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Precalving factors affecting conception risk in Holstein dairy cows in tropical conditions

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Abstract

The objective of this study was to identify precalving nutritional risk factors that may affect variation in first service conception risk in 21 commercial Holstein dairy herds in a tropical environment (Reunion Island). The data set included 473 lactation records in 404 cows. A multivariate logistic-regression model including herd as a random effect was used to analyse the relationship between first service conception risk and energy status (body condition score, plasma glucose, insulin, cholesterol, non-esterified fatty acids and β-hydroxybutyrate), nitrogen status (urea), hepatic function (γ-glutamyltransferase, glutamate deshydrogenase, albumin), and mineral deficiencies (calcium, phosphorus, magnesium), adjusting systematically for factors such as breeding, season, parity, previous milk yield and fertility, calving to first service interval and type of oestrus (spontaneous versus induced).

The overall mean conception risk was 0.27 ± 0.02 (mean ± S.E.M., $n = 473$). First service conception risk was penalized by calving to 1st service interval shorter than 60 days, synchronized oestrus, previous 305-day milk yield >8000 kg ($p < 0.05$), low blood glucose concentration in high-yielding cows ($p < 0.05$) and combined high urea and β-hydroxybutyrate concentrations ($p < 0.01$). Precalving energy imbalance, revealed by low prepartum glucose concentration, was a strong nutritional predictor of low first service conception risk in high-yielding cows. Some precalving nutritional disorders potentially associated with consumption of spoiled silage which induces elevated circulating urea and β-hydroxybutyrate have a delayed detrimental effect on conception, even if the true causes of this effect remain to be elucidated. As a conclusion, our findings should lead the breeders to pay more attention to the feeding of dry cows that is usually neglected in Reunion Island dairy farms.

Keywords: Dairy cows; Infertility; Prepartum; Nutrition; Milk yield; Metabolic status; Body condition score

1. Introduction

Reproductive performances observed in dairy cows from breeds originated from temperate climates and that are raised in tropical and sub-tropical conditions are usually poorer than the counterparts in their native conditions [1,2]. Such a situation is confirmed in Reunion Island, an overseas district located in Indian Ocean. First service conception risk is rather low and also declined from 39 to 31% between 1992 and 1998, i.e. about 1% per year as observed in Holstein dairy herds in most of temperate countries during the last

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decade [3]. Nowadays, in Reunion Island, the dairy cow's reproductive performances have reached a level that may endanger the profitability of the whole production chain from breeders to dairy industries.

In these peculiar raising conditions, the importance of factors responsible of conception failures remained poorly known. In a preliminary study conducted in one third of Reunion Island dairy herds, the variance of reproductive parameters has been found to be mainly located at the individual lactation level (90% of variance), while other levels such as farm, or geographical area poorly explained infertility rates [4].

Nutrient partitioning and accompanying metabolites change dramatically after calving in dairy cows, especially during the first month of lactation [5]. Cows in early lactation are usually in negative energy balance, which magnitude and duration partly depends on precalving feeding and body condition at calving [6]. Inadequate precalving feeding may cause various delayed effects in the postparturient cow, including health disorders, infertility and decrease in milk production [7,8]. Cows that are overconditionned at calving have a lower postpartum feed intake, a higher adipose tissue mobilization and a higher incidence of metabolic and infectious diseases (fat cow syndrome), that have all in turn a negative impact on reproductive performance [8–10]. Low body condition score at drying-off or at calving is also reported to be associated with inactive ovaries and longer open period [11]. Increasing undegradable dietary protein during the dry period was found to improve fertility [12].

Most investigations on the influence of precalving nutritional status on fertility were conducted in controlled conditions with factorial treatments and were based on body condition score, plasma metabolites, or hormones measurements [8,13,14]. The primary objective of this study was to identify, at the lactation level, the precalving nutritional risk factors linked to first service conception risk in commercial dairy herds. To study this, methods generally used in experimental station were applied to a long term on-farm multifactorial study.

2. Materials and method

2.1. Dairy production system

Reunion Island is located in Indian Ocean, 800 km east from Madagascar (21°06′S, 55°32′E, with a maximum elevation of 3069 m). The island has shown a rapid expansion of its dairy industry for the last four decades. Most dairy herds are located in upland areas, above an altitude of 400 m, with temperate, wet summers, from December to May, and cool, dry winters, from June to November. In these areas, the daily temperature humidity index is below 70, which is the threshold for cow's sensitivity to heat stress, above which feed intake, production and reproductive performances were found to be impaired [15].

At the beginning of this study, the whole dairy sector comprised 150 herds and about 4500 lactating cows, mainly purebred Holstein (90%) and Brown Swiss (10%), originally introduced from France. Average 305-day mature equivalent milk yield was 5378 kg in 1999 and a 10% yearly increase of total milk production was recorded since 1990, due to both genetic and feeding improvements. Cows are milked twice daily and artificial insemination is carried out routinely with frozen semen. In herds located in the western part of the highlands (dry area), cows are kept all the year round on pastures of *Pennisetum clandestinum*, a permanent tropical grass. In others areas (central and southern highlands), cows are maintained under a zero-grazing system: they are fed in a stanchion barn with either temperate (*Lolium perenne*, *Dactylis glomerata*), or tropical (*Chloris gayana*) grass round baled silage and hay. The feeding value of conserved forage varied greatly, depending on grass species, cut periods and climatic conditions. The range for Crude Protein (CP) and Metabolizable Energy (ME) content usually observed during the whole study were 87–147 g/kg DM and 8.0–10.9 MJ/kg DM, respectively. Due to chronic shortage of forage, high proportions of concentrate are generally incorporated into the diets of lactating cows (i.e. 40–70%).

2.2. Farm data collection

An observational survey was conducted over two consecutive years, from July 1999 to June 2001 in 21 dairy herds which raised pure-bred or cross-bred Holstein (Brown Swiss cows were not included in this study). Herds were chosen based upon previous reproductive performances (low, high and medium levels), geographic location, feeding system, herd size, availability of milk yield records and producers' willingness to participate actively to this study. Herd size (including lactating and dry cows) averaged 41 (range from 15 to 88). Herds were visited fortnightly by three technicians. During farm visits, all demographic events (entry, mortality, culling), reproductive events (calving, AI, pregnancy diagnosis, drying-off) and disease occurrences were recorded directly from owners. Updated information on reproductive females