

EFFECT OF WINTER HOUSING FACILITIES ON ANIMAL HYGIENE, SOMATIC CELL SCORE AND MASTITIS INCIDENCE

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SUMMARY

Three designs of wood-chip out-wintering pad (OWP) (sheltered, unsheltered and OWP with silage provided on top of the woodchips) were compared to indoor cubicle accommodation with regard to cow cleanliness, somatic cell score (SCS) and mastitis incidence. Cows on OWPs were accommodated at a stocking density of 14.52m² per head. Although sheltered cows were cleaner than cows on the unsheltered OWPs, there was no difference in SCS or mastitis incidence between treatments. Accommodating animals on OWPs at this stocking density during the winter poses no greater threat to udder health than housing indoors in cubicles.

Keywords: dairy cow, animal hygiene, mastitis, somatic cell count

INTRODUCTION

Mastitis is one of the main production diseases of dairy cows. The disease leads to reduced milk production (Rajala-Schult, 1999), increased costs due to prevention and treatment (Kaneene and Scott-Hurd, 1990), and may ultimately result in the culling of animals (Grohn, et al., 2005). Unhygienic accommodation systems have a negative impact on udder health (Bartlett et al., 1992), so in developing alternative accommodation systems it is important to consider the potential for maintaining a clean environment. Outwintering pads (OWP's) are a low cost winter accommodation system for cattle that may be a suitable alternative to indoor cubicle housing for dairy cows in Ireland. They consist of a woodchip lying area, with or without shelter, which has a drainage system underneath. Grass silage can either be conserved on top of the woodchips to facilitate self-feeding, or fed from an adjacent concrete feed face. Under optimum management conditions the woodchips are replaced when they become soiled. OWPs pose no threat to the health and welfare of beef cattle (Hickey et al, 2002). However, previous work showed that housing spring calving dairy cows on an OWP at a high stocking density (6m² woodchip area/head) during the winter leads to higher dirt scores while on the OWP, and reduced udder health three weeks post-calving compared to cows in cubicles or on an OWP with a lower stocking density (12m² woodchip area/head) (O'Driscoll et al., 2006). Results from the latter were confounded by the fact that cows accommodated at the high stocking density had shelter, while cows at the low stocking density did not. The objective of this study was to compare three OWP options for spring calving dairy cows that incorporate various design features (concrete feed face vs. self-feeding on the woodchips; sheltered vs. unsheltered) with traditional indoor cubicle

housing. Stocking density was the same on all OWP's. The measures chosen for analysis were dirtiness scores, incidence of mastitis, and somatic cell scores (SCS).

MATERIALS AND METHODS

Animals and treatments

Ninety six pregnant dairy cows (*Bos Taurus*) (40 primiparous and 56 multiparous) were blocked according to breed [Holstein-Friesian or Norwegian Red], parity (1.56 ± 1.785), expected calving date (ECD) (22 Feb 2006 \pm 20.1 days) and body condition score (3.09 ± 0.29) into 8 groups. Animals were randomly assigned to one of the following treatments; (i) indoor cubicles (IC), (ii) an unsheltered OWP with a concrete feed face (UP), (iii) a sheltered OWP with a concrete feed face (SP) and an unsheltered OWP with a self feed silage pit (SF) in two replicates. Multiparous and primiparous animals were assigned to treatment on 17 November 2005, and 5 December 2005, respectively.

Indoors the cubicles were bedded with rubber mats and provided at a ratio of 1:1. They were of a 'Super Dutch Comfort' design (O'Connell, et al., 1991) and were manually cleaned and treated with lime each day. Animals on UP and SP were allocated 12m² woodchip space allowance per head and a concrete feed face allowance of 2.52m² per head (40cm per cow). SF cows had a woodchip space allowance of 14.52m² per head. IC cows were also fed silage from a concrete feed face with 40cm per cow. The feed face of IC, UP and SP was cleaned 6 times daily by an automatic scraper. The feed faces in each SF replicate were 13.5m in length. In order to prevent spoilage of the silage, it was necessary for 26 animals to feed from these areas. For this reason 14 'filler' cows were allocated to each of the SF replicates. OWPs were scored weekly for cleanliness using a subjective 4 point scoring scale (1=fresh woodchip, 4=extremely soiled woodchip), and managed so that each animal had a clean lying area of 2.2m²/head.

All multiparous cows were dried off by 17 November 2005. The mean calving date was 21 February 2006. Approximately 3 days pre-calving (3.2 ± 5.51 days) animals were removed to a straw bedded calving shed. Cows remained with the calf until the next milking, after which they returned to a separate straw bedded shed for one night. Thereafter, cows that calved between 24th January and 13th February 2006 (n=40) were kept on a separate unsheltered OWP by night and were at pasture by day, until 14th February, when they were kept at pasture both day and night. Cows that calved from 14th February onwards were at pasture by day and night. As cows calved and were turned out to pasture the stocking density in each treatment was maintained by adjusting an electric wire (UP, SP and SF) or metal gate (IC) accordingly. Cows were re-randomised and accommodated on either an unsheltered OWP (n=36) or at pasture (n=60) from 18 April which was the start of the breeding season, for 6 weeks after which they all returned to pasture until the following November. All cows were dried off by 19 December 2006.

Grass silage was offered *ad-libitum* daily in the morning at 0.1kg above requirement in order to ensure animals were not restricted. Fresh water was available from self-filling troughs in each treatment. While at pasture animals were managed as a single herd. Pasture consisted primarily of perennial ryegrass (*Loilum penne*). (Animals that were accommodated on UP during the breeding season were offered freshly cut grass *ad-libitum* each morning).

Animal dirtiness scoring

Animals were scored for dirtiness at the beginning of the experiment, and subsequently approximately every 2.5 weeks (17 ± 3.3 days) until 30 January. Only animals that had not yet calved and were still in their treatment groups were scored. The animal was scored on the left side of the body, which was subdivided into 5 areas; front leg, rear leg, hind quarter, belly and udder, and each section scored using a scale from 1 (clean) to 4 (completely soiled) in half score increments. The sum of these scores constituted the overall dirtiness score for each animal (max = 20, min = 5). The scoring system was tested for inter and intra observer repeatability prior to the experiment.

Somatic cell count (SCC)

Cows were milked twice daily for the entire lactation, at approximately 07:00 and 15:30. Milk yield was measured at each milking for every cow using electronic milk meters. Clusters removed automatically once milk flow fell below 0.2kg/min. Individual cow milk samples were taken approx. every other week (15.4 ± 5.84 days) at one morning milking, and SCC determined using the Bentley 300 (Bentley Instruments Incorporated, USA). The last sample to be included in the analysis was taken on 1 November 2006. On average 14.4 ± 3.48 samples were taken per animal.

Clinical mastitis (CM)

Clinical mastitis was assessed daily by the stock people over the period from assignment to winter accommodation, and the following inter-calving period. The udder was observed for redness, soreness, and/or inflammation as indicators of CM. On identification of a case of CM a sample of milk from the affected quarter was taken aseptically and analysed for bacteriology. These recorded cases are referred to as CM, and are based solely on the herdsman's interpretation of CM (Pryce et. al., 1999).

Quarter milk samples (QMS)

Quarter milk samples were taken at drying off (30 November 2005), approx. 3 weeks post partum (18.3 ± 3.52 days), and on 14 June 2006. All samples were analysed for bacteriology as well as SCC quantification. Quarter milk samples were also collected 1.8 ± 1.29 days post calving, and assayed for California Mastitis Test (CMT) and bacteriology. On each QMS test day all milk samples were collected aseptically from all udder quarters into individual sterile plastic containers after drawing of foremilk. Clinical mastitis was diagnosed at each QMS test day when macroscopic changes in the milk or udder were observed. Subclinical mastitis was diagnosed at each QMS examination when $SCC > 500,000$, $CMT > 2$, and no macroscopic changes were evident.

Statistical analysis

All data were analysed using the Statistical Analyses System (SAS, V9.1). The animal was considered the experimental unit. Data was tested for normality prior to analysis. A log₂ transformation of SCC to SCS was used to normalize the data distribution. Dirt scores were analyzed using repeated measures, with inspection day as the repeated variable using the MIXED procedure. Treatment and inspection day were considered fixed effects. Replicate was considered a random effect. The interaction between treatment and inspection date was also examined.

Lactation average SCS was calculated as the mean of all SCS test day records for each cow within the lactation. Average SCS was also calculated for three stages of lactation: 6 to 60 days in milk (DIM) (early), 61 to 220 DIM (mid), and 221 to 305 DIM (late). Lactation average SCS was analysed using ANOVA with a mixed model. Replicate was included as a random effect. Cow was nested within replicate and treatment. Treatment, whether the animal was accommodated on treatment while lactating, accommodation during the breeding season, lactation number and breed were treated as fixed effects. Average SCS for each stage of lactation was also analysed using a similar model. Residuals were examined to verify normality and homogeneity of variances. Differences in the incidence of CM, SCM, and the incidence of pathogens detected in QMS were analyzed using Fishers exact probability test.

RESULTS

On January 20th 2006 there was less than the recommended clean lying area per cow in all treatments so all OWP's were cleaned and the woodchips were replaced. Treatment had an effect on animal hygiene, SF cows having the highest dirtiness scores overall (9.8 ± 0.27 , mean \pm s.e.) and SP cows the lowest (8.3 ± 0.27 ; $P < 0.001$). There was no difference between SF and UP or between IC and SP ($P > 0.05$, data not shown). There was no difference in dirtiness scores between treatments at the initial exam (8.3 ± 0.27 ; $P > 0.05$), or at the final exam (post cleaning) (9.1 ± 0.18) (Figure 1.). Dirt scores in IC remained at a level similar to the initial exam over the course of the experiment ($P > 0.05$). Cows in SP had numerically the lowest score at the initial exam, and a score similar to IC on all other occasions. However, dirtiness scores in UP and SF increased from the start of the experiment until the OWPs were cleaned.

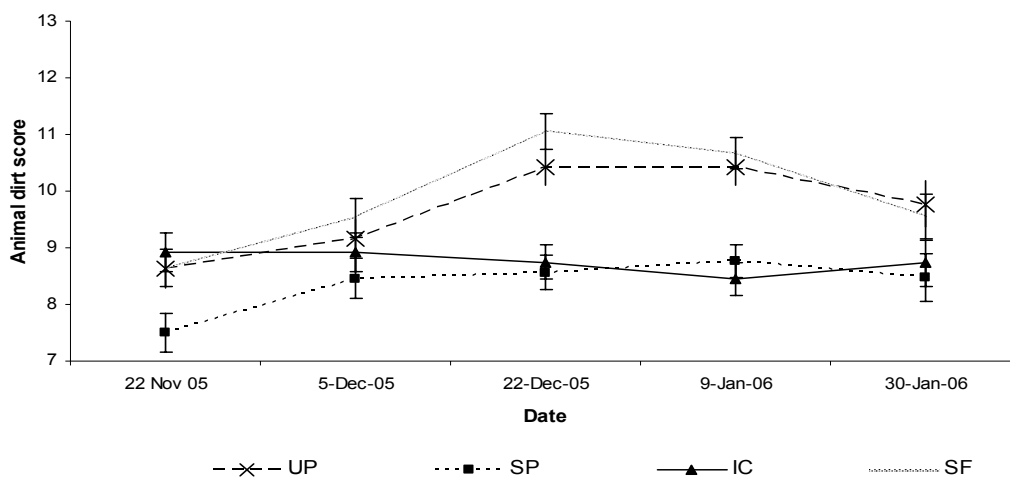


Figure 1. Effect of treatment on the dirtiness scores of cows at five inspections

There was no effect of treatment on average SCS over the entire lactation, or in stages 1, 2 or 3 of lactation ($P > 0.05$, data not shown). There was only 1 case of CM during the dry period, and this occurred in SF. There was no difference in the number of animals displaying symptoms of CM at calving or during the lactation period. There was no difference in the number of animals on each

treatment diagnosed with SCM at drying-off, at calving, at the three week post partum exam, or on 14 June, or in the number of animals that had pathogens isolated from QMS on any test day ($P > 0.05$, data not shown).

DISCUSSION

Initial animal dirtiness score assessment was conducted as cows were assigned to winter accommodation treatment, and so were typical of dirtiness scores of cows at pasture (all animals were managed at pasture prior to the experiment). In this experiment the dirtiness scores of animals that were sheltered from the weather did not change significantly from the initial inspection for the majority of the accommodation period, regardless of whether they were indoors in cubicles, or outdoors on a sheltered OWP. In contrast, animals on both unsheltered OWPs had higher dirtiness scores than at the beginning of the trial at all but the last inspection, which occurred after the OWP's were cleaned. In comparison to the unsheltered pad where cows were fed from a concrete feed face that was cleaned regularly, the feeding area of the second unsheltered OWP with the self-feed silage was much dirtier as it was not possible to remove soiled material on a regular basis in this system. Nevertheless, there was no difference in animal dirtiness scores between both unsheltered pad designs. This is probably due to cows in the self-feed system selecting areas away from the feed face area to lie down. Although previous work found no effect of shelter on animal hygiene (Hickey et al., 2002) cattle in that experiment were only sheltered by windbreaks and not overhead from rain. Thus moisture is an important factor determining animal cleanliness probably because moist faecal matter attaches to an animals coat more easily than dry matter.

In a similar experiment (O'Driscoll et al., 2006) animals that were accommodated on a sheltered OWP at a high stocking density (6m^2 woodchip area/head), had much higher dirtiness scores than animals accommodated on an unsheltered OWP at a lower stocking density. This suggests that a high stocking density in sheltered OWPs negates any positive effects of shelter on animal cleanliness. One reason why animals at the high stocking density had high dirt scores is that a high stocking density not only increases the number of animals per area woodchip, but also results in a higher manure load on the woodchip area. Although in a sheltered OWP manure may not be as moist as on an uncovered OWP, a greater volume of manure may result in a thick fecal layer building up more quickly, and probably more contact between the animals' coats and manure when they lie down. Findings from this study, however, clearly demonstrate that overhead shelter in itself does not result in high animal dirtiness scores

Furthermore, O'Driscoll et al. (2006) reported that the combined incidence of clinical and sub clinical mastitis was higher in the sheltered OWP than in either the unsheltered OWP or indoors in cubicles ($P < 0.05$). Infectious agents were also isolated in that experiment from more animals in the sheltered OWP than in the other two treatments three weeks post calving. Intra-mammary environmental pathogens are significantly associated with udder hygiene scores (Schreiner and Ruegg, 2003) so it is likely that dirty conditions led to these udder health problems. The lower stocking density in the sheltered OWP in this experiment resulted in superior animal hygiene, and this is reflected in the lack of difference in incidence of mastitis, sub-clinical mastitis, and the presence of intra mammary pathogens between treatments.

After cleaning of the OWPs and application of fresh woodchip, animal dirtiness scores on the uncovered OWPs returned to a level similar to that recorded indoors in cubicles and in the sheltered OWP. This may have important management applications. Assessment of animal

hygiene by the stockperson during the dry period, and subsequent removal of dirty animals to clean accommodation, or replacement of bedding, may improve animal hygiene during the dry period. There is evidence that intra-mammary infections that occur during the dry period can cause clinical disease post-calving (Green et al., 2002), and thus these management practices may reduce the risk of developing intra mammary infection during the following lactation.

Results from this study indicate that dairy cow hygiene is affected by the cleanliness of bedding, and also by the presence of shelter from weather. However, although animals on both uncovered OWPs had higher dirtiness scores than animals in the other accommodations, this did not affect SCS or mastitis incidence post-calving. Therefore management of the OWP's was sufficient so that milk quality and animal health was not compromised when compared to animals accommodated in traditional indoor cubicles during their dry period. These findings have important implications for the management of dry cows.

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