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Environmental and animal factors associated with gestation length in Holstein cows and heifers in two herds in the Czech Republic

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ABSTRACT

The objective was to assess the effects of the month of conception, month of calving, sex of the calf, and twins on gestation length (GL) in Holstein cows and heifers in two dairy herds with different milk yields. The study was performed in northeast Czech Republic over a 6-year period on two commercial dairy herds with a mean annual milk production of 11,060 kg per cow in the higher milk-producing herd and 8854 kg per cow in the lower milk-producing herd. Gestation length in cows that conceived in different months of the year was longer in the higher milk-producing herd than that in the lower milk-producing herd throughout the year ($P < 0.01$), whereas GL in heifers was almost the same in both herds. Gestation length in cows that conceived in different months of the year was longer than that in heifers through the whole year in both herds ($P < 0.05$). Similar results were found in cows and heifers that calved in different months of the year. Gestation length in cows and heifers that conceived in the first months of the year was longer than in those that conceived in the last months of the year in both herds ($P < 0.05$). Gestation length in cows and heifers that calved in late fall and throughout winter was longer than in those that calved in spring and summer in both herds ($P < 0.05$). Gestation length in females carrying male calves was longer than in those carrying female calves ($P < 0.0001$). Gestation length in cows ($P < 0.0001$) and heifers ($P < 0.05$) carrying singles was longer than in those carrying twins in both herds. In conclusion, results indicate that GL in Holstein cattle is associated with the month of conception, month of calving, herd, parity, sex of the calf, and twins.

1. Introduction

Preparations for impending parturition would be more efficient with improved information on the expected date of calving. More accurate prediction of parturition can help dairy producers to meet the requirements of pregnant females and to provide better health care during high-risk phases of animals' lives [1]. A number of factors affect prenatal development from conception to birth. Dam parity has an effect on gestation length (GL). Older cows tend to have a longer GL than younger cows [2,3]. The number of days in milk has an effect on GL. Gestation length increases as days in milk decreases [1]. Gestation length is also affected by the sex of the calf. Male calves are carried longer than females [4,5]. Single births are associated with longer GL than twin births [6].

The effect of the month of conception on GL was analyzed in several studies [1,7]. It was shown that GL is associated with the month of conception [1]. The effect of the month of calving on GL was investigated mainly in beef cattle [8,9]. Cows that calved in August had a shorter GL than cows that calved in October [8]. Different effects of the

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month of conception and month of birth on GL in the temperate zone were reported in horses [10]. To our knowledge, no study has simultaneously analyzed the effects of the month of conception and month of calving on GL in dairy cattle. Cows with higher milk yield tend to have a longer GL [1]. Based on this, we hypothesize that differences in GL between cows and heifers during the year may be greater in herds with higher milk production. Therefore, the primary objective of the present study was to examine the effects of the month of conception and month of calving on GL in Holstein cows and heifers in two herds with different milk yields. An additional objective was to determine the effects of the sex of the calf and of twin births on GL in these two dairy herds.

2. Materials and methods

2.1. Animals and management

The study was performed on two commercial dairy herds (5924 pregnancies) with different milk yields in northeast Czech Republic at a latitude of 50° North over a 6-year period (calving from January 1, 2009 to December 31, 2014). The distance between the herds was 5 km. In the higher milk-producing herd, 1909 gestations were from 1031 cows and 906 gestations were from heifers. In the lower milk-producing herd, 2085 gestations were from 1130 cows and 1024 gestations were from heifers. Mean annual milk production for this period was 11,060 kg per cow in the higher milk-producing herd and 8854 kg per cow in the lower milk-producing herd. Management of both herds was exactly similar. Cows were milked three times daily. Cows and heifers were housed in free stalls with concrete slatted floors and cubicles (length 2.3 m and width 1.2 m). The space per cow in calving pens was 12 m^2. Straw was used for bedding in the stalls and pens. Total mixed rations were offered ad libitum twice a day (at 5 AM and 2 PM). The total mixed rations in both herds was based on corn silage, alfalfa haylage, and a combination of commercial dairy concentrates and was in line with the recommendations of the National Research Council [11]. All animals were reared within the herd. From a health standpoint, the herds were well managed. The voluntary waiting period for these herds ranged from 45 to 60 days postpartum. Heifers were moved to the breeding group between 390 and 420 days of age. Data on reproductive traits of cows and heifers in both herds are shown in Table 1. All females were free of tuberculosis and brucellosis and artificially inseminated using semen from sires of proven fertility. Artificial insemination was the only form of breeding used in these herds. Gestation length was calculated for cows and heifers conceiving to artificial insemination.

Table 1
Means of reproductive traits in cows and heifers on two commercial dairy herds over a 6-y period (2009–2014).

Reproductive traits	Higher milk-producing herd		Lower milk-producing herd	
	Cows	Heifers	Cows	Heifers
Days from calving to first insemination	66		70	
Days from calving to pregnancy	135		135	
Number of insemination per lactation	2.5	1.4	2.5	1.6
Conception rate (%)	34	62	37	61
Calving-to-calving interval (days)	408		402	

2.2. Synchronization of ovulation

For both herds, synchronization of ovulation was initiated at a random stage of the estrous cycle using intramuscular injections of GnRH (2 mL of Supergestran; NORDIC Pharma Ltd., Jesenice, Czech Republic) and PGF2alpha analogue, cloprostenol (2 mL of Oestrophan; Bioveta Co., Ivanovice na Hane, Czech Republic) as follows: Day 0, GnRH; Day 7, PGF2alpha analogue, Cloprostenol; Day 9, GnRH. Ovulation was synchronized with 50 μg GnRH and 0.5 mg PGF2alpha analogue, Cloprostenol, per injection.

Cows and heifers were inseminated within 16 to 18 hours after the second GnRH injection. Only females (free of detectable reproductive disorders) in which estrus had been confirmed by examination of the genital tract and vaginal fluid were inseminated using semen from sires of proven fertility. Females failing to conceive or maintain pregnancy were reinseminated using the same treatment until diagnosed pregnant or culled from the herd.

2.3. Pregnancy diagnosis

Pregnancy was diagnosed by transrectal ultrasonography between 28 and 35 days after insemination using a portable B-mode ultrasound scanner with a 5-MHz transducer (Honda HS-101V, Honda Electronics Co., Toyohashi, Japan). Scanning was performed along the dorso/lateral surface of each uterine horn. Pregnancy was reconfirmed by rectal palpation of the uterus between 65 and 80 days of gestation. All ultrasonographic examinations and manual pregnancy diagnoses were performed by the same operator.

2.4. Statistical analyses

Statistical analyses were performed using SAS 9.1 (SAS Institute Inc., Cary, NC, USA). The normality of distribution of GL was verified using the Kolmogorov–Smirnov test. The effects on GL were analyzed by the mixed model procedure [12]. Data were tested using three models. All models were analyzed in three steps: (1) main effects were examined; (2) two-way interactions were added; and (3) a three-way interaction was added.

The final version of the first model included the fixed effects of the month of conception (12 categories, months of the year), parity (two categories, heifers vs. cows), herd (two categories, the lower milk-producing herd vs. higher milk-producing herd), sex of the calf (two categories, males vs. females), and the three-way interaction among the