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Research

Semiextensively reared lactating ewes: Effect of season and space allowance reduction on behavioral, productive, and hematologic parameters

Pasquale Centoducati, Aristide Maggiolino*, Pasquale De Palo, Paola Milella, Alessandra Tateo

Department of Veterinary Medicine, Faculty of Veterinary Medicine, University of studies of Bari, Valenzano, Bari, Italy

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ABSTRACT

Thirty lactating Comisana breed ewes were used for the trial and were subdivided into 2 experimental groups. Both experimental groups were placed on pasture during daylight hours and reared in 2 equal indoor pens during nighttime. The indoor pen was provided with an outdoor area allowing 2.5 m^2 per head and was always available during nighttime housing. During the experiment, the density of indoor pens varied weekly, whereas the outdoor area did not change. The indoor stocking densities tested were low stocking density (1.5 m^2 per ewe), medium stocking density (1.0 m^2 per ewe), and high stocking density (0.5 m^2 per ewe). Throughout the trial period, indoor experimental pens were provided with unlimited access to water and a consistent number of feeding places at troughs equal to the number of ewes in the pen. Each density test lasted 7 days. The first 5 days were used to allow adaptation to experimental conditions. During the last 2 nights (sixth and seventh day), we recorded behavioral patterns. Jugular vein blood samples were taken to determine the hematologic and biochemical profile. Ewe milk yield was recorded on the seventh day, and individual milk samples were analyzed for milk composition, renneting properties, and somatic cell count. All the experimental activities were performed during winter and summer seasons to evaluate the effect of both seasons and space allowance on all parameters considered. No effects of space allowance and season were observed on hematologic and biochemical parameters ($P > 0.05$). During summer, animals spent more time in external areas, and this time increased with the reduction of space allowance. Ewes spent more time standing ($P < 0.001$) and less time lying down ($P < 0.001$) during the summer. During winter, in contrast, ewes did not use external area, but they spent more time standing and less time lying down in the indoor pens ($P < 0.001$). Milk production was poorly affected by stocking density. However, these results suggested that behavioral measurements seem to be more sensitive for the detection of stressful conditions as compared with other commonly used measures like endocrine, biochemical, or productive indicators of welfare in short-term stocking increase.

Introduction

In some production systems, farm animals compete for resources: Food may be distributed in a limited space, access to water and attractive lying places may be limited, and freedom of moving around, itself, may be restricted. Increased space allowance is generally considered to improve the welfare of farm animals (Bøe et al., 2006). Space allowance and housing conditions can markedly affect the welfare of farm animals. Intensive farming systems are characterized by a large number of animals per unit of space to maximize production levels (Estevez et al., 2007; Caroprese et al., 2009).

Different studies across different species have evaluated the effects of space allowance on behavior, health, and production measures. In loose-housed dry sows, increased space allowance has been shown to decrease aggression and lesion score (Weng et al.,

* Address for reprint requests and correspondence: Aristide Maggiolino, DVM, PhD, Department of Veterinary Medicine, Faculty of Veterinary Medicine, University of studies of Bari, S.P. per Casamassima, Km 3, Valenzano 70010, Bari, Italy, Tel: +39 0805443919; Fax: +39 0804679925.
E-mail address: aristide.maggiolino@uniba.it (A. Maggiolino).

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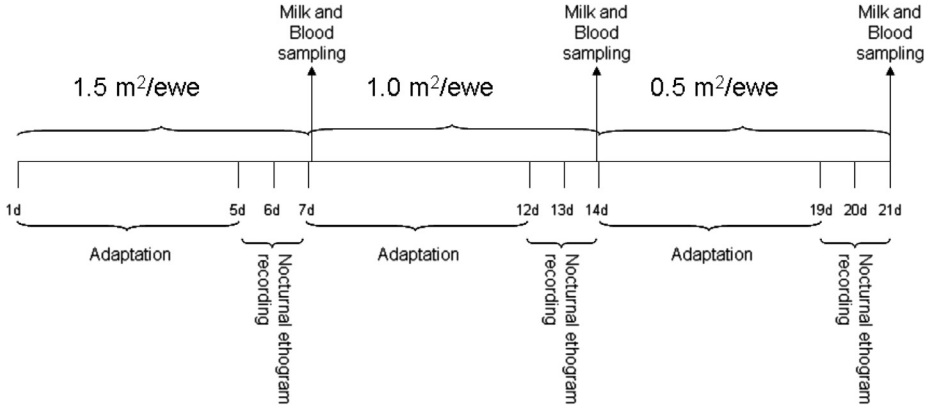

Figure 1. Experimental protocol applied to the 2 lactating ewe groups.

1998). In finishing pigs, the average daily gain was significantly reduced when space allowance was reduced (Hyun et al., 1998). In cattle, increased space allowance is associated with an increased weight gain, increased lying time, more synchronous lying, and fewer aggressive interactions (Zeeb et al., 1988; Fisher et al., 1997; Mogensen et al., 1997; Nielsen et al., 1997). In sheep, Gonyou et al. (1985) found that reducing the space allowance resulted in a lower daily gain, whereas Arehart et al. (1969) did not find any relation between space allowance and daily gain when increasing the space allowance over 0.37 m^2 per lamb. Space reduction also appears to result in more rigid dominance relationships and increased aggressive behaviors (Dove et al., 1974; Lynch et al., 1985).

The Commission Regulations (EC) 834/2007 and 889/2008 indicate that the minimum space allowance in organic sheep farming is 1.5 m^2 per adult sheep of indoor area plus 2.5 m^2 per adult sheep of outdoor paddock for nocturnal rearing. During daytime, animals must be conducted on pasture. Traditionally, grazing has played a prominent role in sheep rearing in the Mediterranean basin, so the required nocturnal indoor densities represent an "obstacle" for the conversion of farms from conventional to organic methods. Lack of large indoor areas made farm conversion from conventional to organic difficult, so this process would only be possible through further building enlargement or by reducing flock size.

We sought to evaluate the effect of space allowance reduction using a behavioral, physiological, and productive point of view, both in summer and winter periods, representing the extreme seasons in the Mediterranean, to make available new information useful to improve sheep rearing system, productivity, and animal welfare.

Materials and methods

Animals and rearing conditions

Thirty Comisana breed lactating ewes were used and subdivided into 2 groups of 15, with homogeneous live weight (57.48 ± 2.17 kg), body condition score (2.84 ± 0.29), parity (2.76 ± 0.95 lambings), and days in milk (94.67 ± 8.33 days). One group was tested during summer period (from the 3rd to the 23rdof July) and one group was tested during winter period (from the 7th to the 27th of January). All the experimental groups were kept on pasture during daylight hours and reared in 2 equal indoor pens during nighttime. The indoor pen was provided with an outdoor area allowing 2.5 m^2 per head, which was always available during night housing. During the trial the indoor pen density varied weekly. The indoor stocking densities tested were as follows: low stocking density (1.5 m^2 per ewe), medium stocking density (1.0 m^2 per ewe), and high stocking density (0.5 m^2 per ewe). Indoor experimental pens guaranteed unlimited access to water and a consistent number of feeding places at the trough equal to the number of ewes in the pen. An integration of the grazing ration of oat hay and commercial feed was administered as dry total mixed ration in relation to pasture nutritive level. Each 7-day density test was performed by modifying the space allowance of the indoor nocturnal pens. Outdoor space allowance did not change during the trial. The first 5 days were used to allow adaptation to experimental conditions. During the last 2 nights (sixth and seventh day), we recorded behavioral patterns (Figure 1). These recordings were made from 8 PM to 5 AM for a total of 18 hours in 2 days. The evaluation of the ethogram of all experimental groups was done only for nighttime behaviors because only in this period the ewes were confined and kept at different densities, whereas during daytime they were on pasture without differences in stocking density. During the seventh day milk and blood were sampled. At the end of the 7th day, space allowance of the indoor pens was reduced for both experimental groups creating the conditions of a higher density, and then the experimental protocol was repeated. In this way, the same groups of ewes were tested for the 3 densities, from the lowest (1.5 m^2 per ewe) to the highest (0.5 m^2 per ewe).

Behavioral patterns

Animals were individually marked on their fleece with a nontoxic sheep marking spray (Raidex; Dettingen an der Erms, Germany). After the first 5 days of adaptation for each stocking density and for each season, the group was observed from 8 PM to 5 AM for 2 consecutive nights (6th and 7th). Total observation time was 18 hours (9 hours per night).

Behavioral observations were video recorded and were taken by the same trained observers for all parts of the trial. The following behavioral patterns were recorded: lying down, standing, feeding, aggressive behavior, watering, self-grooming, urination, defecation, and nonaggressive interaction (Table 1).

Behavioral categories were expressed as total time spent in 18 hours and individual frequencies per hour, but short-lasting events (aggressive behavior, watering, self-grooming, urination, defecation, nonaggressive interaction) were expressed only as frequency per hour.

Blood sampling and analysis

Before the morning milking and at the end of the second day of behavioral recording, 3 blood samples were collected for each ewe: 1 in a 10-mL blood collection tube with potassium EDTA (for the