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Short communication

Assessment of different organic beddings materials for fattening lamb

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ABSTRACT

In sheep production, the choice of bedding material affects production costs, animal growth, and animal welfare, but few organic alternatives to straw have been evaluated. In this study, 96 entire male lambs (19.11 ± 1.07 kg live weight, approximately 80 days old) were fattened for 14 days on straw, cellulose, rice husk, and sawdust in two replicate trials. The pH, dry matter (DM), bacterial count, water absorption capacity and ammonia concentration of each bedding material were calculated before and after fattening. A score was developed to visually assess the dirtiness of bedding and lambs, in addition to a behavioural analysis of activity. Straw was the cheapest material (total cost €1.00 per pen), followed by rice husk (€2.35), cellulose (€2.80) and sawdust (€13.50). The latter had the highest water absorption capacity and the highest final pH, compared to cellulose with the highest final DM. Straw had the lowest final DM, upon which lambs spent a slightly higher percentage of time lying (79%) than cellulose (75%), which was dryer and produced cleaner animals. Lambs on straw spent slightly more time eating (7.2%) compared to the other substrates. In conclusion, although straw may be the cheapest bedding, cellulose and rice husk are viable alternatives.

1. Introduction

Bedding is used to provide thermal insulation and to absorb excrement, prevent drafts, improve skid and slip resistance and protect animals from hard surfaces (Bøe, 1990), all of which can improve animal comfort and welfare (Fairchild et al., 1982). Researches on bedding material for sheep have focused on finding alternatives to slats, especially in climates where sheep are housed indoors in winter and where cereal straw is expensive and in limited supply. However, few studies have compared the effects of straw bedding with other organic alternatives in terms of their physical and chemical characteristics and their effect on lamb behaviour.

Although straw is the most frequently used bedding material in Europe and provides comfort for lambs during the fattening phase (Teixeira et al., 2012; Hansen et al., 2012), its price has increased in recent years due to demand for amending soils or producing energy. In pastoral regions without arable crops, straw can be a high-cost bedding material (even excluding transportation and storage costs), so it would seem appropriate to consider alternatives from the productive and economic points of view, as well as from the perspective of the animals over time.

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The health and comfort of animals on bedding is related to wetness and cleanliness (Fregonesi et al., 2007). Bedding quality decreases with decreasing dry matter (as faeces and urine accumulate), resulting in dirtier animals and higher bacterial counts (Zdanowicz et al., 2004), which vary with the inherent quality and amount of bedding material (Godden et al., 2008; Corrêa et al., 2009).

Bedding type and quality may also influence ovine behaviour, such as lying and walking (Teixeira et al., 2013), since sheep do not have specific locations for dunging and are expected to defecate and urinate in all areas of the pen. The frequency and total time spent resting indicate how animals perceive the quality of the bedding material (Hansen et al., 2012). Sheep prefer to lie down on solid floors with appropriate bedding than to lie down on slats (Jørgensen and Bøe, 2009; Gordon and Cockram, 1995) and they spend more time lying down on straw, especially after shearing (Cooper and Jackson, 1996). Lambs without straw spend more time standing than lambs on straw (Teixeira et al., 2012). Among sawdust, cellulose,[1] straw, and rice husk, lambs show a clear preference to lie down on sawdust (Teixeira et al., 2013). The objectives of this study were to compare straw bedding with three other organic alternatives (sawdust, cellulose and rice husk) in terms of chemical and microbiological characteristics and to analyse how those in turn affect behaviour during the finishing phase of fattening.

2. Material and methods

The study was carried out at the experimental farm of the University of Zaragoza, Spain (latitude 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 317 mm average annual rainfall. The Animal Experimentation Ethics Committee of the University of Zaragoza approved the experimental protocol.

A total of 96 entire male lambs of the *Rasa aragonesa* breed, clinically healthy, were assigned to two consecutive replicates. The average live weight upon arrival at the Classification Centre (CC) was 19.11 (±1.07) kg and lambs were approximately 80 days old. In each replicate, 48 animals were kept in a holding pen for 24 h after arrival from the source farm to adjust the animals to new feedstuffs and surroundings, and then randomly assigned to one of four groups with different bedding material (12 lambs each) where they were fattened for 14 days (finishing phase). Each pen housing 12 lambs measured 2.9 × 3.7 m (stocking density 0.90 m^2 per lamb). All lambs were individually marked with numbers on their side and back using livestock paint spray. Physical contact among lambs from different treatments was prevented by a metal wall (1.0 m high) that separated adjoining pens. All groups were feed *ad libitum* with a pellet concentrate in a feeder, as well as fresh water. The commercial concentrate (Ovirum High Energy®) contained barley, corn, wheat, vegetable fat, soya tort, sugar cane molasses, calcium carbonate, sodium chloride and a vitamin mineral corrector (18% CP and 3.5 Mcal/kg DM/day of ME).

2.1. Bedding quality

The floor in each pen (10.7 m^2) was covered with approximately 10 cm of one of four bedding materials: sawdust, cellulose, straw and rice husk. The cellulose was delivered baled and the other substrates were delivered loose in bulk. No new material was added or replaced during the experiment. At the beginning and end of each trial (day 14), five samples were taken from the bedding in each pen using sterile plastic gloves (four around the perimeter of the pen and one from the centre) and placed in a sterile plastic bag to measure pH, DM, bacteria and water absorption capacity. Ambient temperature, relative humidity, ammonia concentration were also recorded. An ocular scoring system was developed to visually assess the dirtiness of bedding and lambs.

Bedding pH was measured 1 h after milling a 2 g sample mixed with 20 ml of distilled water that had been shaken for 4 h. To obtain the DM content, a 500 g sample was oven dried at 104 °C for 24 h. For bacterial counts 10 g of bedding sample was added to 90 ml of peptone water buffered in a sterile recipient. After mixing for 1 min, a serial dilution of 1:10 was aspirated with 1 ml of solution into 9 ml of peptone water buffered per tube. Each dilution (1×10^3 to 1×10^6) was plated on the surface of the medium. Bacteria were counted after being incubated for 24 h at 37 °C. After each period, bacteria were recorded as cfu/g (colony-forming units/grams) of fresh weight. Plates with 30–300 colonies were used to calculate cfu/g, and the numbers were converted to $\log_{10}$/g.

To determine the water absorption capacity, four samples of 50 g of each bedding materials were placed in a hydrophobic (nylon) single knee high pantyhose. All samples were immersed in water for 24 h and then removed from the water, suspended, and allowed to drain excess water for 1.5 h. Materials were reweighed and the water absorption capacity was calculated based on the following equation: [(weight of sample after immersion − weight of sample before immersion)/weight of sample before immersion) × 100].

Environmental temperature and relative humidity were recorded every 10 min with thermo-hygrometers (Testo 174H, Testo Ltd., UK). Ammonia was measured at lamb head level on the last day of the experiment (after all lambs had left), at four points around the pen perimeter and in the centre, with a hand held ammonia meter (Gasman II, Crowcon Detection Instruments Ltd., Abingdon, UK).

A 3-point scale (0 as very clean and 3 as very dirty; and adjusted to half a point) was developed to evaluate the visual quality of bedding based on dirtiness, wetness, compactness, crustiness, homogeneity and patchiness. Measurements were carried out on days 1, 5, 10 and 14 of the trial. On day 14, after all animals had left, the patchiness percentage of each bedding material was evaluated by measuring the area with hard crust after removing any loose substrate. Lamb dirtiness was also measured using a 3-point scale (adjusted to half a point), on the same days as bedding was scored. Animals that obtained a 0 had clean skin and wool and animals with a 3 were quite dirty, most of their wool was matted, and little wool was visible.

2.2. Lamb behaviour

A video-recording device (model VDVR-9, Circontrol S.A., Terrassa, Spain) was set up in a room nearby to record the maintenance behaviour (using one camera in front of each pen, 220 cm above the ground) for 12 h per day (0800–2000 h). Scan sampling was performed every 10 min to record lying (lamb resting on the lower hind leg and thigh, abdomen and front legs), standing (lamb standing on all four legs), walking (lamb on all four legs and moving), feeding (lamb searching for feed in the trough and eating it) and drinking (lamb drinking water from the drinker). The same trained observer analysed all video recordings.

2.3. Statistical analysis

Data were analysed using the Statistical Analyses System (SAS, 1988, version 9.1, SAS Institute Inc., Cary, NC, USA), and tested for normality prior to analysis by examination of box and normal distribution plots and transformed when necessary. The effect of treatments on water absorption capacity and ammonia concentration were analysed by the GLM procedure, which included the fixed effect of type of bedding. The data from DM, pH, bacterial counts and final patchiness percentage of crusted bedding material on the floor were not statistically analysed and thus are presented as descriptive information only. Bedding scores were analysed using an analysis of variance, with treatment as fixed effect and residual as random effect. Lambs scores were analysed using Mixed procedure, with day as repeated measurements, treatment as the fixed effect and lamb as random effect. A Kruskal–Wallis test was used to test the effect of bedding on behaviour, using the percentage of animals performing specific behaviours throughout the trial. Following the Bonferroni methods, Mann–Whitney-*U* tests were used to compare treatments, penalized by the number of comparisons used. The probability of obtaining *P* values ≤0.05 was deemed to be statistically significant.

[1] Cellulose was composed of the industrial waste, including pulp, from paper production. The Spanish registered code is LER-030310.