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Daytime summer access to pasture vs. free-stall barn in dairy cows with year-long outdoor experience: A case study

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ABSTRACT

With its documented health and behavioural benefits, one would expect dairy cows to have near unconditional preference for pasture. However, dairy cow preference is multifaceted with numerous factors contributing to the choices and or actions of the cow. Experience is one such factor that may play a role in the level of preference that a dairy cow displays for pasture. In the current case study, we investigated if cows, when given the choice, would go to and remain at pasture under Eastern Canadian summer climatic conditions. Two important components were introduced in the case study: the use of a herd with year-round experience with the outdoors and the provision of the same feed options (both fresh-cut forage and haylage) inside and on pasture. In doing so, the effects of a novel, outdoor environment and feed preference could be mitigated. 32 organic Holstein cows (parity average \pm SD: 2.8 ± 2.0) averaging 9211 kg/cow milk production were submitted to a 6-d test cycle comprised of three consecutively and randomly applied 2-d phases repeated 4x over the course of 8 weeks. During these phases, cows were restricted to a free-stall barn (forced-indoor), restricted to pasture (forced-outdoor), or provided the access to both options (free-choice) for a 7-h period. Live observations of activities (drinking, eating haylage, eating fresh forage, lying, and other) were conducted every 2 min by scan sampling during the forced-outdoor and choice phases. A group level analysis with a Friedman test followed by an Asymptotic General Independence test was used to analyze the difference in time spent performing each activity between weeks and hours when forced-outdoor. The number of cows on pasture during the free-choice phase was averaged by week and hour. A 2-sample *t*-test was also used to compare time doing activities inside (free-choice phase) to those outside (forced-outdoor phase). When given the option, as a group, cows went to and remained at pasture for a majority of the time, with the exception of week 3 where a reduction in the number of cows on pasture was observed (from >90 to 40%), possibly due to inclement weather. No difference in activities were reported between the indoor vs. pasture environments. Eating fresh forage more than haylage was observed in both the indoor and pasture environments. The case study suggests that cows with outdoor experience have a strong inclination towards the outdoors and to elements such as eating fresh forages that is normally associated with the natural behaviour of grazing, providing a baseline for future research on the importance of providing outdoor access to cows for more sustainable dairy systems.

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1. Introduction

According to a recent online engagement activity conducted in Canada and the US, providing dairy cows with more natural living conditions, such as access to pasture, was viewed as important both for the general public and industry-affiliates (Schuppli et al., 2014). Studies have noted the numerous benefits of pasture on cow welfare, including the opportunity to perform natural

behaviours (Kilgour, 2012), a decrease in the prevalence of lameness (Hernandez-Mendo et al., 2007), as well as a lower incidence of udder-related issues (Washburn et al., 2002) and improved hind limb cleanliness (Nielsen et al., 2011). In addition, a well-managed pasturing system is viewed as a potentially more sustainable and environmentally conscious model for dairy production (Basset-Mens et al., 2009; Beukes et al., 2010). In organic dairy productions, pasturing of dairy cows during the grazing season is a requirement of the organic standards. (Canadian General Standard Board, 2011) and even the Canadian Code of Practice for dairy cows (Dairy Farmers of Canada-National Farm Animal Care Council, 2009) recommends dairy exercise for all dairy units, albeit at the discretion

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of the producers. However, in many of today's dairy herds, cows have been selected for maximum output which, in turn, requires a high input of quality feed that may be difficult to meet on pasture alone. Feeding high levels of a total mixed ration (TMR) in a restrictive housing setting are suggested in previous research to be a more effective method, when compared to pasture, to meet the high energy demands of modern larger and higher producing dairy cows (Kolver, 2003).

To tip the balance towards promoting one housing method over the other, there is an additional factor that may be considered: will dairy cows go to pasture if provided the option? While it may be assumed that cows prefer to be outdoors as this is the most natural environment for these animals, some studies have shown the exact opposite, with a majority of cows preferring to remain indoors and primarily utilizing the pasture only at night (Charlton et al., 2011a; Legrand et al., 2009). These studies suggest that the high-yielding dairy cows common in many modern dairy herds prefer the indoors to meet nutritional requirements. However, preference can be quite complex and may be driven by a number of factors. For instance, dairy cows that have had prior experience outdoors, such as during the grazing season (Charlton et al., 2011b) or continuously throughout the year (Krohn et al., 1992; Shepley et al., 2016) have been shown to have an increased preference for the outdoors.

The current case study is adapted from Legrand et al. (2009), which looked at the cow's preference for pasture or indoor housing. In this previous study, however, the provision of a TMR for cows remaining indoors only as well as a limited experience at pasture may have led many high producing cows to choose to remain indoors when provided a choice. The objective of the present study was to determine if cows with experience at pasture would, as a herd, go and remain outdoors on pasture or indoor in a free-stall barn during the day under typical Eastern Ontario summer conditions when provided the choice of and the same feed options in both locations. Additionally, the study sought to document cow activity when forced outside and to compare behaviours observed outside with those seen inside.

2. Materials and methods

2.1. Ethical statement

The experiment was conducted at the University of Guelph's (formerly) Alfred Campus (Alfred, Ontario, Canada) and was approved by the University of Guelph's Animal Care Committee, which adheres to the Canadian Council on Animal Care (CCAC) guidelines (CCAC, 2009).

2.2. Animals and housing

Thirty-two lactating organic Holstein cows (annual milk production: 9211 kg/cow) were selected from the formerly University of Guelph organic dairy research centre (Alfred, Ontario, Canada) and randomly assigned to four groups of eight cows balanced by stage of lactation (average \pm SD: 186.8 \pm 85.2 DIM) and parity (2.8 \pm 2.0). Prior to the start of the study, cows had year-long outdoor experience with pasture access during the previous grazing season and access to an outdoor exercise area during the winter months. During the present study, cows had constant pasture access during grazing season (April–October), except for during the twice-daily milkings at 5:00 and 17:00 h. Additionally, daily access to outdoor exercise areas was provided during the winter months. Heifers and dry cows were kept on pasture during the grazing season as a regular management practice. Rotational management of pastures was used with fresh strips of mixed pasture provided twice daily to ensure sufficient quantities of quality pasture would be

available to meet the nutritional needs of the animals following the Canadian organic standards (Canadian General Standard Board, 2011). Pasture mix was composed primarily of brome grass, timothy, and red and white clover. Shade was not available on pasture during the course of the study. Indoor housing consisted of a naturally ventilated free-stall barn consisting 43 cubicle stalls (stall width of 1.3 m, bed length of 1.9 m, stall length of 2.1 m) with geotextile mats and 2 cm of straw bedding in addition to concrete-slatted alleys. Indoor feed bunk space contained a greater number of head gates than cows. Cleaning of the alleyways and stalls occurred one time per day during the grazing season. Fresh bedding was provided as needed to maintain 2 cm of straw bedding per stall.

2.3. Procedures

Cows were subjected to a 6-d test cycle, from April 2012 to June 2012, consisting of three 2-d phases (forced-outdoors, forced-indoors, and free-choice), as described by Legrand et al. (2009). Phases were applied for 7-h durations between milkings, and cows remained as a herd on a pasture separate from those used during the phase applications the rest of the time. During the two 2-d forced phases, two groups of 8 cows were randomly combined, resulting in a different combination of 16 cows during each forced-phase application ($n=4$), and restricted to either the free-stall barn (forced-indoor) or to an outdoor pasture (forced-outdoor). The 2-d free-choice phase combined all four groups ($n=1$) of cows and allowed cows to go freely between the barn and pasture. Order of application of the forced phases was randomized from one group to the other and four repetitions were conducted every second week over 8 weeks with a rest week in between.

Two modifications to the methodology used by Legrand et al. (2009) were made: 1) the provision of the same feed options both indoors and outdoors and 2) the use of cows with experience on pasture. Freshly cut grass was delivered each morning prior to the start of observations and fed along with haylage during the forced-indoor and free-choice phases. Similarly, cows were offered haylage when at pasture during the forced-outdoor and free-choice phases. The fresh forage was approximately equivalent to 80% of the total daily dry matter intake (DMI). Fresh forage and haylage was provided at high enough quantities both inside and outside to ensure that cows had ad libitum availability of both feed types for the duration of each phase.

2.4. Observations and measures

Observations of cow activities were performed every 2 min using instantaneous scan sampling from 9:00 to 15:00 h during the forced-outdoor and free-choice phases. Two observers recorded behaviours on pasture (forced-outdoor) and indoors (free-choice), documenting the number of cows performing each behaviour during each scan sampling. Observers received the same training and inter-observer reliability was 86.1% ($K_w=0.95$). Five behaviours were observed: drinking, eating haylage, eating fresh forage, lying, and other. During the free-choice phase an additional measure, the number of cows outdoors, was calculated. A description of each behaviour can be found in Table 1.

Descriptions of weather conditions were recorded throughout the course of the study and temperature loggers (Hobo Pro Data loggers, Onset Computer Corp., Bourne, MA) were used to record air temperature and relative humidity. Air temperature and relative humidity were used to calculate the temperature humidity index (THI) following Schütz et al. (2011):

$$THI = (1.8 \times T + 32) - [(0.55 - 0.0055 \times RH) \times (1.8 \times T - 26)]$$

Where T = air temperature ($^{\circ}$ C) and RH = relative humidity (%). $THI \leq 72$, the established thermal comfort threshold for Holstein dairy cattle (Ravagnolo et al., 2000), for all but two days:

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