated for parasites orally with fenbendazole (Safeguard; Merck Animal Health) at 5 mg/kg of BW and topically with doramectin (Dectomax; Zoetis Animal Health, Florham Park, NJ) at 1 mL/10 kg of BW; and implanted with 16 mg of estradiol, 80 mg of trenbolone acetate, and 29 mg of tylosin tartrate (Component TE-IS with Tylan; Elanco Animal Health).

Before the start of the experiment, calves were fed a common receiving diet for 7 d (Table 1). Throughout the experiment, calves were housed in twenty 4.57 × 15.24 m pens that contained a 4.57 × 4.42 m concrete pad covered by a solid shade awning. The remainder of the pen was open aired and soil surfaced. Each pen contained a 4.57-m concrete feed bunk, and a concrete water tank (model J 360-F; Johnson Concrete, Hastings, NE) was shared between 2 adjacent pens. Calves were weighed on d 0 for initial BW and on d 14, 28, 42, and 56.

Experimental Treatments

Pens were randomly assigned to treatment within block. Calves were blocked by initial processing BW on d −7, and calves treated with an antimicrobial for clinical signs of bovine respiratory disease (**BRD**) before d 0 were placed into a single block. Steers were assigned to pens (5 pens per treatment with 5 steers per pen except for the heavy BW block, which contained only 3 to 4 steers per pen due to limited animal numbers) in a randomized complete block design with a 2 × 2 factorial arrangement of treatments. Factors were (1) roughage source [30% hay on a DM basis (**HY**) or 15% cottonseed hulls (**CSH**) and 15% soybean hulls (**SBH**) on a DM basis (**HLS**)] and (2) exercise (**EX**) or no exercise (**NEX**). Exercise consisted of walking 3 d/wk (Monday, Wednesday, and Friday) at approximately 0530 h (before the morning feed delivery) for a distance of 529 m around the east side of the Willard Sparks Beef Research Center. Average walking speed for each pen was 3.59 km/h, resulting in approximately 10 min of exercise. Exercise was conducted by walking behind the calves on foot with no verbal communication or driving aids in an attempt to minimize stress.

Feed and Bunk Management

Cattle were fed experimental diets ad libitum twice daily at 0630 and 1300 h throughout the 56-d experiment to the nearest 0.45 kg of that day's feed call. Diets were mixed and fed in a 2,377- or 5,207-L, trailer-mounted feed

Table 1. Composition of experimental diets[1]

Item	HY	HLS
Ingredient, % DM		
Dry-rolled corn	10.00	10.00
Wet corn gluten feed[2]	54.80	54.80
Dry supplement B-273[3]	5.20	5.20
Prairie hay	30.00	—
Cottonseed hulls	—	15.00
Soybean hulls	—	15.00
Analyzed nutrient composition (DM basis)[4]		
DM, % (as-fed basis)	71.99	70.79
NE_m, Mcal/kg	2.01	1.76
NE_g, Mcal/kg	1.34	1.15
TDN, %	82.10	74.30
CP, %	17.40	18.57
Crude fiber, %	16.57	18.23
NDF, %	42.87	46.33
ADF, %	18.40	25.17
Calcium, %	0.83	0.77
Phosphorus, %	0.72	0.76
Magnesium, %	0.32	0.35
Potassium, %	1.23	1.33

[1]HY = 30% hay on a DM basis; HLS = 15% cottonseed hulls and 15% soybean hulls on a DM basis.

[2]Sweet Bran (Cargill, Dalhart, TX).

[3]Dry supplement B-273 was formulated to contain (% DM basis) 38.46% ground corn, 30.36% limestone, 21.04% wheat middlings, 6.92% urea, 1.03% magnesium oxide, 0.618% zinc sulfate, 0.38% salt, 0.119% copper sulfate, 0.116% manganese oxide, 0.05% selenium premix (contained 0.6% Se), 0.311% vitamin A (30,000 IU/g), 0.085% vitamin E (500 IU/g), 0.317% monensin (Rumensin 90; Elanco Animal Health, Greenfield, IN), and 0.195% tylosin (Tylan 40; Elanco Animal Health).

[4]Feed samples were analyzed for nutrient composition, and energy values were calculated from the analyzed composition by an independent laboratory (Servi-Tech Laboratories, Dodge City, KS).