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Research

Finishing feedlot lambs in enriched pens using feeder ramps and straw and its influence on behavior and physiological welfare indicators

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ABSTRACT

Sixty lambs were placed in enriched (EE) or conventional (CO) pens (3 pens per treatment or 10 lambs per pen), in which the EE pens had a wooden platform with ramps giving access to a concentrate hopper, straw as bedding and forage, and a further ramp for play. The CO pen was barren without any enrichment. The general behavior of the lambs and the use of space were similar for both treatments; however, CO lambs developed significantly more stereotypies ($P \leq 0.05$). The EE lambs resolved a T-maze more quickly ($P \leq 0.05$), and their physiological adaptation response to the feedlot environment was more efficient. The CO lambs mobilized more body reserves and had lower levels of immunity (i.e., increased nonesterified fatty acid and neutrophil/lymphocyte ratio, respectively, $P \leq 0.05$) than EE lambs at the end of the fattening period, which indicates chronic stress, probably associated with the barren environment. The EE lambs had a higher ($P \leq 0.05$) average daily gain, heavier carcasses and higher fattening scores, as well as lower pH_{ult}. This study shows that enrichment can improve the welfare of feedlot lambs by reducing stereotypies and enhancing the physiological adaptation response to a novel environment.

Introduction

As in other animal production industries, sheep production has become more intensive and increasingly takes place indoors, with high densities and in environments that lack complexity (Fraser et al., 2013). The finishing phase of fattening lambs in some Mediterranean countries (e.g., Spain) is as intensive as pig production (Miranda-de la Lama et al., 2010b). Lamb feedlotting externalizes the final stage of fattening to off-farm units (Aguayo-Ulloa et al., 2013; Miranda-de la Lama et al., 2009), stratifying production in 2 specialized parts, flock breeding on the farm (under the farmer's responsibility) and fattening at feedlots, also called classification centres (CCs). It is assumed that this approach simplifies the finishing process for the farmer and improves carcass homogeneity (Miranda-de la Lama et al., 2010a; Miranda-de la Lama et al., 2010b). However, farmers and animals face other problems, such as dependency on external resources, multiple live transports, social mixing and frequent handling in novel, and barren environments (Aguayo-Ulloa et al., 2013; Miranda de-la Lama et al., 2012).

Adjusting to newly formed groups can entail difficulties, particularly with regard to competition for food or access to other resources, which in turn can lead to decreased fitness (Estevez et al., 2007). Stress in animals can have a psychological origin related to the novelty of the situation, social separation, the mixing of unfamiliar animals, and/or handling (Terlouw et al., 2008). This situation can be further worsened if the environment is not stimulating, encouraging the development of stereotypies, abnormal behavior, frustration, and stress (Fraser, 1980; Lawrence and Rushen, 1993; Wood-Gush and Beilhartz, 1983).

Because of increasing public concern about the conditions in which animals are produced, over the years pressure has been exerted on government authorities to establish new regulations to control the quality of the livestock industry (Garnier et al., 2003;

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Figure 1. Control pen without furniture or straw (left side). Enriched pen with wooden ramps and cereal straw as forage and bedding (right side).

María, 2006; Lusk and Norwood, 2008; Winter et al., 1998). Many scientific studies have been carried out to improve the welfare of farm animals, mostly referring to poultry and pigs. Less is known about how to improve the well-being of lambs under similarly intensive indoor systems, about which the public is less aware (María, 2006).

Environmental enrichment is a subject that in recent years has attracted much scientific and media attention because of its link to animal well-being (Schetini de Azevedo et al., 2007; Young, 2003). Enrichment devices and substrates may have a positive effect on weight gain, decrease morbidity (Flint and Murray, 2001), and reduce abnormal behavior (Mason et al., 2007). They may also help to facilitate adjustment to feedlots in ruminants (Wilson et al., 2002) by reducing negative emotional states such as fear and stress associated with the adaptation to a novel environment (e.g., the CC). This will reduce the frustration that animals may experience when unable to express their behavioral needs (Hughes and Duncan, 1988a; Nicol, 1992; Wood-Gush and Vestergaard, 1989). The current trend in European legislation for various species is to develop regulations that increase environmental enrichment, making it important to identify the most adequate elements for each species. The study that follows is based on the hypothesis that full enrichment (multiple items, Abou-Ismail, 2011) during the finishing period of fattening may improve the adaptation process of lambs to a novel environment at the CC and hence optimize their welfare. This study was conducted to evaluate the influence of environmental enrichment (ramps and substrate) on use of space, behavior, cognitive abilities, physiology of stress, and performance traits in lambs fattened in feedlots.

Methods

The study was carried out at the Animal Experimentation Service of the University of Zaragoza in the Autonomous Community of Aragon, Spain (41°41′ N). The area is located in the Ebro river depression, characterized by a dry Mediterranean climate with an average annual temperature of 15°C and mean annual rainfall of 317 mm. Experimental protocols were approved by the Animal Experimentation Ethics Committee of the University of Zaragoza (ES 50 297 0012 006).

Sixty entire Rasa Aragonesa male lambs (65 days old) with an average live weight of 17.13 (±0.18) kg were allocated to 2 treatments (weights were balanced across treatments) according to their pen environment during the finishing phase of fattening (5 weeks). Lambs were housed indoors in 6 pens with 10 lambs each (2.9 × 3.3 m, animal density of 0.95 m^2 per lamb) and 3 replicates per treatment. Lambs from the enriched group (EE) were kept in pens with a wooden platform with slatted ramps that provided access to a concentrate hopper (Figure 1). The dimensions of the platform and ramps were 2.35 m long × 1.55 m wide × 0.35 m high. The platform area was 1.67 m^2. The ramp slope was approximately 20°. The platform in the pen was attached to the fence below the food hopper, allowing the lambs to feed, explore or to lie down. The EE lambs were provided with cereal straw (72% neutral detergent fiber: 38% cellulose, 25% hemi cellulose, 8% lignin, and 0.2% cutine) as forage in the fodder rake (fresh straw was added every morning, ad libitum) and bedding on the floor. Additionally, a small slatted ramp (0.90 m long × 0.50 m wide × 0.35 m high and 0.08 m^2 surface area) was placed near to the opposite solid fence but away from the food hopper and fodder rake, to allow lambs to play. Lambs from the control group (CO) were kept in a barren pen that had the same dimensions as enriched lambs, but without any furniture or cereal straw as bedding or forage, mimicking CCs conditions. For hygienic reasons, a thin layer of sawdust was added at the beginning of the experiment to the CO pens only. All lambs were fed with commercial concentrate (Ovirum Alta Energía) containing barley, wheat, calcium carbonate, sodium chloride, and a vitamin supplement corrector (18% crude protein and 11.5 MJ metabolizable energy/kg dry matter). Feeding and water consumption were ad libitum. In both treatments, the concentrate hopper was wide enough to allow all lambs to eat simultaneously. Water was provided using a float drinker installed in a corner of