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Low colostrum yield in Jersey cattle and potential risk factors

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ABSTRACT

Consumption of an adequate volume of high-quality colostrum is vital to a dairy calf's ability to survive and become a productive herd member. However, some dairy herds have reported a deficiency of colostrum production, which ranges from a low volume to no colostrum produced, by cows during fall and winter. Little information regarding this phenomenon exists. The purpose of this study was to characterize the syndrome and identify potential risk factors for low colostrum yield. A 2,500-cow Jersey dairy farm was enrolled in a prospective cohort study in May 2016, to evaluate possible effects of photoperiod, temperature, and cow factors on colostrum production. Dairy personnel were trained to collect, weigh, and evaluate colostrum quality. Information on parity, previous lactation length, previous 305-d mature equivalent milk production, and dry period length were collected through the farm's dairy management software. Weather and photoperiod data were also collected. Over the year of enrollment, 2,988 eligible cows calved and had colostrum weights recorded and 38% were primiparous (n = 1,143), 25% were in their second lactation (n = 752), and 37% were in their third or greater lactation (n = 1,093). The overall average colostrum yield was 6.6 kg/cow in June 2016, 2.5 kg/cow in December 2016, and 4.8 kg/cow in May 2017. Multiparous cows had a larger decline in colostrum production between June and December (6.6 to 1.3 kg/cow) compared with primiparous animals (6.5 to 4.2 kg/cow). Overall, average colostrum production decreased by 0.17 kg/cow per week during this time, 0.22 kg for multiparous cows and 0.08 kg for primiparous cows. A logistic regression model was constructed for all cows to evaluate effects of cow factors on low colostrum production (<2.7 kg at first milking). Dry period length, calf sex, singleton or twin, age at freshening, month of calving and previous lactation length were significantly associated with the probability of low colostrum yield (<2.7 kg at first milking). A cross-correlation function analysis between the time series for colostrum yield and photoperiod revealed a high correlation at the time of calving and 1 mo prior, particularly for multiparous cows. A pedigree analysis showed that extreme colostrum yield (low vs. high) followed some sire lines. Low colostrum production in this herd could have an economic effect on the dairy and calf health and appears to have a strong seasonal and, potentially, a genetic component.
Key words: colostrum production, dairy cattle, photoperiod, pedigree analysis

INTRODUCTION

Colostrum feeding is a critical part of raising healthy calves, and to provide this cows must produce adequate amounts of colostrum with high concentrations of immunoglobulins, cytokines, nutritional elements, and growth factors (McGuirk and Collins, 2004). Calves not receiving sufficient IgG, and therefore suffering from failure of passive transfer of immunity, can have morbidity and mortality risks up to 5 and 6 times higher than that of herd-mates experiencing successful passive transfer of immunity (Donovan et al., 1998). Additionally, successful transfer of passive immunity through the colostrum has been associated with improved ADG in heifers and increased milk production in cows (Faber et al., 2005).

Many factors are implicated in the production of high-quality colostrum, including dry period nutrition, dry period length, parity, season, and previous 305-d milk production. A recent study showed that cows fed balanced diets during the dry period produced colostrum with significantly greater IgG concentrations (96.1 vs. 72.4 mg/dL) compared with cows fed at 150% of the required dietary energy level (Mann et

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al., 2016). Dry period length, milk production history, and parity have also been shown to affect colostrum immunoglobulin level. Cows with an 8- to 12-wk dry period were found to produce greater IgG concentration in their colostrum than cows with dry periods less than 8 wk in length, and cows with the highest previous 305-d milk yield also had the greatest colostrum IgG concentration (Dunn et al., 2017). In another study, cows in their fifth or greater lactation produced greater IgG concentration colostrum than lower-parity cows (Dunn et al., 2017). Season of calving has also been implicated as a factor involved in colostrum production. A study in Ireland found that cows calving in the winter produced colostrum with higher IgG levels than cows calving during the spring and fall months (Dunn et al., 2017). Although several factors that may influence the IgG content of colostrum have been studied, little information has been published on the potential risk factors for low colostrum volume in dairy cows.

Factors that may influence colostrum volume production include nutrition, dam health, and environmental conditions such as photoperiod. An ovine study by Swanson et al. (2008) found that ewes fed 100% of the NRC (2007) requirements from d 50 of gestation to parturition produced greater volumes of colostrum than ewes fed 60 or 140% of NRC requirements. A similar study with dairy cows evaluated the effect of dry period dietary energy level on colostrum production with inconclusive results. Cows fed control diets produced numerically less but not significantly different amounts of colostrum compared with cows fed at 125 or 150% of the required dietary energy level (Mann et al., 2016). Cow health is another factor implicated in colostrum production, as Maunsell et al. (1998) found, as cows with 2 or more mastitis events in late gestation experienced significantly reduced colostrum production at the next calving (1,313 vs. 2,647 mL).

In addition to cow nutrition and health, environmental conditions such as heat stress have been evaluated for effects on colostrum production. A study by Karimi et al. (2015) found no difference in colostrum volume from cows cooled by misters and fans during the dry period compared with those without cooling (Karimi et al., 2015). Unlike the previously mentioned factors, the effect of photoperiod on colostrum production has not been studied, although it does have a known role in milk production. Dry cows exposed to a short day photoperiod were observed to produce approximately 3.1 kg/d more milk during the next lactation than cows exposed to a long day photoperiod (Dahl and Petitclerc, 2003). Manipulated photoperiod during the dry period did not affect colostral IgG concentrations in Holstein cows (Morin et al., 2010).

The genetics of an animal might also play a role in colostrum production. An ovine study by Pattinson and Thomas (2004) found that sire breed had an effect on colostrum yield in crossbred ewes; to our knowledge, this has not been evaluated in dairy cattle. Because dairy cattle have long been selected for milk production and not necessarily selected for colostrum production, there could be a genetic component to colostrum production that has gone undetected.

Although anecdotal reports from veterinarians, nutritionists, and dairy producers have indicated a periodic depression in colostrum production during fall months in North America (Litherland, 2009), little information is available in the literature about this condition. The objective of our prospective cohort study was to characterize seasonal low colostrum yield as observed on 1 large dairy and identify potential risk factors for this phenomenon.

MATERIALS AND METHODS

Animals, Facilities, and Housing

A Jersey dairy herd in Texas (about 2,500 lactating cows) was enrolled in a prospective cohort study in May 2016 due to its multiyear history of periodic low colostrum yield. Cows were loosely housed in naturally ventilated compost-bedded pack barns oriented in an east-west direction with weather curtains on the north sides. Pens inside the barns were 12 m wide and 46 to 183 m long with a 3.5-m alley. Cows had free access to an outside paddock that was 24 m wide and the same length as the pen. Milking cow pens were harrowed and lime was applied twice daily, whereas dry cow and close-up calving cow pens were harrowed and limed once per day. During hot months, cows were cooled with a combination of soakers and fans in the holding pen and milking parlor. Cows were dried off weekly at approximately 60 d before their expected calving dates and moved to a far-off dry cow pen. Dry cows were moved into a close-up calving cow pen approximately 21 d before calving and pregnant heifers were moved into a separate close-up calving cow pen approximately 50 d before calving. The far-off dry cow pen was a naturally ventilated compost-bedded pack barn, with a 24 by 183 m outside pen and 300 headlocks. The primiparous and multiparous close-up calving cow pens were 12 m wide and 46 and 82 m long, respectively, with no outside access. The primiparous pen had 75 lockups, and the multiparous pen had 135 lockups. Shade from the barns was the method of cooling provided.

Cows were fed a TMR, balanced by a ruminant nutritionist, which mostly consisted of locally grown feeds.