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Effect of aluminized reflective hutch covers on calf health and performance

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ABSTRACT

The effect of polyethylene hutches wrapped in aluminized reflective covers (ARC) on health and performance of pre-weaned Holstein heifers during summer was evaluated. Ambient and hutch temperature and temperature-humidity index (THI) were also assessed. The study was conducted from June to October 2016 where temperature, humidity, and THI ranged from −1.3 to 38.4°C, 9.8 to 99.7%, and 33.6 to 81.1 units, respectively. Heifers enrolled at 1 d of life and housed in individual polyethylene hutches with (covered) or without (control) ARC were monitored until 60 d of life in 2 study groups (SG1, n = 94, monitored from June to September; and SG2, n = 101, monitored from August to October 2016). Calves were assessed twice per week for health status, behavior, rectal temperature, and respiratory rate. Similarly, hutch inner wall and sand bedding temperatures were determined for comparison between covered and control hutches housing calves. Four empty hutches per treatment group were continuously monitored for temperature and THI. The odds (95% confidence interval) of presenting diarrhea were 1.30 (1.01–1.60) times greater for calves housed in covered hutches than for those in the control group. Similarly, the odds of an abnormal ear score were 1.40 (1.03–2.00) times greater for calves in covered hutches compared with calves in control hutches. The odds of nasal discharge, eye discharge, and clinical dehydration did not differ between treatment groups. Rectal temperatures and respiratory rates were also similar in both groups. No differences were found in average daily gain between calves housed in covered and control hutches. Calf location determined at a fixed time during the day (starting at 1200 h) was associated with the use of ARC. The odds of remaining inside the hutch were 1.33 (1.03–1.70) times greater for calves housed in control compared with covered hutches. Overall, the average of hutch interior temperature was higher in covered compared with control hutches in both studies (SG1, 23.2 ± 0.06 vs. 22.8 ± 0.06°C; SG2, 17.1 ± 0.07 vs. 16.9 ± 0.07°C). Hutch THI was higher in covered empty hutches compared with control hutches in both study groups (SG1: 68.6 ± 0.06 vs. 67.6 ± 0.06°C; SG2: 60.2 ± 0.08 vs. 59.6 ± 0.08°C). Average temperature (measured at 1200 h) of the inner surface of the hutch wall was lower in covered compared with control hutches by 1°C (24.4 ± 0.13 vs. 25.4 ± 0.13°C), whereas the temperature of the sand bedding did not differ between groups. Our results suggest that the use of ARC did not generate a hutch microclimate that resulted in significant improvements on health and performance of pre-weaned dairy calves under these specific study settings.
Key words: heat stress, aluminized cover, calf

INTRODUCTION

Calf rearing is a complex constituent of dairy systems, where adequate growth, health, and well-being are critical components (Windeyer et al., 2014). In extensive areas of the United States, calves are challenged by extreme environmental conditions occurring during the hot season, resulting in reduced weight gain and increased morbidity and mortality (Roland et al., 2016). During summer, calves are exposed to thermic stress, defined as a change in the environment causing an alteration in body temperature that is not entirely compensated by thermoregulatory mechanisms (IUPS, 2001). The adverse effects of extreme heat begin before birth, during the periconceptional period and continue until late gestation, where heat-stressed dams produce offspring with lower milk yield during their first lactation, reduced survival, and impaired immunity and metabolism (Carroll et al., 2012; Brown et al., 2016; Guo et al., 2016; Roland et al., 2016).

The association between the magnitude of thermic stress and temperature-humidity index (**THI**) has been explored in lactating cows (Johnson et al., 1963; Bohmanova et al., 2007). In adult Holstein cows, critical THI values associated with milk yield decline ranged from 64 to 76 (Igono et al., 1992; West, 2003; Bohmanova et al., 2007). Although index values below 72 are generally

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identified as within the comfort zone (Armstrong, 1994; Bohmanova et al., 2007), lower THI thresholds have been proposed in recent reports (Schüller et al., 2017). Nonetheless, reference THI values associated with the performance of pre-weaned dairy calves are not well established.

In growing calves, body temperature regulation mechanisms are immature (NRC, 2001), resulting in higher susceptibility to changes in ambient conditions (Bateman et al., 2012). Consequently, heat stress may affect behavior, DMI, ADG, rectal temperature, respiratory rate, and disease frequency and survival (Sims et al., 2015; Peña et al., 2016; Yazdi et al., 2016). To address this concern, multiple housing strategies to improve calf cooling by creating more moderate housing microclimates have been evaluated (Spain and Spiers, 1996; Hill et al., 2011; Carter et al., 2014).

Recently, the use of sunlight reflective technology to reduce polyethylene hutch interior temperatures has been proposed (Binion et al., 2014; Carter et al., 2014; Friend et al., 2014). A recent report showed a decrease of about 4°C inside polyethylene hutches, when aluminized reflective hutch covers (**ARC**) were evaluated in dairies in central Texas for a total of 21 d of data collection, during late September and August (Binion et al., 2014). However, to the authors' knowledge, no evaluations have been performed during the entire preweaning period in commercial calf rearing operations assessing the effectiveness of the expected temperature reduction on improving calf health and performance.

Considering previous reports, our hypothesis was that the expected change in temperature due to sunlight reflection provided by ARC on polyethylene hutches would indirectly have an effect on the health and performance of pre-weaned dairy calves under hot conditions. Furthermore, resulting lower temperatures would alter calf behavior during the hottest periods of the day. Consequently, our objective was to evaluate the effect of ARC applied on polyethylene hutches on health and performance of pre-weaned dairy calves during the hot season in Northern Colorado, where summer temperatures can exceed 37°C (Colorado Climate Center, 2017). Additionally, the effects of ARC on hutch temperature and THI were evaluated.

MATERIALS AND METHODS

Study Population and Calf Management

All the animal-related procedures in this study were reviewed and approved by the Institutional Animal Care and Use Committee at Colorado State University (protocol ID: 16–6704AA). This research was conducted from June to October (2016) in a large dairy calf rearing facility, part of a dairy under certified organic management, located in Colorado. Pre-weaned calves were maintained in a total area of approximately 174,000 m^2 and housed in polyethylene hutches (Agri-Plastics, Stoney Creek, ON, Canada) exposed to direct sunlight. Walls built with straw square bales (3 m high) were installed on the perimeter of the calf rearing area (Figure 1).

Calves were immediately separated from the dam at birth. During the first hour of life had their navel dipped into an iodine 7% solution and were fed 2.8 L of colostrum warmed to 37°C. Colostrum feeding was repeated at 3 and 8 h of life in the maternity facility. The colostrum globulin was determined by use of a colostrometer (Fleenor and Stott, 1980). The colostrum fed to calves had at least 52 mg/mL of globulin.

Within the first day of life, calves were transferred to the calf rearing facilities and housed individually in polyethylene hutches (inside dimensions: 201 cm length × 113 cm wide × 127 cm height). A front yard of 2.25 m^2 enclosed by a galvanized welded wire fence and sand bedding was provided. Subsequently, calves received 3.8 L of colostrum fed in a 10-h interval 4 times. At 4 d of life, calves had access to small amounts of an organic certified calf starter (16% Organic Calf Starter, Feedex Companies, LLC, South Hutchinson, KS) that increased according to intake up to 1.8 to 2.3 kg/animal per day until 56 d of life. A description of this product is presented in Table 1.

Starting at 4 d of life, calves received 2.5 L of pasteurized milk every 12 h until 14 d of life. From d 15 until d 49, calves received 3 L of milk every 8 h. At 50 d of life, milk was fed only in the mornings and at 65 d of life, calves were weaned. Water was provided from d 1 in a plastic bucket (8 L) filled twice per day.

Dehorning was performed before 30 d of life using electrical cauterization under local anesthesia with veterinary supervision. The vaccination protocol included intranasal Inforce 3 (infectious bovine rhinotracheitis, parainfluenza-3, bovine respiratory syncytial virus; Zoetis, Florham Park, NJ) at 1 d of life, Ultrabac 8 (*Clostridium chauvoei*, *Clostridium speticum*, *Clostridium hemoylticum*, *Clostridium novyi*, *Clostridium sordelli*, and *Clostridium perfringens* type B, C, and D; Zoetis) at 21 d of life, Spirovac L5 (*Leptospira canicola*, *Leptospira grippotyphosa*, *Leptospira hardjo*, *Leptospira icterohemorrhagiae*, and *Leptospira pomona* bacterin; Zoetis) plus a booster of Inforce 3 and Ultrabac 8 at 42 d of life.

In addition to health assessment by the authors, calf health monitoring was performed daily by farm personnel. Calves needing antimicrobial therapy or other drugs not allowed in organic dairy systems were sent to a conventional calf ranch for prompt treatment.