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Estrus detection and estrus characteristics in housed and pastured Holstein–Friesian cows

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Abstract

This study compared three methods of estrus detection and characteristics of standing estrus between dairy cows kept in cubicle housing and fed a total mixed ration diet (HOUSED treatment) and those kept at pasture with concentrate ration supplementation (PASTURE treatment). The 23 spring-calved Holstein-Friesians in each treatment were monitored by three estrus detection methods simultaneously—visual observations, tail paint and radiotelemetry (HeatWatch)—for 9 wk. Milk progesterone profiles were used to determine the dates of true standing estrus events. All three detection methods had a higher efficiency of estrus detection in the PASTURE treatment than in the HOUSED treatment ($P < 0.001$), but there was no difference in the accuracy of estrus detection between the two treatments ($P > 0.05$). Within each treatment there was no difference between the efficiency and accuracy of the three methods ($P > 0.05$). HeatWatch was as efficient as visual observations at detecting standing estrus events. However, during visual observation sessions all occasions when animals were observed standing to be mounted were not recorded by HeatWatch. More cows expressed sub-estrus events and fewer expressed standing estrus events in the HOUSED than in the PASTURE treatment ($P < 0.05$). The interval between parturition and the second standing estrus was longer in the HOUSED treatment than in the PASTURE treatment ($P < 0.05$). All three detection methods were much less effective in the HOUSED than in the PASTURE treatment. This is because all of the detection methods tested relied solely on standing to be mounted and this was reduced in the HOUSED cows. Alternative approaches to estrus detection are needed for cows kept indoors on concrete.

Keywords: Dairy cows; Estrus behaviour; Estrus detection; Housing; Radiotelemetry

1. Introduction

Efficient and accurate detection of estrus is vital to good reproductive performance in a dairy herd where artificial insemination is used [1] and in turn is essential to maintain profitability [2]. Problems with estrus detection can lead to major financial implications for farmers and increase the number of cows culled for infertility [3]. Over recent decades the fertility of dairy cows has declined, with a contributory factor being a decline in estrus expression [4].

Cows express a number of behavioural changes during estrus, including an increase in chin resting, anogenital licking and sniffing, aggressive interactions [5], and mounting other cows [6]. However, the primary behavioural sign is standing to be mounted by another cow or a bull [7]. The period between the first and last time the cow stands to be mounted is known as standing estrus. Many estrus detection methods use standing to

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be mounted as the only criterion to determine whether a cow is in estrus.

The most widely used method of estrus detection is visual observation and high detection rates can be achieved with between two [8] and five [4] 20–30 min observation sessions per day. Tail painting, where a strip of paint is applied over the tail head and disruption of the paint strip shows possible mounting activity [8], can be used alone or in combination with visual observations as a continuous monitor of mounting activity. More recently, radiotelemetric devices such as HeatWatch have been developed. They comprise a pressure sensitive transmitter attached anterior to the tail head which records each time an animal is mounted [8,9].

The expression, and hence detection, of standing estrus is affected by a number of factors. These include the number of animals in estrus simultaneously [10], lameness [11], housing type [12], and the surface underfoot, with estrus expression reduced on concrete surfaces compared to dirt surfaces [13].

In recent decades, there has been an increase in the practice of housing cows year round and feeding a total mixed ration (TMR) diet. At present, the most economical system of dairy farming in Ireland is pasture-based with compact spring calving [14]. However, with changes in the reproductive physiology of modern dairy cows [15], declining fertility [4], and the planned abolition of milk quotas in the European Union, this may not always be the case. Hence, this study was carried out as part of a project comparing the welfare and production characteristics of dairy cows kept in a year round cubicle housing system (zero-grazing) with those of cows managed in a traditional pasture-based system [16].

The first aim of this study was to compare the detection efficiency and accuracy of HeatWatch, tail paint, and visual observations between animals in a cubicle house fed a TMR diet and animals at pasture offered a diet of grass and supplementary concentrates. The second aim was to compare the characteristics of standing estrus measured by radiotelemetry (HeatWatch) between the two treatments.

2. Materials and methods

2.1. Study animals, housing, and management

This study was conducted between March and June 2007 at Teagasc, Moorepark Dairy Production Research Centre, Fermoy, Co. Cork in the South of Ireland (55°10′ N, 8°16′ W). The minimum and maximum temperature and relative humidity values recorded at the automated Met Eireann weather station at the research centre during the period of this study (March–June) were −1.1–24.1 °C (30.0–75.4 °F) and 60.3–94.9%, respectively. A total of 46 (12 primiparous, 34 pluriparous) spring-calved Holstein-Friesian cows were selected from the Moorepark herd (N = 257). All animals were identifiable with a 3 or 4 digit freeze brand. The pregnant animals were blocked and paired (23 blocks of 2 cows each) according to genetic merit (Irish economic breeding index (EBI) value (€60, ±€17.3; mean, ±SD), parity (2.5, ±1.49), expected calving date (6th March, ±27.9), body condition score (BCS 3.0, ±0.69), and predicted milk (+98 kg, ±123.4) and assigned randomly from within pairs to one of two treatments. Animals were assigned to either a system in which they were indoors in cubicles and fed a total mixed ration (HOUSED; 6 primiparae and 17 pluriparae) or a pasture-based production system (PASTURE; 6 primiparae and 17 pluriparae) in which they were indoors during the winter/dry period and at pasture from calving for the duration of lactation. Treatments commenced at drying off for pluriparous animals (69, ±19 d before expected calving date), while primiparae were allocated to treatments 49 (±7) d before expected calving date. All animals were over-wintered together in a cubicle house and moved from the cubicle house to a straw-bedded calving pen approximately 24 h before calving. After the first milking the cows joined their treatment group. The mean calving date for the HOUSED animals was 28/02/07 and for the PASTURE animals was 27/02/07.

Treatment groups shared the same modern (built in 2001) cubicle house (1.2 cubicles/cow) during the dry period (November 2006 until calving). Cubicles (2.2 m × 1.2 m) were of a cantilever design [17] and bedded with a rubber mat (‘Pasture Mats’, O’Donovan Engineering, Coachford, Co. Cork). The passageway at the feed face was 4.8 m wide and between the cubicles 3.0 m wide, with a slope of 1.5% (for details see Boyle et al., 2007 [18]). The approximate passageway space per animal was 7.6 m^2. The passageways were cleaned by an automatic scraper 6 times every 24 h. The cubicle house was illuminated by supplemental lighting from sunset until 24.00 h and was naturally ventilated.

Animals in both treatments were milked twice a day, by the same staff, at approximately 07:45 and 15:30 Monday to Saturday and at 06:45 and 14:30 on Sundays.

2.2. Treatments

PASTURE treatment: As the PASTURE cows calved they were turned out to pasture on the day of calving for the period between morning and afternoon