Spatial preferences and behavioural patterns of lambs during fattening in straw enriched pens

Pascual-Alonso, M.[1@]; Miranda-de la Lama, G.C.[1,2]; Villarroel, M.[3]; Alierta, S.[1]; Escós, J.[1] and María, G.A.[1]

[1]Department of Animal Production and Food Science. Faculty of Veterinary Science. University of Zaragoza. Zaragoza. Spain.
[2]Group of Animal Welfare and Sustainable Livestock Production. Department of Food Science. Metropolitan Autonomous University. México.
[3]Department of Animal Science. E.T.S.I.A. Polytechnic University of Madrid. Madrid. Spain.

Additional keywords

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SUMMARY

The study analyses spatial preferences and behavioural patterns of lambs during fattening in straw enriched pens. Lambs were allocated in three replicates with 12 lambs each and housed in 6x6 m pens partially divided in two equal areas with and without straw bedding. Each pen was video-recorded continuously from 8 am to 8 pm on days 1, 5, 7, 14, 21 and 28. The use of different pen areas and the behaviour of the lambs were evaluated and analysed. The use of the space was significantly higher ($p<0.05$) for the straw area, where there was also more resting and affiliative interactions ($p<0.05$). In the areas without straw, animals walked more, remained standing longer periods ($p<0.05$) and had more stereotypic and aggressive behaviour ($p<0.05$). The study demonstrated that, when given the choice between two areas with similar resources, lambs prefer straw bedding. Straw is suggested to promote affiliation improving the adaptation to the feedlot. This could be useful to convince system managers that the availability of straw is beneficial to lamb welfare.

Preferencias de espacio y patrones de comportamiento de corderos durante el cebo en corrales enriquecidos con paja

Palabras clave adicionales

Paja de cama.
Comportamiento de corderos.
Bienestar de corderos.
Cebaderos.

RESUMEN

El estudio analiza las preferencias de espacio y los patrones de comportamiento de corderos durante la fase de cebo en corrales enriquecidos con paja. Los corderos se dividieron en tres réplicas con 12 corderos cada una y se alojaron en corrales de 6x6m divididos parcialmente en dos zonas equivalentes una con y otra sin paja de cama. Cada corral fue grabado de manera continua entre las 8 am y las 8 pm en los días 1, 5, 7, 14, 21 y 28 de cebo. El uso de las diferentes áreas del corral y el comportamiento de los corderos fue evaluado y analizado. El uso del espacio fue significativamente más alto ($p<0,05$) para el área con paja, donde asimismo se realizaba más comportamiento de descanso e interacciones afiliativas ($p<0,05$). En las áreas sin paja los animales caminaban más, permanecían de pie parados durante periodos más largos ($p<0,05$) y realizaban más estereotipias y comportamientos agresivos ($p<0,05$). El estudio demostró que, cuando se da la opción entre dos áreas con similares recursos, los corderos prefieren la cama de paja. La paja se muestra como un posible promotor de la afiliación mejorando la adaptación al cebadero. Esto podría resultar útil para convencer a los gestores del sistema de que la disponibilidad de paja es beneficiosa para el bienestar de los corderos.

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mpascual@unizar.es

INTRODUCTION

Environmental enrichment is used to adjust the living environment of captive animals to help them express more of their natural behavioural repertoire and, thereby, improve their quality of life (Newberry, 1995; Abou-Ismail, 2011). Straw bedding can help to improve animal welfare in a number of ways, including increased comfort, recreation and adding more bulk to the diet (Teixeira *et al.,* 2012). For lambs, straw is stimulating and can be considered a practical means of enriching the environment (Fraser *et al.,* 1991). However, one drawback is cost, which tends to be higher in pastoral regions without arable cropping (increasing transport costs). In addition, other alternative uses for straw and arable by-products have arisen years which push prices higher (Wolf *et al.,* 2010).

In Spain, light lamb production has become more intensive over the years, producing a two staged sys-

tem for breeding on farms and fattening-finishing on cooperative feedlots (Miranda de la Lama *et al.*, 2009). This system reduces labour requirements on the farm while producing a more homogeneous, high quality trademark product for consumers (Miranda de la Lama *et al.*, 2010a). However, lambs at the cooperative feedlots are exposed to new stress factors such as regrouping, a novel environment, group handling or double transports. Since the main aim of the feedlots is to reduce production costs, many would like to eliminate straw bedding during finishing, which usually lasts four weeks (Miranda de la Lama *et al.*, 2010b), but it is unclear what effects that change would have on lamb behaviour and welfare.

Changes in the behavioural activity of farm animals are widely used as an indicator for the assessment of animal welfare (Piccione *et al.*, 2011). Daily patterns of behavioural activity, including lying, walking, standing and social interactions have all been well described in sheep (Arnold, 1984). However, it is not known how straw bedding may facilitate adaptation to a new environment or how its presence/absence affects behavioural patterns. We aimed to analyse lamb behaviour and spatial preference in a straw-enriched environment to be able to recommend the most appropriate modifications to housing and management under current commercial practises.

MATERIAL AND METHODS

The study was carried out in the Autonomous Community of Aragon (northern Spain) at the experimental research farm located in Zaragoza (41°41′N). The area is located in the Ebro river depression, characterized by a dry Mediterranean climate with average annual temperature of 15 °C, and about 317 mm annual rainfall. All protocols were approved by the Animal Experimentation Ethics Committee of the University of Zaragoza.

Study description

We used 36 male lambs of the Rasa Aragonesa breed, approximately 60 days old with average live weight at the beginning of the experiment of 16.4 (±1.2) kg. They were allocated in three replicates with 12 lambs each and housed in 6 x 6 m pens **(figure 1)** which were partially divided in two equal areas with a tube fence and a wooden ramp with a 50 cm open pass (width) and 35 cm high. One of the areas had deep straw bedding, whereas the other had none and had solid concrete floor, and lambs could move between the areas by going over the ramp. At the beginning of the experiment lambs entered the pen into the area without straw. However, straw bedding was always present in the straw area. Every fifteen days, the straw bedding was partially renewed with a straw bale (average weight of 30 kg). Feeding was ad libitum with pellet concentrate in two feeders (one on each part of the pen) and straw was provided 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. The total consumption of concentrate was estimated as the difference between the concentrate added (weighted and registered each time) and the concentrate remaining at the end of the experiment on each feeder.

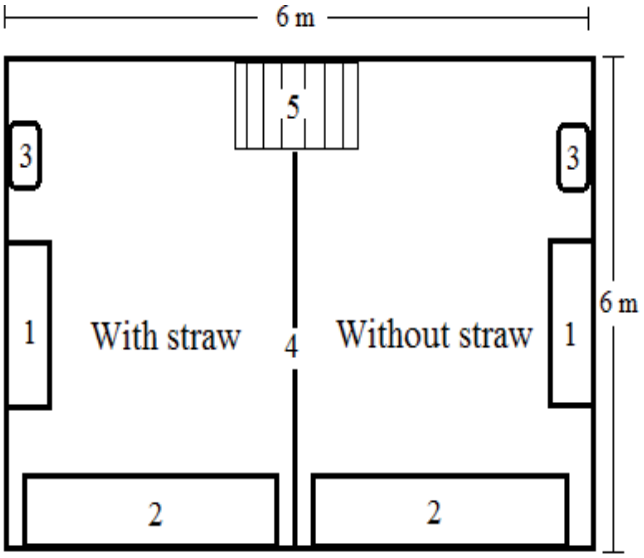

Figure 1. Pen layout: 1 Concentrate feeder; 2 Straw feeder; 3 Water trough; 4 Fence; 5 Wooden ramp (Disposición del corral: 1 Comedero de concentrado; 2 Comedero de paja; 3 Bebedero; 4 Valla; 5 Rampa de madera).

Behavioural measurements

Lambs were individually identified by coloured numbers. A video-recording device (model VDVR-9, Circontrol S. A., Terrassa, Spain) was set up in a room close to the pens to record animal behaviour. The camera was placed in front of each pen 220 cm above the ground. Each pen was recorded continuously for 12 h per day (8 am to 8 pm) on experimental days 1, 5, 7, 14, 21 and 28, making a total of 72 h of observations per pen, always analysed by the same trained observer. The use of different pen areas (occupancy) and the behaviour of the group were evaluated. On each of the observation days, scan sampling was used every 5 min (864 samples per pen) to obtain maintenance behaviour and information on the number of lambs in areas with and without straw and the number of animals that were: lying (lambs resting with eyes open or closed), walking (lambs moving from one place to another), and standing (lambs only standing). The evolution of behaviours throughout the fattening period in areas with and without straw was estimated as the number of observations of a behaviour/total number of scan samplings. The term time budget was defined as the summed proportions (total 100 %) of these behaviours. Only in the case of social behaviours (aggressive: butts, kicks, threats and pursuing another lamb; and affiliative: lamb licking, grooming and sniffing another lamb) and oral stereotypies (lamb licking or gnawing repeatedly on feeders, walls, fences, or wood or metal objects without feed consumption) was recorded using a combination of behavioural sampling with continuous recording (Martin and Bateson, 1991) for six hours each day (from 8-10 am; 12 am-2 pm; and 4-6 pm) . The proportions of these behaviours were calculated as number of events/total events observed in each area.

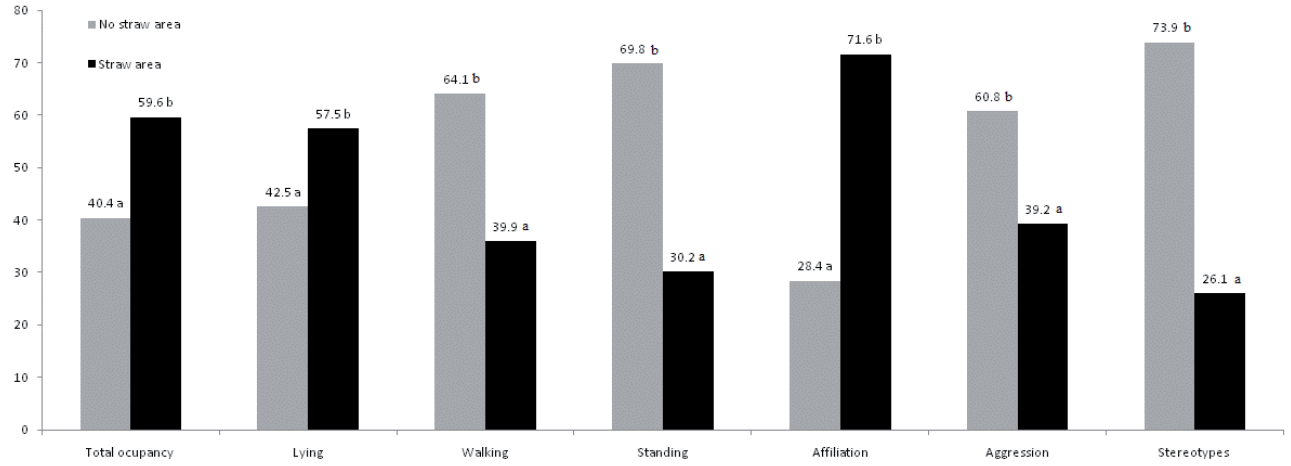

Figure 2. Total occupancy (lambs using each area) and main behaviours (abscissas bar) in percentage (ordinates bar) throughout the fattening period in pens without (light columns) and with straw (dark columns) (n=17749 observations). Different letters within group represent significant differences p<0.05 (Ocupación total y principales comportamientos (eje de abscisas) en porcentaje (eje de ordenadas) durante el periodo de cebo en corrales sin (columnas claras) y con paja (columnas oscuras) (n= 17749 observaciones). Letras diferentes dentro de los grupos representan diferencias significativas p<0,05).

Statistical analysis

Data were analysed by SAS statistical software package (SAS, 1998), using PROC CATMOD (behavioural data) and PROC FREQ (space use data) procedures. The CATMOD procedure performs categorical data modeling of data that can be represented by a contingency table. PROC CATMOD fits linear models to functions of response frequencies, and it can be used for linear modeling, log-linear modeling, logistic regression, and repeated measurement analysis. The model used was $E_A(F) = F(\pi) = X\beta$ where E_A denotes asymptotic expectation, X is the design matrix containing fixed constants, and β is a vector of parameters to be estimated. The use of the two pen areas and the behaviour of the lambs in each area (with straw and without straw) of the three replicates were tested by a Chi-square (χ^2) for goodness of fit. The original full model included the effect of replicate, which was found to be non-significant and consequently was dropped from the model and in consequence data from the 3 repetitions were pooled for statistical analysis. The probability values of p<0.05 were considered to be statistically significant.

RESULTS

We found no differences between consumption of concentrate in the different areas of the pen.

A total number of 17.749 observations were registered in the study. The total occupancy percentages and behavioural patterns are shown in **figure 2** for the areas with and without straw. The total occupancy was significantly higher (p<0.05) for lambs with straw, where there were also more resting (lying) and affiliative interactions (p<0.05). Without straw, animals walked more, remained standing for longer periods (p<0.05) and had more stereotypic and aggressive behaviour (p<0.05).

The changes in total occupancy and behaviour performed in each area on different sampling days are presented in **table I**. With the exception of day 5, occupation of the straw area was higher (p<0.05). A similar trend was observed for lying (p<0.05). Walking and standing were more frequent in lambs without straw on all sampling days (p<0.05) as were stereotypies (p<0.05). The percentage of aggressive interactions was higher in the area without straw on all six days

Table I. Evolution (%) of several behavioural variables observed throughout the feeding period in pen areas with and without straw (Evolución (%) de varias variables de comportamiento observadas durante el periodo de cebo en las áreas del corral con y sin paja).

Variables	Days of observation					
	1	5	7	14	21	28
Total occupancy (lambs using each area) (%)						
Without straw	39.2^a	51.4	39.8^a	37.2^a	39.9^a	34.9^a
Straw	60.8^b	48.6	60.2^b	62.8^b	60.1^b	65.1^b
Lying (%)						
Without straw	43.7^a	48.5	41.9^a	37.8^a	44.7^a	38.4^a
Straw	56.3^b	51.5	58.1^b	62.2^b	55.3^b	61.6^b
Walking (%)						
Without straw	60.2^b	65.6^b	64.1^b	66.1^b	65.1^b	63.5^b
Straw	39.8^a	34.4^a	35.9^a	33.9^a	34.9^a	36.5^a
Standing (%)						
Without straw	71.7^b	69.8^b	69.3^b	66.5^b	71.4^b	70.1^b
Straw	28.3^a	30.2^a	30.7^a	33.5^a	28.6^a	29.9^a
Stereotypies (%)						
Without straw	82.7^b	79.9^b	74.9^b	71.5^b	67.5^b	66.9^b
Straw	17.3^a	20.1^a	25.1^a	28.5^a	32.5^a	33.1^a
Aggressions (%)						
Without straw	50.7	60.1^b	60.5^b	60.9^b	66.9^b	65.7^b
Straw	49.3	39.9^a	39.5^a	39.1^a	33.1^a	34.3^a
Affiliations (%)						
Without straw	29.3^a	29.6^a	26.5^a	30.1^a	27.3^a	27.6^a
Straw	70.7^b	70.4^b	73.5^b	69.9^b	72.7^b	72.4^b

a,b: different letters at the same columns means significant difference within treatments (p<0.05).

of sampling ($p<0.05$), except for day 1 (no significant differences between areas). Finally, the percentage of affiliative interactions was significantly higher in the straw area ($p<0.05$).

DISCUSSION

Bedding material is a microenvironmental factor, which is permanently present during the farm animal's lifetime (Teixeira *et al.,* 2013). The influence of straw on the laying preferences of housed cattle and pigs has been extensively researched (Mogensen *et al.,* 1999; Tuyttens, 2005; Peeters *et al.,* 2006). However, lamb preferences for a laying site and straw in indoor environments have received very limited attention. Our results suggest that, given the same basic resources in two similar areas of the pen, lambs clearly prefer to have straw bedding and are willing to spend some effort to obtain it. Having to move between pens and go over a ramp suggests that the lambs made cognitive effort and that the demand for straw may be an important element in lamb welfare at industrial farming.

Regarding agonistic interactions, on the first day of sampling, lambs interacted aggressively in areas with and without straw, which may be because they were establishing dominance after social regrouping (Miranda-de la Lama *et al.,* 2012). However, on the remaining 5 days of sampling lambs tended to behave more aggressively in the area without straw. One possible hypothesis for this finding, could be related to the inclusive ability of the most dominant animals to monopolize the area with straw while subordinates would have to compete with each other in the area without straw for the more comfortable or driest areas (Fraser *et al.*, 1991; Van de Weerd and Day, 2009). The physical division in the pen and the presence of the ramp made it more difficult to access the straw area easily, increasing competition for that resource (Docking *et al.,* 2008).

Stereotypic behaviours are repetitive behaviours that occur without an apparent goal or function. The proportion of stereotypic behaviour is higher in confined animals compared to animals raised in more natural environments (Rushen and de Passillé, 1992). In our study, lambs performed more stereotypies in the area without straw, which is in agreement with Cooper and Jackson (1996) who reported a greater frequency of oral stereotypic behaviours in lambs housed on slats compared to straw. It is generally accepted that stereotypies may fulfil a role of substituting necessary behaviours that confined animals are not able to perform (i.e. foraging). In our study, the most apparent reason for more stereotypies in the area without straw may be related to the lack of stimulation and increased frustration due to the absence of bedding substrate to emulate foraging. That hypothesis is supported by known causes of stereotypic behaviour in the literature: frustration (Duncan and Wood-Gush, 1972), lack of stimulation (Broom and Johnson, 1993), social regrouping (Miranda-de la Lama *et al.,* 2012) and others stressful farm conditions (Cronin and Wiepkema, 1984; Cronin *et al.,* 1985). Similar results have been found in pigs by De Leeuw *et al.* (2003), who report higher levels of stereotypies in animals without straw bedding compared to those provided with straw as a bedding substrate.

Bedding should be sufficiently comfortable, dry and soft to ensure that animals can rest enough to guarantee their welfare and productivity (Tuyttens, 2005; Norring *et al.,* 2010). Resting patterns can be used as an indication of social stress in animal husbandry (Fraser and Broom, 1997), and sheep show a consistent and synchronous pattern of activities and resting (Rook and Penning, 1991; Fraser and Broom, 1997). In our study, the straw area could have been monopolized by the most dominant lambs and therefore the low-ranked animals occupied the area without straw in the resting periods which leaves them with the less comfortable zone to rest. As a result, the animals without straw had less of a convenient area to lie down and spent more time standing or walking, while the animals in the straw area were resting. This agrees with Bøe *et al.* (2006) who found that low-ranked ewes had limited access to the most comfortable areas of the pen and thereby were more active and spent less time lying than the other ewes in the group.

Our results indicate that lambs in the straw area showed more behaviours that are considered positive indicators of animal welfare, such as rest and affiliations (Boissy *et al.,* 2007), as previously reported in piglets (Arey, 1993; Jordan *et al.,* 2008). Affiliations are an important part of the social relationships of a group (Miranda-de la Lama and Mattiello, 2010), although in conditions of social competition for limited resources (i.e. food) animals can often dispense with them (Miranda-de la Lama *et al.,* 2012). In our experimental conditions, 70 % of affiliations were performed in the straw area, which shows that straw is an affiliation promoter. According Boissy *et al*. (2007), positive effects of affiliative behaviour can be attributed to improved group cohesion, building or strengthening of bonds between group mates and reduced aggression. Evidently, allowing and encouraging the animals to perform behaviours that are associated with positive emotions improves their welfare (Spinka, 2006).

CONCLUSIONS

Our enrichment study showed that, when given the choice between two areas with similar resources, lambs prefer straw bedding, on which there are also less agonistic interactions and stereotypies. The animals in the straw area spent more time resting and had more affiliative behaviour than without straw, which suggests that straw promotes affiliation which may reduce the biological cost of adaptation to the feedlot. Our results could be useful to convince system managers that the availability of straw during the finishing phase of fattening will be beneficial to lamb welfare, and add an extra ethical value to the product.

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