

Full Length Research Paper

Factors affecting reproductive performance of dairy cow in Algeria: Effects of clinical mastitis

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The objective of the present study was to evaluate the effects of clinical mastitis at the beginning of lactation on reproductive performance of dairy cows in Algeria. Calving to first insemination and calving to conception intervals, number of insemination per conception and conception rate at the first artificial insemination were recorded for 432 cows from 16 dairy herds in Algeria. Cows were examined for clinical mastitis during milking by the personnel or the herd manager. A clinical mastitis case was recognized by the presence of modified milk (more watery, presence of lumps, abnormal odor) or by the presence of signs of inflammation in one or all quarters of the udder. Cows were classified according to the time of clinical mastitis occurrence in three groups: cows presenting clinical mastitis before the first artificial insemination (MG1; n = 62 dairy cows), cows presenting clinical mastitis between the first artificial insemination and pregnancy diagnosis (MG2; n = 54 dairy cows), and cows without any signs of clinical mastitis before or after the first insemination (Control - CG; n = 316 dairy cows). Calving to first artificial insemination and calving to conception intervals for cows with signs of clinical mastitis before the first artificial insemination (137.26 ± 7.36 days and 180.48 ± 7.25 days) and in cows with signs of clinical mastitis after the first artificial insemination (190.85 ± 9.23 and 202.51 ± 10.32 days) were significantly ($p < 0.05$) higher than that of the clinically healthy cows (111.01 ± 5.42 and 147.32 ± 8.44 days), respectively. The number of inseminations per conception in cows that exhibited clinical mastitis before the first artificial insemination (1.94 ± 0.85) and in cows with signs of clinical mastitis after the first artificial insemination (2.4 ± 0.94) was significantly higher compared to that of the control cows (1.61 ± 0.75) ($p < 0.05$). Conception rate at first artificial insemination in control cows was significantly ($p < 0.05$) greater than in cows that exhibit clinical mastitis before or after the first artificial insemination (61.39 compared to 38.71 and 33.33% for CG, MG1 and MG2, respectively). The negative effects of clinical mastitis were observed in both primiparous and multiparous cows. In conclusion, results of our study clearly indicate that, clinical mastitis decreases reproductive performance of dairy cows.

Key words: Clinical mastitis, calving to first artificial insemination interval, calving to conception interval, reproduction, dairy cattle.

INTRODUCTION

Reproductive performance efficiency in dairy cattle is an integral section of the production management system in all dairy farms. It is perceived to be on the decline over

the last few decades (Lucy, 2001). The cause of low fertility in dairy cows is multifactorial. The shift towards higher production per animal, inadequate nutrition, poor

reproductive management, increased incidence of metabolic and infectious diseases and their complex interactions appear to be the main factors that negatively affect reproductive efficiency. It is difficult to determine the exact reason for this decline.

Mastitis is one of the most common and costliest diseases in dairy cattle. It is the second most common being in the reproductive insufficiency. Clinical mastitis is characterized by the presence of many symptoms; local (tumefaction and heat), functional (change in quality and quantity of milk), and general symptoms (anorexia and fever). It is the most common cause of antibiotic use in dairy farms which could result to a decrease in the quantity and quality of milk till the death of the animal, with a high economic impact on the dairy industry. Recently, many studies have shown a relationship between mastitis and reproduction in dairy cattle.

The relationship between mastitis and reproductive performance of dairy cow was firstly observed by Moore et al. (1991). These researchers demonstrated this negative relationship as, the alteration in estrus cycle duration and the decline in the length of the luteal phase in cows suffering from clinical mastitis. More recently, Nava Trujillo et al. (2010) and Yang et al. (2012) found that the incidence of clinical mastitis at the beginning of lactation reduced reproductive performance by, increasing the calving to first insemination interval, calving to conception interval and decreasing conception rate in the first insemination.

Nevertheless, in Algerian dairy cows the negative impact of clinical mastitis on reproductive performance is generally unknown. Therefore, the aim of the present study was to evaluate the impact of clinical mastitis at the beginning of lactation on reproductive performance of dairy cows in Algeria.

MATERIALS AND METHODS

Animals and management

Data of the present study were collected from 432 dairy cows in 16 dairy farms from September 2012 to 2014 in Algeria. These dairy farms were selected due to the following reasons: application of artificial insemination, preventive medicine standard operating procedures, ease of access to dairy farms, availability and accessibility of information concerning the reproductive treatments, sufficient milk production, feeding management and husbandry practices of dairy cows.

All cows were milked twice daily by milking machines during the experimental period. Dry period of cows had a length of two months before the scheduled calving. Dairy cows were classified and assigned according to time of clinical mastitis occurrence in three groups: (I) Mastitis group 1 (MG1; n = 62 dairy cows): cows with signs of clinical mastitis before the first artificial insemination; (II)

Mastitis group 2 (MG2; n = 54 dairy cows): cows with signs of clinical mastitis between first artificial insemination and pregnancy diagnosis; (III) control group (CG; n = 316 dairy cows): cows without any signs of clinical mastitis before or after the first insemination.

Diagnosis of clinical mastitis

During each milking, dairy cows were examined for clinical mastitis symptoms by the personnel or the herd manager. Clinical mastitis was perceived by the presence of modified milk (more watery, presence of lumps, abnormal odor) or signs of inflammation in one or all quarters of the udder (dolor, redness and heat). Each clinical mastitis case observed was confirmed by a veterinarian, who applied treatment protocols for each case. In general, treatment of mastitis was performed by intramammary infusion of antibiotics. Dairy cows with a background of chronic clinical mastitis or other concomitant diseases were not included in the present study.

Reproductive management

Insemination of cows was performed between 8 and 12 h after estrus detection that was accomplished due to visual surveillance of the cows by the farm personnel, during a half hour in the morning and a half hour in the afternoon. Specific signs that were evaluated in a descending order of significance were; acceptance of overlap, sniffing the vulva of other cows, mucus presence in the vulva, nervousness, pink vulva and hyperactivity. After 60 days or more, cows that did not return to estrus were examined for pregnancy by an experienced veterinarian (rectal examination).

The collection of data on reproduction was carried out from the individual records of dairy cows. The reproductive performance criteria that were assessed in the present study were the conception rate at first insemination, the number of artificial inseminations per conception (coital index), calving to first insemination and calving to conception intervals.

Statistical analyses

After collecting and categorizing all the available data, analyzed statistical analysis was performed using SPSS 19.0 (IBM) software. Conception rate at first artificial insemination was analyzed by a logistic regression model (binomial data) (Allison, 1999), calving to first insemination interval, calving to conception interval and number of artificial insemination per conception which were analyzed by using a General Linear Model (GLM). Data are presented as least squares mean (L.S.M.) \pm standard error of mean (S.E.M). Treatment differences with $p \leq 0.05$ were considered significant.

RESULTS

As it is shown in Table 1, the interval from calving to first insemination was greater ($p < 0.05$) in cows with clinical mastitis after the first artificial insemination (190.85 ± 9.23 days) than in cows that exhibited clinical mastitis before the first artificial insemination (137.26 ± 7.36 days) or cows without signs of clinical mastitis (111.01 ± 5.42

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Table 1. Impact of the timing of clinical mastitis occurrence on the reproductive performance parameters.

Groups	N	Calving to first artificial insemination	Calving to conception interval	Number of inseminations per conception	CRIA1 Percentage (%)
Control group	316	111.01±5.42 ^a	147.32± 8.44 ^a	1.47± 0.65 ^a	61.39 ^a
Mastitis group 1	62	137.26±7.36 ^b	180.48± 7.25 ^b	1.94± 0.85 ^b	38.71 ^b
Mastitis group 2	54	190.85±9.23 ^c	202.51±10.32 ^c	2.04 ± 0.94 ^b	33.33 ^b

^{a,b,c} Values with different letters within the same column are significantly different ($P < 0.05$). CRIA1 (%): Conception rate at first artificial insemination (percentage).

Table 2. Impacts of the time of clinical mastitis occurrence adjusted by parity on reproduction performance parameters.

Groups	Cow	Control group	Mastitis group 1	Mastitis group 2
Calving to first artificial insemination interval	Primiparous	115.49±5.53 ^a	148.93±7.78 ^b	196.73±10.76 ^c
	Multiparous	107.49±5.37 ^a	125.88±7.23 ^b	176.28±8.68 ^c
Calving to conception interval	Primiparous	155.89±8.67 ^a	185.71±7.74 ^b	216.00±9.85 ^c
	Multiparous	137.22±8.15 ^a	176.17±7.27 ^b	195.00±10.78 ^c
Numbers of artificial inseminations per conception	Primiparous	1.49±0.66 ^a	1.93±0.83 ^b	2.18±0.87 ^c
	Multiparous	1.45±0.64 ^a	1.94±0.90 ^b	1.94±0.94 ^b
CRIA1 (%)	Primiparous	58.75 ^a	35.71 ^b	29.27 ^b
	Multiparous	65.79 ^a	41.18 ^b	34.33 ^b

^{a,b,c} Values with different letters within the same column are significantly different ($p < 0.05$). CRIA1 (%): Conception rate at first artificial insemination (percentage).

days). Furthermore, calving to conception interval was significantly ($p < 0.05$) greater in cows of clinical mastitis group 1 and 2 than in cows without clinical mastitis (control group) (180.48 ± 7.25 and 202.51 ± 10.32 vs. 147.32 ± 8.44) days, respectively. Calving to conception interval was greater in MG2 than MG1 cows.

Additionally, when parity was integrated in the analysis, this effect was also observed in both primiparous and multiparous cows (Table 2), since calving to first artificial insemination and to conception intervals were increased in MG1 and MG2 primiparous and multiparous cows. Cows of mastitis group1 (MG1) and 2 (MG2) had similar conception rate in the first artificial insemination (38.71% vs. 33.33%; $p > 0.05$) (Table 1). However, cows of both MG1 and MG2 groups had lower conception rate in the first artificial insemination compared to the cows of the control group (CG) (61.39%). The coital index (number of artificial inseminations per conception) for MG1 (1.94 ± 0.85) and MG2 cows (2.04 ± 0.94) was significantly ($P < 0.05$) greater than that of the clinically healthy cows (1.47 ± 0.65). This effect was found in both multiparous and primiparous cows (Table 2). Consequently, clinical mastitis significantly increased the number of artificial inseminations per conception and decreased conception rate in the first artificial insemination in both primiparous

cows and multiparous MG1 and MG2 than control cows.

DISCUSSION

Our results demonstrated that cows suffering from clinical mastitis before or after first artificial insemination had a worse reproductive performance compared to clinically healthy cows. In detail, cows with signs of clinical mastitis before the first insemination had greater calving to first insemination and calving to conception intervals than cows that exhibited clinical mastitis after the first insemination or cows without signs of clinical mastitis. Ours results are in accordance with the findings of Barker et al. (1998) and Schirck et al. (2001).

Barker et al. (1998) in a study conducted in a herd of cows at the University of Tennessee Dairy Experiment Station, reported that the interval from calving to first artificial insemination is significantly higher in the cows with clinical mastitis before the first insemination (93.6 ± 5.6 days) than the other groups of cows (71.0 ± 2.2 days). Additionally, interval from calving to conception for cows with clinical mastitis symptoms exhibited, after the first artificial insemination (136.6 ± 13.3 days) and before the application of the first artificial insemination ($113.7 \pm$

10.8 days) was significantly higher than cows which developed clinical mastitis after pregnancy detection (92.1 ± 4.6 days) and the control healthy cows. Cows that developed clinical mastitis after the first insemination had significantly higher number of inseminations per conception (2.9 ± 0.3) than cows with signs of clinical mastitis before the first insemination (1.6 ± 0.3) and after pregnancy detection (1.7 ± 0.1), and control cows.

This study demonstrates that cows with signs of clinical mastitis before (1.94 ± 0.85) or after the first insemination (2.04 ± 0.94) needed significantly greater insemination applications for conception than cows without signs of clinical mastitis (1.61 ± 0.75). Schrick et al. (2001) reported similar findings; cows with signs of clinical mastitis before the first insemination needed more insemination applications for conception (2.1 ± 0.2) compared to cows of control group (1.6 ± 0.2). In another study performed by Nava-Trujillo et al. (2010) an effect of parity was found on the interval between calving and first insemination; multiparous healthy cows needed less days (84.94 ± 4.65 days) in comparison to primiparous healthy cows (112.11 ± 7.72 days). Furthermore, primiparous cows that developed clinical mastitis needed 53 more days in average from calving to first insemination than multiparous cows with signs of clinical mastitis (165.66 ± 8.75 vs 106.97 ± 5.24 days). In addition, these researchers found that a cow with clinical mastitis needed 43 more days from calving to conception in comparison to clinically healthy cows and this period was increased when the effect of parity was also included in the analysis (86 days).

In another study carried out in Nanning, China (Yang et al., 2012), the impact of clinical mastitis between calving and next conception on reproductive performance was evaluated. Six hundred and three multiparous Holstein dairy cows from a commercial dairy farm were allocated into three groups: cows with signs of clinical mastitis before the first artificial insemination (MG1), cows with signs of clinical mastitis between the first artificial insemination and pregnancy diagnosis (MG2) and clinically healthy cows (CG). As it was found, MG1 cows had a significantly greater interval from calving to first insemination compared to MG2 and CG cows. Interval from calving to conception was similar for MG1 and MG2 cows, but higher than that of CG cows. MG1 and MG2 cows needed are significantly more insemination applications for conception than control cows, while MG1 cows needed less insemination efforts for conception in comparison to MG2 cows. Conception rate at first artificial insemination was similar for MG1 and MG2 cows, but significantly lower compared to clinically healthy animals.

According to the results of the present study, occurrence of clinical mastitis before or after the first artificial insemination induced negative effects on reproductive performance in dairy cows. These findings were in accordance with that of previous studies (Gunay and Gunay, 2008; Ahmadzadeh et al., 2009; Hertl et al.,

2010; Nava-Trujillo et al., 2010; Yang et al., 2012). Although the correlation of mastitis with high infertility rates is well known, the mechanisms underlying this relationship are not clear and several hypotheses could be formulated.

Clinical mastitis affects reproduction through the secretion of several bacterial toxins that may induce the secretion of inflammation mediators such as prostaglandin $\text{PGF}_{2\alpha}$; the high concentration of $\text{PGF}_{2\alpha}$ that is associated with clinical mastitis which may cause a premature luteolysis, a decrease in progesterone levels and the death of the embryo, especially during the first 3 months of pregnancy (Barker et al., 1998; Huszenicza et al., 2005; Santos et al., 2004). Clinical mastitis is also accompanied by fever which may disrupt feed intake by depressing appetite, increasing water intake and decreasing forage digestibility (Rhoads et al., 2009; Shwartz et al., 2009). This decreased feed intake can lead to, worsening of body condition and prolongation of energy deficit, resumption of ovarian cycles and delaying of follicular maturation (Santos et al., 2004). Excessive mobilization of body reserves may also lead to decreased synthesis of immune proteins (globulins) and increased susceptibility to infections. These factors could further explain the reduction of the reproductive efficiency in cows with clinical mastitis (Schrick et al., 2001).

Furthermore, heat stress that is common in Algeria due to high temperatures is also known to cause an impaired oocyte quality (Sartori et al., 2002). Increased temperature is associated with high early embryonic mortality rates and limited embryonic development. The combination of hyperthermia with an infectious process hinders embryonic development (Wolfenson et al., 2000).

Heat stress can result to disturbances in the secretion of hypothalamic-pituitary hormones (LH and GnRH); and a decrease in blood concentration of LH is observed (Badinga et al., 1985). The decrease in the secretion of LH further results in a reduction of follicular synthesis of estradiol (Yaniz et al., 2008), a reduction of the duration and expression of estrus (De Rensis and Scaramuzzi, 2003; Hansen and Arechiga, 1999) and may lower the success rate of insemination and increase the interval from calving to conception (Ryan et al., 1993).

Conclusion

This study evaluates the relation between clinical mastitis occurrence and reproductive performance in Algerians dairy cows. As it was revealed, clinical mastitis had a negative effect on reproductive performance of dairy cows; delayed calving to first artificial insemination and calving to conception intervals, increased the number of inseminations per conception and reduced conception rate at first artificial insemination in both primiparous and multiparous cows. Consequently, it is necessary to decrease the incidence of clinical mastitis in order to improve the reproductive performance of dairy cows.

Conflict of Interests

The authors have not declared any conflict of interests.

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