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Effects of non-lactating period length on the subsequent calving ease and reproductive performance of Holstein, Brown Swiss and the crosses

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ABSTRACT

The aim of this study was to evaluate the effects of the non-lactating period (NLP) length on the subsequent calving ease and reproductive performance of the purebred Holstein (HO), Brown Swiss (BS) and F_1 crosses (BF) of these breeds. The NLP length was classified into four categories: D_1: <45 d; D_2: 45–60 d; D_3: 60–75 d; and D_4: >75 d. The lesser incidence of calving difficulty in the purebred HO and BF crossbred cows was recorded at D_3, with no significant differences with D_2 [11.6% and 9.5%; Crude Odds Ratio (COR) = 1.10 and 0.84, respectively]. However, the minimum incidence of calving difficulty in the purebred BS cows was at the same NLP length with significant differences with D_2 (3.8%; COR = 0.31). All reproductive indices of the purebred HO cows were less as the NLP length increased. However, lesser estimates of calving interval and days non-pregnant in purebred BS and BF crossbred cows were recorded at longer (D_3) NLP (350 and 328 d; 112 and 133 d, respectively). Purebred HO cows had decreased milk production at extremely short (D_1) and long (D_4) NLP. Purebred BS cows, however, were more persistent in milk production and had more consistent body condition scores (BCS). In conclusion, shortening the NLP of the purebred HO cows in addition to making minimum changes in diet composition could be an appropriate solution for improving reproduction. Purebred BS and BF crossbred cows were more persistent in milk production and tolerated the diet changes during the NLP.

1. Introduction

Reproductive efficiency in high producing dairy cows has been reduced in recent decades (Royal et al., 2000; Butler, 2003; Evans et al., 2006). Intensive genetic selection for improved milk production has led to greater milk yields per cow but has also been related with a worldwide decrease in dairy cow fertility. There is a negative correlation between the genetic trait for milk yield and reproductive performance (Van Arendonk et al., 1989; Pryce et al., 1997; Pryce and Veerkamp, 2001). The decrease in fertility is probably due to a combination of physiological and management factors that have an additive effect on reproductive efficiency (Lucy, 2001). The non-lactating period (NLP) for pregnant dairy cows is recommended between sequential lactations based on the nutritional requirements of the late pregnant cow and to permit appropriate involution of the mammary gland epithelium to maximize milk yield during the subsequent lactation. Furthermore, papillae of the rumen and the small intestine are regenerated during the NLP and the gut microbial populations of the

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cow are changed so as to contribute in providing for an increased nutrient requirement of the mammary gland during lactogenesis (Annen et al., 2004; Church et al., 2008). The NLP also allows for the application of an extended intra-mammary antibiotic therapy to minimize the prevalence of existing infections and reduce the incidence of new infections (Eberhart, 1986). Many observational and experimental data have been generated to establish an optimal period for the NLP of cows (Gulay, 2005). The optimal duration of the NLP has been a subject of dispute with a period of 50–60 d given as the traditional recommended length (Bachman and Schairer, 2003; Church et al., 2008). However, because of management decisions related to gestation length and milk yield, it is common on many farms to have involuntary long or short NLP. In recent years, however, consideration has been given to shorter NLP, enabling additional income from milk yield at the end of lactation and an improved nutritional state to meet the physiological challenges of the transition period from non-lactation to lactation (Bachman and Schairer, 2003; Gulay et al., 2003). In addition, the shorter NLP may eliminate the need to separate non-lactating cows from the other cows and reduce the number of ration changes in the periparturient period and the associated stress. Conversely, greater production may also result in a demand for a longer NLP to maintain production, health and fertility in the subsequent lactation.

Considerable research has been conducted regarding the effect of number of days of the NLP on subsequent lactation milk yield but far less research is available on the fertility aspects. Earlier studies demonstrated that short NLP resulted in decreased fertility as indicated by the additional 14 or more days before cows become pregnant (0–10 d NLP compared with 61–65 d NLP; Bachman and Schairer, 2003). Inconsistent with these findings is the reproductive performance of cows that have had three or greater numbers of lactations being improved at shortened NLP compared with the conventional NLP length (Watters et al., 2009). Length of the NLP might influence postpartum energy balance by potentially modifying reproductive performance. There is a relationship between energy balance and time of first postpartum ovulation with energy balance being an important factor for determining first postpartum ovulation and time of initiation of estrous cycles following calving. Furthermore, the first postpartum ovulation was reported to occur between 10 and 14 d after the energy balance nadir was reached (Canfield et al., 1990; Butler, 2003). Consistent with the relation between energy balance and days to first postpartum ovulation, reproductive performance of dairy cattle improved with an earlier initiation of estrous cycles after calving (Thatcher and Wilcox, 1973; Darwash et al., 1997; Staples et al., 1990); however, earlier reports indicated there was little or no change in reproductive performance with a shorter time to first ovulation after calving (Smith and Wallace, 1998; Royal et al., 2000). Dystocia was more prevalent in cows with NLP of >60 d compared with those with shorter NLP (Atashi et al., 2013). However, Enevoldsen and Sorensen (1992) reported that for cows with shorter NLP before becoming pregnant (0–88 d), the risk of calving difficulty was greater in cows with 10-wk NLP than in those with 7- or 4-wk NLP. Pezeshki et al. (2007), however, reported that decreasing the NLP from 56 to 35 d had no significant effect on dystocia.

Shortening the NLP (to <40 d) minimizes milk yield (Coppock et al., 1974; Swanson, 1965). Similarly, recent retrospective studies indicated that reducing the NLP length resulted in a reduction in milk yield in the subsequent lactation (Bachman and Schairer, 2003; Watters et al., 2008; Mantovani et al., 2010; Atashi et al., 2013; Cermakova et al., 2014). When the NLP has been shortened, additional milk is produced in the ongoing lactation which may be advantageous if there is no yield depression in the subsequent lactation. Other studies indicated that the optimum NLP length may be shorter than previously considered and that a 30- to 40-d NLP is sufficient for maximizing milk yield in dairy cows (Bachman, 2002; Gulay et al., 2003; Pezeshki et al., 2007). However; lengthening the NLP (to >60 d) may increase costs and diminish the productive longevity of dairy cows (Hurley, 1989). Food intake and postpartum metabolic status of cows might be changed because of changes in diet and grouping of cows during the NLP (Collier et al., 2012). It has been suggested that cows with short or no NLP between two consecutive times of calving have improved dry matter intake, metabolic profiles, BCS, body weight and mean negative energy balance (Pezeshki et al., 2007; Watters et al., 2008). Furthermore, short NLP were associated with greater somatic cell scores during the subsequent lactation (Kuhn et al., 2006). However, one aspect that has received little attention, if any, in either past or recent research on NLP is whether breeds respond differently to variations in NLP length; virtually all research has been conducted using Holsteins. To the best of our knowledge, this is one of the few recent studies to investigate the effects of NLP length on the subsequent reproductive and production performance of crosses originating from two temperate breeds and managed under subtropical Egyptian conditions. Therefore, the objectives of the present study were to evaluate the effects of NLP length on the subsequent calving ease, reproductive and production performance of the purebred HO, BS and their F_1 crosses under subtropical conditions.

2. Materials and methods

This research was reviewed and approved by the Animal Care and Welfare Committee of Zagzaig University, Egypt (ANWD-206).

2.1. Animals and management

This study was conducted at EXPANDED herd, Ismailia road, Cairo. To minimize health problems and overcome decreased fertility of Holstein (HO) cows, the breeders tended to cross with Brown Swiss (BS). Originally, the herd consisted of 1000 purebred HO and 112 BS cows. Crossing the two breeds resulted in 211 F_1 crossbred cows (BF; 50% BS and 50% HO). All cows were housed in a dairy barn with sand-bedded free stalls, milked three times daily with yields recorded at each milking and pedometers being applied to all cows. The total mixed ration (TMR) was provided twice a day. The ration was mixed daily and modified according to the exact milk production and BCS of