

**Research article****The effect of the most common diseases during the first 100 days of post partum on pregnancy rate and reproductive performance in the Mexican highlands dairy cows**

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Abstract

The aim of the study was to determine the reproductive problems caused by the most common diseases that occur during the first 100 days in milking (DM) among Holstein cows managed in the Mexican highlands. In this study, 654 pregnant and near parturition (25±7 days before calving) cows were selected. Following calving, their health status was assessed for a period of 100 days and their reproductive performance (days up to first service, days-open, services per conception, percentage of abortions and pregnancy rate) was recorded up to 171 DM (average days-open of the farm). The cows were grouped as healthy or according to the diseases they suffered from namely mastitis (n = 129), pneumonia (n = 124), digestive problems (n = 117) and lameness (n = 129). The pregnancy rate was affected (P <0.01) by diseases, regardless of the type. Healthy cows had the highest (P <0.05) pregnancy rate (74.19±1.5) compared with diseased cows: mastitis (46.5±2.1), pneumonia (30.6±1.9), digestive problems (46.1±2.2), lameness (60.4±2.1). Diseases that affected cows during the first 100 DM had no effect (P >0.10) to days open, number of services per conception or percentage of abortions compared with the group of healthy cows. Diseases that affected cows during the first 100 DM had a significant effect (P<0.05) to days up to first service compared with the group of healthy cows (Healthy: 77.6±2.9), (mastitis: 70.5±3.2), (pneumonia: 60.6±3.3), (lameness: 81.6±3.2), (digestive problems: 72.4±3.4). In conclusion, Holstein cows that remained healthy during the first 100 days in milk had higher pregnancy rates suggesting that the health of the cows is key to obtain good reproductive profiles.

Keywords: Days in milking; mastitis; pneumonia; lameness; reproductive performance

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Introduction

Today, the dairy industry is focusing on strategies to increase milk production. The Holstein cow has undergone a real transformation since records were first published in 1944 that mentioned their lactation with 2,000 kg/cow. Change has occurred over the years successfully transforming into stabled systems, with larger cows and greater production, to the extent that today's specialized lactating Holstein cows exceed 10,000 kg of milk per lactation (USDA, 2007). High grade cows start with an accelerated increase in milk production which reaches its peak production during the period at 5-7 weeks postpartum (Ingvarstsen et al., 2000). During the rapid increase in milk production, specialized cows suffer from negative energy balance resulting in disequilibrium (Ingvarstsen et al., 2003). Many studies have shown that negative energy balance is associated with an increased risk of developing various diseases, reproductive disorders and changes in milk production (Raboisson et al., 2014).

A disturb in the energy balance during postpartum in the specialized dairy cow predisposes it to reduced performance and production, and likewise the cow becomes very vulnerable to postpartum disease such as mastitis, ketosis, lameness, retained placenta, pyometra, metritis, pneumonia, diarrhea, hypokalemia and displaced abomasum, among others (Mulligan and Doherty, 2008). These diseases usually occur during the first 2-3 weeks after calving, which is unfortunately a very critical stage in terms of future milk production throughout lactation and reproduction (Ingvarstsen et al., 2003). For this reason, the objective of this study was to determine the consequences on pregnancy rate, days to first service, days-open, number of services per conception, and percentage of abortions for specialized dairy cows in the Mexican highlands after suffering convalescence during the first 100 days in milk, since there is not enough information available in this region of Mexico.

Materials and Methods

The study was carried out on a commercial farm, located in the municipality of Actopan, Hidalgo, at an altitude of 2,620 meters above sea level, with an average annual temperature of 16.8°C and an annual rainfall of 436.3 mm.

Cows were milked 3 times daily, with a production of 36.4±2.1 (Mean ± SE) liters. The cows were milked for 305 days (± 13 days) with a voluntary waiting period of 55 days. In this study, 654 registered Holstein cows clinically healthy near calving date were selected.

Considering the date of service, at 21 days (± 5 days) prior to delivery, dry cows were transferred to an

antepartum pen with different feed to the dry cows, with emphasis on the use of anionic salts (0.3 kg) and 10 kg of dry matter (Table 1). The cows in the antepartum pen were observed several times a day at intervals of 2-3 hours and if they needed assistance during calving, this was provided. The criterion for assistance were: when the cow assumed the position of urinating or walking with outstretched tail for 2 or more hours; when the fetal membranes were seen by more than 2 hours and when there was no labor after 1 hour of seeing the rupture of the membranes. After calving, the cows were milked three times a day and remained in the pen for fresh cows, along with a group of these animals (Table 1), where rectal temperature, feed intake and milk production were monitored for 10 consecutive days. Subsequently, the cows were transferred to high production pens. The health of the cows was monitored up to 100 days in milk. If a cow was ill, it was diagnosed and treated by the veterinarian, and the cow's data were recorded. Distribution according to days of milking and diseases suffered are presented in Table 2. Animal procedures were approved by the Veracruz University Animal Care and Use Committee.

Description of the clinical problems analyzed

Pneumonia or Bovine Respiratory Disease (BRD): a cow with pneumonia showed fever (above 40°C), depression, animals hang their heads, look lethargic and often stand away from other cattle, off-feed and serous nasal and eye discharge.

Standard therapy: The antibiotic selected was penicillin, applying a dose on the first day of 44,000 IU/kg of body weight and subsequent maintenance doses, using 22,000 IU/kg of body weight every 24 hours; only if at 3 or 5 days the infection not ceded and fever persisted, it was changed to a oxytetracycline which was applied in a dose on the first day of 20 mg/kg of body weight and subsequent maintenance dose of 10 mg/kg of body weight every 24 hours for 7 days and Flunixin Meglumine at the rate of 2.2 mg/kg of body weight every 12 or 24 hours.

Mastitis: a cow with this disease was identified by abnormalities in the udder such as swelling, heat, redness, hardness, or pain (clinical). Other indications of mastitis found were abnormalities in milk such as a watery appearance, flakes, or clots (just clinical mastitis was analyzed in this study).

Standard therapy: a syringe with Trimetoprim (40 mg) and Sulfadiazin (200 mg) were introduced into each mammary quarter affected after each milking for 3 consecutive milking were applied.

Table 1: Nutrient content for prepartum and postpartum cows

Ingredient	Prepartum	Postpartum
Dry material (kg)	10.1	15
Crude protein (%)	15.5	17.5
Metabolic energy Mcal/kg DM	2.52	2.66
Net lactation energy Mcal/kg DM	1.62	1.71
Macro minerals (g)	35.0	209.0
Anionic components of macro minerals (g)	300	--
Micro minerals (g)	15.0	8.0
Additives (g)	150.0	220.0
Vitamins: A, D3, E (g)	53.0	103.0
Total minerals (g)	553.0	540.0
Minerals (%)	5.5	3.6
Fodder (kg)	6.0	8.6
Concentrates (kg)	4.0	6.36

Food intake of the cow was in relation to its milk production, with a conversion from 1.2 to 1.6 liters of milk per kilogram of dry matter consumed. (1.4 ± 0.2 Mean \pm SE)

Table 2: Number of observations per disease and days in milking (DM)

Disease	0-45 days in milking (n)	46-100 days in milking (n)	Total number/group (n)
Healthy	90	65	155
Pneumonia	69	55	124
Mastitis	70	59	129
Lameness	78	51	129
Digestive problems	65	52	117
Total	372	282	654

Lameness: A cow with pain condition in the hoof which results in lameness of cattle (1-5 scale) was categorized as lameness. Lameness was graded on a scale of 1 (minimal) to 5 (maximal) (Alawneha et al., 2012). Grade 1, see minimal lameness; Grade 2, visible, but slight head nod or hip hike on a straight line; Grade 3/ 4, obvious head nod or hip hike on a straight line; Grade 5, lame or non-weight bearing at the walk (Analyzed cows with grade 1 to 3).

Standard therapy: Often times the treatment was accomplished with topical or systemic antibiotic for single cow (e.g. lincomycin or oxytetracycline) and Flunixin Meglumine 2.2 mg per kg body weight (one or two application).

Digestive problems: The most common disorders digestives in the farm were diarrhea, bloat and rumen acidosis. The left or right displaced abomasum was not found in this study.

Standard therapy: The treatment was based on broad-spectrum systemic antibiotics and hydrotherapy to prevent dehydration.

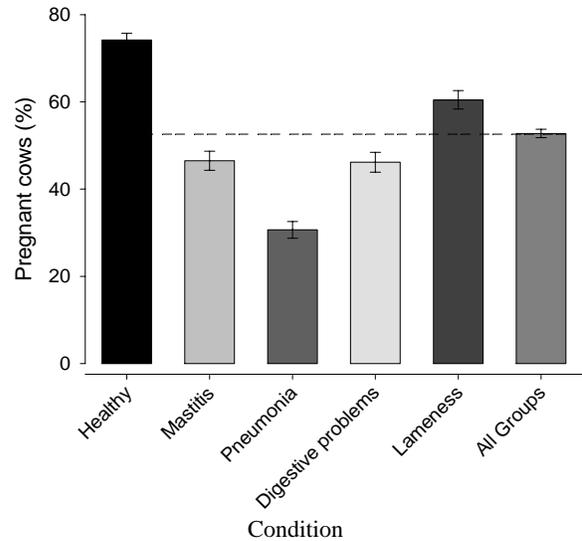


Fig. 1: Percentage of pregnant cows up to 171 days in milking. The pregnancy rate was affected ($P < 0.01$) by diseases, which appeared during the first 100 days in milk in registered Holstein cows ($n=654$) stabled in the Mexican highlands.

Reproductive profiles for each cow were recorded up to 171 ± 6 days in milking, which was average for days-open at the stable during the months of the study. Pregnancy diagnosis was performed using ultrasonography (Easy-Scan lite, LTD, Real time B mode with a transducer of 5 MHZ) at 35 ± 7 days after artificial insemination and confirmed once again at 45, 90 and 120 days of pregnancy.

The data were analyzed with STATISTICA V.10.1 (Stat Soft, 2011) applying one-way ANOVA using GLM procedure. The dependent variables were days until first service, day-open and services per conception and the independent variables were the illness condition. Statistical analysis for differences in the percentage of cows either aborted or pregnant for up to 171 days in milking was performed, applying the χ^2 test. Data were confirmed to have normal distribution using the Shapiro-Wilk-test and the Bartlett test to confirm the homogeneity of groups.

As there were non-significant differences ($P > 0.05$) in reproductive profiles among cows that became ill during days 0-45 and 46-100 days in milking, statistical analysis was performed during 0-100 days in milking.

Results

Pregnancy rate was significantly affected ($P < 0.01$) for diseases appearing from 0-100 days in milking regardless of disease type. Cows that stayed healthy during the first 100 days in milk had a significantly higher ($P < 0.05$) percentage of pregnancies up to 171 days in milk (Fig. 1).

Table 3: Reproductive profiles for different diseases during the first 100 days in milk among Holstein cows stabled in the Mexican highlands

Disease	*Days to first service	*Days-open	*Services per conception	% of abortions
Healthy	77.6±2.9 ^b	178.6±10.7 ^a	3.0±0.18 ^a	7.74± 0.57 ^a
Mastitis	70.5±3.2 ^{ab}	207.9±11.8 ^a	3.7±0.35 ^a	11.63± 0.90 ^a
Pneumonia	60.6±3.3 ^a	175.3±12.0 ^a	2.8±0.50 ^a	4.03± 0.34 ^a
Lameness	81.6±3.2 ^b	173.4±07.6 ^a	2.8±0.22 ^a	5.43± 0.45 ^a
Digestive problems	72.4±3.4 ^{ab}	194.3±12.4 ^a	3.4±0.36 ^a	7.69± 0.65 ^a
Average	72.8±1.4	185.7± 5.2	3.1±0.32	7.33± 0.26

* Least square means ± standard error of the mean; ^{a,b} Different letters in the same column are statistically significant between row (P<0.05)

Diseases that affected cows during the first 100 days in milking had non-significant effect (P>0.05) on number of services per conception, percentage of abortions and days-open, but in term of days to first service there was a significant difference (P<0.05) between conditions compared to the group of healthy cows (Table 3). Days to first service was significantly affected in case of those animals suffered from pneumonia. However, it should be noted that only serviced cows were taken into account for statistical analysis.

Discussion

The results from this study clearly indicate that the health of the cows during the first 100 days in milk is extremely important for promoting optimal reproductive profiles. In this study, cows that remained healthy during the first 100 days in milk had a higher (P<0.05) percentage of pregnancies. These results are similar to those reported by Arana et al. (2006) indicating that healthy cows have a higher percentage of pregnancies, prior to 180 days in milk. Similarly Ingvarsten et al. (2000) reported that stable Holstein cows that fell ill during the first weeks after calving increased the number of days-open, thus decreasing the number of pregnant cows.

Cows with lameness that fell ill during the first 100 days producing milk manifested 60% pregnancy rate up to 171 days producing milk, these results are similar to those reported by Hernández et al. (2001) who reported that cows with hoof injuries and lameness were 52% less likely to become pregnant. Generally different authors from around the world corroborated the results from this study; cows suffering from leg diseases during the first weeks after calving have lower reproductive rates, thus drastically reducing the percentage of pregnant cows up to 180 days in milk (Collick et al., 1989; Hernandez et al., 2001; Hultgren et al., 2004).

Cows infected with mastitis showed only 46% pregnancy rate at 171 days in milking, this figure is below than that for healthy cows (74%). Other authors corroborate that cows that were ill with mastitis during the first weeks after parturition had significantly

reduced reproductive rates (Moore et al., 1991). In this case, Moore et al. (1991) indicated that only 50% of cows with mastitis became pregnant, similar to the results presented in this study.

It is reported that the negative effect on reproduction caused by clinical and subclinical mastitis may be due to an alteration in the endocrine profile, causing failures in follicular development and oocyte maturation and during the post-ovulatory estrus period (Schrick et al., 2001). Kelton et al. (2001) suggested that the effect of mastitis on reproduction involved the release of mediators for inflammation, which can negatively affect luteal function, circulating levels of progesterone and maintenance of early pregnancy. Barker et al. (1998) stated that the effect of mastitis on reproductive profiles was due to the release of endotoxins that induce luteolysis affecting concentrations of the serum progesterone. Barker et al. (1998) also confirmed the negative effect of these endotoxins on the concentration of LH receptors, and for stimulating the release of the corticosteroid releasing factor, ACTH and steroidogenesis. Peter et al. (1989) reported that administration of endotoxin among heifers that were in cycle resulted in high cortisol concentration and a decrease in follicular size.

Cows that were ill with digestive problems manifested a lower percentage of pregnancies up to 171 days in milk (46%) compared to healthy cows, similar to cows suffering from pneumonia (30%), indicating the negative effect of these diseases on reproduction. No studies have reported a relationship between digestive disorders and reproductive profiles. However, Inchausti et al. (2013) suggested that digestive diseases could affect rumen pH, causing lysis of Gram-negative bacteria and thus increasing lipopolysaccharides, possibly causing a higher level of markers of systemic inflammation similar to mastitis (clinical or subclinical). It has also been suggested that a low rumen pH may result in lameness which is a contributory reason for a drop in body condition with postpartum reproductive consequences (Garbarino et al., 2004).

In this study, no negative effects by any disease on days up to first service, services per conception or percentage of abortions were detected, contradicting

most published studies (Collick et al., 1989; Hernandez et al., 2001; Kelton et al., 2001; Inchaisri et al. 2013; Garbarino et al., 2004). The difference between studies may result from the fact that in this study, the data from un-serviced cows up to 171 days producing milk was not taken into account. In other words, in this study most cows with diseases were not subjected to artificial insemination protocol, until they were diagnosed as healthy and manifested adequate body condition.

Conclusions

According to the results found in this study among stable registered Holstein cows in the Mexican highlands, we can suggest that cows suffering any health problems whether it be mastitis, pneumonia, digestive problems or lameness during the first 100 days in milk had a lower pregnancy rate for up to 171 days in milking, thus it is advisable to prevent these conditions and try to maintain cows healthy specially the first 100 days in milk.

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