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Lying patterns of high producing healthy dairy cows after calving in commercial herds as affected by age, environmental conditions and production

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ABSTRACT

An animal expresses its physiological and well-being status by its behaviour. Changes in behaviour can be associated with health, production or well-being problems and therefore with the profitability of the farm. The objectives of the present study were to analyse lying patterns of healthy cows, collected with a commercial behaviour sensor, in early lactation in relation to environmental conditions, age of the cow and production performance. In future, these results may be used as a 'baseline' for detection of alterations in behaviour that indicate health problems. The study involved 210 healthy multiparous Israeli Holstein cows in three commercial dairy farms. Only healthy cows during the first 28 days after calving were included in this study. Data were analysed in relation to calving season, age of cows and correlation between milk production and lying time.

The results show that lying time increased significantly with age and is significantly ($P < 0.05$) higher in winter than in summer (summer lactation 2: 491 ± 17 min/day (mean $\pm$ SD), summer lactation 3 and more: 520 ± 25 min/day, winter lactation 2: 531 ± 25 min/day, winter lactation 3 and more: 579 ± 38 min/day).

The proportion of positively and negatively milk production and lying time correlated cows is affected by calving season.

This study indicates that behaviour variables in early lactation are affected by calving season, lactation number and type of correlation between milk production and lying time.

1. Introduction

When milk production starts after calving, nutrient demand, and therefore also demand for energy, protein and minerals increases dramatically, which results in metabolic changes (Ingvartsen, 2006). The period from late gestation to early lactation is also associated with hormonal changes (Holtenius et al., 2003). The cows experience immunosuppression and have to cope with sudden dietary changes after calving (Mulligan and Dohorty, 2008). The diet shifts from a high-roughage ration fed during the dry period to a more energetic, low-roughage total mixed ration (TMR) fed immediately after calving (Adin et al., 2009). This shift can cause digestive disturbances (Mulligan and Dohorty, 2008). Additionally, there are environmental stressors arising from the normal group changes that are associated with dairy farm management of dry and lactating cows (Mulligan and Dohorty, 2008). Early lactation is therefore a sensitive period in the life of a cow, in which the majority of health problems occur (Ingvartsen, 2006).

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An animal expresses its physiological and well-being status through behaviour. Changes in behaviour, e.g. lying behaviour or feeding behaviour, can be associated with health problems, well-being, production and therefore with the profitability of the farm (e.g. Bewley et al., 2010; Huzzey et al., 2005). Tolkamp et al. (2010) suggest that information on standing and lying behaviour can be used for early diagnosis of disorders. Several studies relate lying behaviour to well-being (e.g. Fisher et al., 2003; Haley et al., 2001) and production (Bewley et al., 2010; Fregonesi and Leaver, 2001). The amount of time spent lying down resting is considered to make a significant contribution to the well-being and comforts of dairy cows (Fisher et al., 2003; Tolkamp et al., 2010), because cows have a strong behavioural need to rest and attempt to maintain a rather constant lying time (Metz, 1985; Munksgaard et al., 2005). When lying time is disturbed, dairy cows cannot recuperate sufficient, they can show aversive behaviour (Munksgaard and Simonsen, 1996), they may experience discomfort or pain and are at an increased risk for health problems such as lameness (Galindo et al., 2000; Juarez et al., 2003). Lying time is also associated with rumination. Cows spend most time ruminating while lying down (Cooper et al., 2007; Philips and Leaver, 1986).

It was shown by Arazi et al. (2010) that there were significant alterations in lying time in early lactation when milk production increased from zero up to more than 50 kg/day within a short period of four weeks. However, no attempt was made to study lying time and/or other behavioural variables of healthy cows after calving in relation to the age of the cow (lactation number), calving season (summer or winter) and production level. One of the reasons for the lack of information about behaviour was that in the past, behaviour had to be recorded manually (Fregonesi and Leaver, 2001; Perera et al., 1986) or with video recordings (e.g. Halachmi et al., 2000; Munksgaard et al., 2005). This was time consuming, subjective and could only be done on a small scale. The development of dairy farming to more intensive production systems, with large numbers of cows per herd and the use of automatic milking units and feeders increased the need for 'real-time' information recorded in commercial farms. This can be achieved only by integrated monitoring systems and sensors to get a wider range of information (Frost et al., 1997; Halachmi et al., 2000). Recently, a commercial behaviour sensor became available that can be used to characterize a variety of behavioural variables under commercial conditions (Livshin et al., 2005). Hence the possibilities for behavioural studies for applications on commercial farms increased considerably (Tolkamp et al., 2010).

The objectives of the present study were to analyse lying patterns of healthy cows in early lactation (from calving to four weeks in lactation) with the use of commercial behaviour sensors. The lying patterns were analysed in relation to the age of the cow, environmental conditions and production performance in order to provide practical information to the stockperson about the optimal course of lactation progress after calving. Diversions from this behavioural pattern may evolve in the future into an early warning for health problems.

2. Materials and methods

2.1. Animals and housing

The study involved 210 healthy multiparous Israeli Holstein cows in three commercial Israeli dairy farms, one of 65 and two of 250 milking cows (Table 1). In one of the farms with 250 cows only one group of 60 cows was investigated. For 34 cows more than one lactation was included in the study. These cows were evenly distributed across all farms according to herd size. In total 246 lactations were analysed. Only healthy multiparous cows during the first 28 days after calving were selected for this study. A healthy cow was considered as one that (i) did not have a reported occurrence of a metabolic, digestive, post-calving or any other disorder during the first 28 days after calving, (ii) had a normal lactation curve increasing gradually with no 'collapses' during the period of 28 days after calving, (iii) did not suffer from lameness, injuries or other reported health problems. When body weight measurements were available (69% of the cows), also the body weight curve was checked for abnormal 'collapses' during the period of 28 days after calving.

Every cow was routinely checked by a veterinarian between 7 and 12 days after calving. All health problems (such as ketosis, metritis, retained placenta, milk fever, mastitis), treatments, and vaccinations were updated in the management software (see Section 2.2). The housing system was similar in all three dairy farms.

The cows were housed as groups in no-stalls fully roofed open cowsheds with no bedding, which is the common dairy housing in Israel. The cows could move freely in the open yard and the available space was about 22 m^2 per cow. In the small dairy farm the cows were kept in one group, and in the larger farms the cows were housed in groups of about 40–70 cows in similar sheds.

The cows were milked thrice daily, in intervals of 8 h, in a herring bone milking parlour. All cows were fed a TMR according to NRC (2001) recommendations. A local feeding center distributed the feed once per day between 8:00 AM and 11:00 AM.

In summer the cows were cooled. All farms used the same cooling procedure, based on water evaporation from the cow's surface. Each cooling period lasted 45 min and consisted of several cycles of showering followed by forced ventilation (ICBA, 2009). The cooling procedure started every year in April. The cows were routinely cooled three times per day in the waiting area before milking. As summer progressed, the cows were brought twice per day to the waiting yard of the milking parlour and forced cooled between morning and noon milking and between noon and evening milking too. In the hottest period of the summer, the cows were also cooled between evening and morning milking. Therefore, the extra time spent in the waiting area before milking during summer was at most 2.25 h/day (three cooling sessions between milkings). The cooling procedure stopped gradually according to the climate. The distance between the cowshed and the waiting area before milking was at most 35 m.