

Postcalving factors affecting conception risk in Holstein dairy cows in tropical and sub-tropical conditions

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Abstract

The objective was to identify postpartum risk factors between nutritional imbalance and health disorders affecting first-service conception risk (FSCR) in 21 commercial Holstein herds in Reunion Island. Multivariate logistic-regression models including herd as a random effect were used to analyze the relationship between FSCR and energy status, nitrogen status, hepatic function, mineral deficiencies, and postpartum health disorders.

Two models (A and B) were built on two subsets of data ($n = 446$ and $n = 863$) with risk indicators measured during the first month of lactation and around time of first service, respectively, adjusted for season, breed, parity, origin, milk yield, calving to first service interval (CS1), and type of estrus (spontaneous vs. induced).

The averaged conception risk was 0.266 ± 0.015 ($n = 913$) (mean \pm S.E.M.). In both models, FSCR was decreased by $CS1 \leq 60$ d and induced estrus. In model A, FSCR was decreased ($p < 0.05$) for cows with mean cumulative 100 d daily milk yield ≤ 23 kg/d and >27 kg/d, with losses of body condition score >1.5 , and with retained placenta. In model B, FSCR was decreased ($p < 0.05$) for cows inseminated during wet season, previously raised out of the farm as nulliparous, with blood magnesium concentration ≤ 0.9 mmol/L, and for high-yielding cows (100 d milk yield > 27 kg/d) with glutamate dehydrogenase > 17 UI/L.

Hence, high-body-lipid mobilization during the first month of lactation was a strong nutritional predictor of low FSCR together with liver damage in high-yielding cows. Interestingly, our models revealed that infertility is better related to nutritional factors than to postpartum health disorders occurrence.

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1. Introduction

In Reunion Island (Indian Ocean), first service conception risk (FSCR) of dairy cows declined from 39% to 31% between 1992 and 1998 and has remained very low ($<30\%$) until now [1]. In contrast, during the same time, milk production increased from 3881 to

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5186 kg per lactation (305 d). This decrease in reproductive performance is generally ascribed to genetic merit improvement. However, the respective effects of nutritional factors and health disorders remained largely unknown in sub-tropical conditions.

Several reviews have examined the influence of main factors on reproductive efficiency in high-lactating cows [2–6]. These factors can be separated into two main groups: nutritional imbalance and health disorders. It is well established that nutrients partitioning and accompanying metabolites change dramatically after calving, especially during the first month of lactation. Cows in early lactation are usually in negative energy balance, whose magnitude and duration depend on body condition at calving, postpartum feed supply and milk yield [7]. In temperate countries, the postpartum energy deficit is one of the major causes of poor reproductive efficiency [2,3], possibly in association with fatty liver syndrome [8] or dietary protein excess [2]. Among various postpartum health disorders, only metritis seems to have a consistent negative effect on first service conception risk (FSCR), as reviewed by Fourichon et al. [4].

In addition, nutritional imbalances during early stages of lactation might also have a delayed effect on subsequent fertility [9]. Consequently, the influence of nutritional status on cow fertility has often been investigated at various lactational stages, i.e. in the first weeks of lactation and at the time of first service [10]. Different methods were used to assess the nutritional status of the cow, namely body condition score (BCS) measurements and assays on plasma metabolites, enzymes or hormones [6,10–13]. Until now, very few of these studies were carried out in on-farm conditions, particularly in tropical environment.

The objective of the study was to identify, at the lactation level, the postpartum risk factors among nutritional imbalance and health disorders linked with FSCR in commercial dairy herds, adjusting the effects for breeding, season, parity, milk yield, calving to first service interval and type of estrus (spontaneous vs. induced estrus). An underlying objective was to compare the predictive ability of two different sets of risk factors measured during the first month of lactation and around the time of first service, as potential predictors of infertility.

2. Materials and methods

The study was conducted in Reunion Island, located in the Indian Ocean, 800 km east of Madagascar (latitude 21°06'S, longitude 55°32'E). The island has

diverse climatic and environmental conditions due to variation in altitude, rainfall, and agricultural activities. The coastal area is dominated by sugarcane production, whereas the upland central area is mainly used for cattle farming. Hence, although the island is in the tropics, most dairy herds are located above an altitude of 400 m, with temperate, wet summers, from December to May, and cool, dry winters, from June to November.

Fodder resources consist of both temperate and tropical grasses. In the western farming area, cows are kept all year round on pastures of kikuyu (*Pennisetum clandestinum*), a permanent tropical grass, whereas in central and southern areas, cows are predominantly fed round bale silage of temperate grass (*Lolium perenne* and *Dactylis glomerata*), or tropical (*Chloris gayana*) grass (in zero-grazing system). During the course of this study, measures of the feeding value of silage varied greatly, depending on grass species, cut periods and climatic conditions, with a crude protein (CP) and metabolizable energy (ME) range of 87–147 g/kg DM and 8.0–10.9 MJ/kg DM, respectively. Because of the chronic shortage of forage due to cattle density, lactating cows' diets usually included high proportions of concentrate (i.e. 40–70%).

In Reunion Island, milk production has grown from a million liters in the 1970s to more than 23 million liters at present. At the beginning of this study, the dairy sector included 150 dairy farms with about 4500 lactating cows, mainly of purebred Holstein originally introduced from France, with an average 305 d mature equivalent milk yield of 5378 kg. Cows are milked twice daily, artificial insemination (AI) is carried out routinely with frozen semen, and hormonal treatment (subcutaneous Norgestomet[®] implant or PGF_{2α} administered twice at 12-d interval) is occasionally performed to induce estrus.

2.1. Farm data collection

Data were collected from 21 dairy herds that raised purebred or crossbred Holstein. The herds were selected according to previous reproductive performances, geographic location, feeding system, herd size, availability of test-day records, and the willingness of the farmer to participate. The study was conducted from 1 July 1999 to 30 June 2001 and included data from only multiparous purebred or crossbred Holstein dairy cows that calved during this period. As a whole, the collected data represented 14% and 25% of the total population of herds and of multiparous dairy cows in Réunion Island, respectively. Mean herd size (including lactating and dry cows) was 41 (range from 15 to 88). Each herd was

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