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Research Article

Hot Topic: Influence of Fetal Sex on Pregnancy Length and Postpartum Reproductive Performance in Holstein Dairy Cows

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Abstract

The length of pregnancy is the period between conception and parturition. The reproductive efficiency for dairy cows depends on the changes that occur during postpartum period. The experiment involved observations of 341 normal parturient Holstein-Friesian cows aged 4 - 9 years old with 1 - 7 lactation season and 3 - 4 BCS (172 cows gave male calves and 169 cows gave female calves) to determine the effects of calve sex and the season of parturition on gestation length in dairy cattle and the correlation between gestation length and other reproductive traits (postpartum ovarian resumption, days open, number of services per conception). The male calves were found to contribute to longer pregnancy duration (282.73 ± 5.60) than female calves (272.82 ± 2.96). No significant differences were found for postpartum ovarian resumption (male: 22.71± 6.07 vs female: 25.44 ± 10.89), days open (male: 158.6± 76.16 vs female: 166.6 ± 80.86), number of services per conception (male: 1.67 ± 0.93 vs female: 1.72 ± 0.79). In conclusion, significant effect of fetal sex was obvious in gestational length than the postpartum reproductive traits of cows.

Keywords: *Holstein-Friesian Breed; Gestation Length; Ovarian Rebound; Days Open*

Introduction

Recently in human reproduction, the evidence of fetal gender effect on the length of gestation was discussed by Torche and Kleinhaus, 2012 [1]. They found that the gestation length was shorter in female versus male fetuses. Furthermore, the evidence of fetal sex effect on the placenta has been identified in terms of gene expression, histological examination, cytokine production and blood flow perfusion [2-4]. There are sex specific differences in placental gene expression that are not limited just to X and Y linked genes, but also to genes related to immune pathways and polyamine synthesis [5,6]. In veterinary reproduction, gestation length, the period from effective fertilization until calving, is a reproductive trait that considerably affects cattle breeding and production. The cow's age is the key environmental factor influencing gestation length. Gestation length is shorter in heifers than in older cows [7-9]. Calf survival has a major influence on the profitability of suckling cow production systems [10]. Mortality of calves reduces beef income and adds significantly to beef production costs [11,12]. In small ruminants, it has been investigated that the length of gestation is longer in dams carrying male versus female fetuses [3,13]. No significant differences were found in the Doppler parameters used to evaluate the uterine blood flow, on the basis of fetal sex during peri-parturition in small ruminant. The same findings were also recorded in cows [14]. There is insufficient data related to the effect of fetal gender and/or the birth season on the length of gestation and postpartum reproductive performance in Holstein-Friesian dairy cows. So, we figure out to investigate the effects of fetal sex on length of pregnancy and postpartum reproductive performance in Holstein cows.

Materials and Methods

Experimental animals and data collection

This study was carried out from September 2009 to September 2013. A total of 341 normal parturient Friesian- Holstein cows aged 4 - 9 years old with 1 - 7 lactation season and 3 - 4 BCS (172 cows gave male calves and 169 cows gave female calves), (scale 1 = thin to 5 = fat; Bhalaru, Tiwana and Singh, 1987 [17]) belonging to a private farm at Damietta governorate (Sanad Farm), Egypt, were used in this study. The study was approved in accordance with the Ethics Committee of the National Research Centre, Egypt, which considers animal rights and welfare.

These animals were kept in an open hygienic yards provided with holding pens for veterinary examination. Animals were offered a daily ration (calculated according to Gavish program under National Research Council (NRC) recommendation). Ration consists of corn silage, ground yellow corn, soybean meal, barseem or hay and minerals-vitamins supplement. Analysis of this ration included, dry matter intake (20 - 22 kg), crude protein (18%), Total Digestible Nutrient (TDN) (76%), Calcium (0.1%), and Phosphorus (0.5%). All animal had free access to water.

During the summer season, the animals were exposed to mist of water forced by water sprayers to protect them from heat stress. All animals were kept under strict control measures for internal and external parasites, as well as periodical deworming. These animals were regularly tested for freedom of genital diseases. The prophylactic immunization system for the animals included annual vaccination against the endemic diseases such as Foot and Mouth Disease, Rift Valley Fever, Lumpy Skin Disease, and Bovine Ephemeral Fever (FMD, RVF, LSD and BEF) in addition to *Pasteurella* and *Clostridium* by the local veterinary authorities. These cows were milked three times/ day "5.00 AM, 13.00 PM and 21.00 PM" using a milking machine (8 hours intervals) through automatic modern machine connected with computer net via detachment unit under the control of ALBRO system (ALPHA D-Laval Company 2000, Swede). The experimental cows were closely observed through the whole day for estrus detection by a skilled person and confirmed by rectal and vaginal examination. Cows and heifers were bred artificially by using imported frozen semen (-96°C) from an international company (CRI Company, USA) using recto-vaginal insemination technique. Pregnancy diagnosis was applied through rectal palpation at 45 - 60 days post service.

Statistical analysis

Data were collected, organized and then analyzed by using statistical package SPSS. Analysis of variance (ANOVA) test was used to test variance between different seasons, months and parturition number according to Elmetwally., *et al.* 2018, 2019 [15,16]. T-test was used to test variance in ovarian rebound between male and female fetuses, days open and milk yield. Mann-whitney test was used to test variance between male and female in number of parturitions.

Results

The length of gestation (Figure 1) in cases of male calves was found to be significantly ($P < 0.0001$) longer (282.73 ± 5.60) than female calves (272.82 ± 2.96). On the other hand, no significant differences were found for postpartum ovarian resumption (Figure 2, male: 22.71± 6.07 vs female: 25.44 ± 10.89, $P = 0.18$), days open (Figure 3, male: 158.6± 76.16 vs female: 166.6 ± 80.86, $P = 0.51$), and number of services per conception (Figure 4, male: 1.67 ± 0.93 vs female: 1.72 ± 0.79, $P = 0.32$). In the present study as described in table 1, the length of gestation was not significantly affected ($P = 0.255$) by the season of parturition. The length of gestations were 276.55 ± 6.12; 276.37 ± 6.02; 278.12 ± 6.54 and 278.30 ± 6.54 in winter, spring, summer and autumn respectively.

Gestation period							
	N	Mean	Std. Deviation	95% Confidence Interval		Minimum	Maximum
				Lower Bound	Upper Bound		
Winter	70	276.55[a]	6.10845	273.6912	279.4088	265.00	285.00
Spring	75	276.37[a]	6.01965	274.8116	277.9217	265.00	299.00
Summer	127	278.12[a]	7.05153	276.8798	279.3564	265.00	301.00
Autumn	69	278.30[a]	6.53791	276.7338	279.8749	265.00	296.00
Total	341	277.67	6.66033	276.8811	278.4595	265.00	301.00

Table 1: *Length of gestation in different birth seasons.*

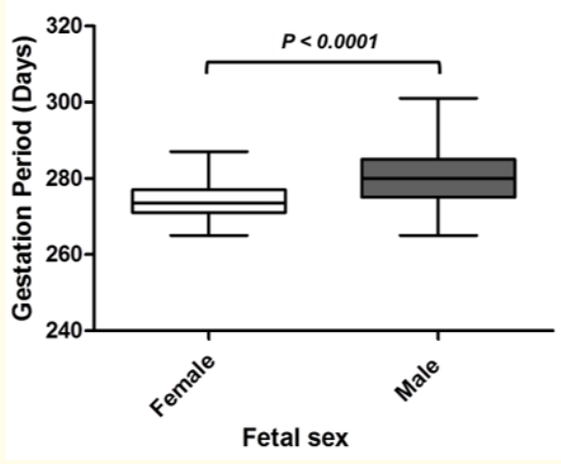

Figure 1: *Effect of fetal sex on length of gestation. All quantitative data are presented as means ± SD.*

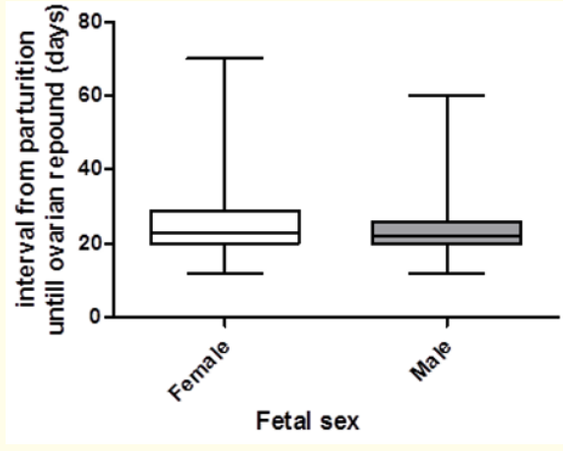

Figure 2*: Effect of fetal sex on postpartum ovarian rebound. All quantitative data are presented as means ± SD.*

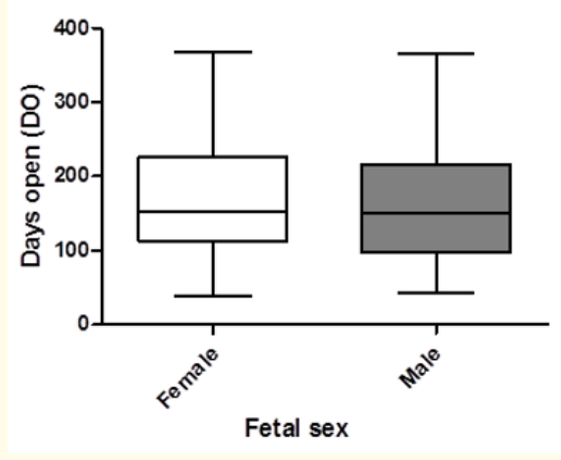

Figure 3: *Effect of fetal sex on days open. All quantitative data are presented as means ± SD.*

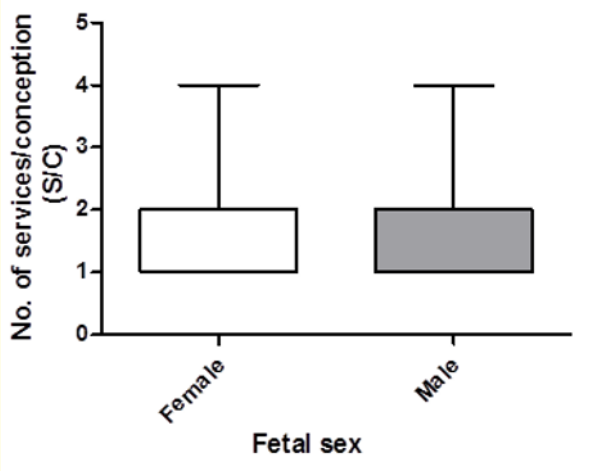

Figure 4: *Effect of fetal sex on number of service per conception. All quantitative data are presented as means ± SD.*

Discussion and Conclusion

The cow's age is the key environmental factor influencing gestation length. Gestation length is shorter in heifers than in older cows [7]. The length of gestation in this study was investigated to be significantly ($P < 0.0001$) longer in case of male fetuses (282.73 ± 5.60) than female ones (272.82 ± 2.96). The fetus' dominant effect on length of pregnancy could be related to the induction of parturition. The fetal adrenal cortex secretes cortisol, increasing placental prostaglandin levels which initiate parturition [17]. The previous results from Nogalski and Piwczyński, 2012 [18] were similar to results in the present study. They found that the gestation length values were significantly affected by the sex of the fetus, and they were 1.8 days longer for male fetuses. Meanwhile, according to Silva., *et al.* 1992 and Hansen., *et al.* 2004 [19,20] gestation length was 1.1 days longer for male calves. But, in our study, the length of gestation was about 10 days longer for male calves. The difference of values between our study and previous ones may be correlated to managemental practice. The length of gestation in days for female calves in our study was shorter (272.82 ± 2.96) than that reported by Nogalski and Piwczyński, 2012 [18] (278.1 ± 4.39) while the gestation length for male calves (282.73 ± 5.60) was longer in compared to the same study (279.9 ± 4.97). The variation in the values may be attributed to management and/or genetic factors [20]. Unlike the present study, it was recently reported in human beings; by Roland., *et al.* 2014 [21] that there is a difference in birth weight between male and female. He attributed these results to insignificant difference in weight of placenta in case of boys and girls. As well, Elmetwally, 2012 [3] found no significant difference in uterine blood flow in pregnant sheep and goats carrying male, female and/or both sexes.

In the present study, the length of gestation was not significantly affected ($P = 0.255$) by the season of parturition. The length of gestations were 276.55 ± 6.12; 276.37 ± 6.02; 278.12 ± 6.54 and 278.30 ± 6.54 in winter, spring, summer and autumn respectively. These results were matching those investigated by Nogalski and Piwczyński, 2012 [18]. In the aforementioned study, the length of gestations were 279.1 ± 4.65; 279.3 ± 4.84 and 278.5 ± 4.88 in winter; spring and summer respectively. On the other hand, these results were diverged, compared to the results investigated by Bakir and Cilek, 2009 and Melaku., *et al.* 2011 [22,23]. They recorded that season of birth had a significant influence on gestation length and that cows calved in the wet season (282.19 ± 0.38) had longer gestation length than those calved in the dry season (281.48 ± 0.37). Altogether, the length of pregnancy in Holstein dairy cows is significantly affected by fetal sex than the other postpartum reproductive traits cows.

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