

## REPRODUCTIVE EFFICIENCY IN HIGH-MILKING DAIRY COWS AFTER CALVING\*

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*SUMMARY: The aim of this work was to determine incidence of calving and postcalving reproduction disorders and their effect on the major parameters of cows reproductive efficiency at dairy farm in the R. Serbia. Total number of 1835 high-milking dairy cows (av. milk production >8500L/305d of lactation) records has been reviewed during one year period, at the large dairy farm in area of Vojvodina (R. Serbia). Normal calving and puerperal period without health problems was observed at 583 cows (27,6%), while different abnormalities during and after calving were recorded in 1252 cows (72,4%). The highest percentages of registered peripartal disorders were dystocia and endometritis (62% and 64%, respectively), affecting almost the same percentage of cows. Peripartal disorders had statistically significant influence ( $P < 0.05$ ) on the increase of number of services/conception (3,5 vs. 2,7, reproductive disorders vs. healthy cows, respectively), prolongation of the interval from first postpartal insemination till conception (110 vs. 57 days, reproductive disorders vs. healthy cows, respectively), and increase of days open period (214 vs. 146 days, reproductive disorders vs. healthy cows, respectively). This results have confirmed increased incidence of reproduction disorders during calving and postcalving period that significantly reduces reproductive efficiency in high milking dairy cows after parturition.*

**Key words:** reproduction disorders, reproduction efficiency, dairy cows.

### INTRODUCTION

Modern dairy farming with continuous pressure for the increase of milk production is inevitably linked to the dairy cows reproductive efficiency. One of the major

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parameters of reproductive efficiency in dairy cows is calving interval. Maximal milk production and continuous calving in the high-milking dairy farms is achieved if the average calving interval is between 12-13 months (Stevenson and Britt, 1977). However, in the field conditions calving interval is often longer than 14 months. Since pregnancy duration is biologically constant, calving interval has been determined by the period between calving and first successful artificial insemination (AI), namely service period (SP). Service period is under the influence of many paragenetic factors like parity, season, housing and nutrition, contact with fertile bulls, as well as dairy cows health status, with special consideration of reproductive tract condition (Petrović, 1976; Stančić, 1989; Stančić and Košarčić, 2007). From the reproduction management view SP period is directly determined by the duration of interval between calving and first ovulatory estrus, and period between very first and first successful insemination. In healthy dairy cows first postpartal ovulation usually occurs between 15-30 days after calving, but unfortunately about 70% of these ovulations are „silent“, ie. without manifested signs of estrus. However, from practical standpoint it could be important to detect such ovulations, since it could ease the observation of the next estrous cycle with estrus detection and increase chances for successful insemination. If our goal in dairy farming is to have optimal 12 months calving interval it is necessary to achieve successful conception within maximally 90 days post partum (Bousquet et al., 2000; Crowe, 2008).

Many researchers during the last decades indicated permanent decline of modern high-milking dairy cows reproductive efficiency (Roche, 2000; Lucy, 2001; Dobson et al., 2007). Decrease of reproductive efficiency is manifested as prolonged postpartal anoestrus (Thacher et al., 2006), increase number of cows in silent estrus with irregular estrous cycle duration, resulting from short luteal phase in the first few postpartal cycles (Darwash et al., 1997), decline in the first insemination conception rate (CR) (Lucy, 2001), as well as an increase number of cows with abnormal early embryonic development and various forms of uterine diseases, increasing embryonic and fetal mortality rate (Diskin, 1987; Fourchon et al., 2000; Bouchard i Du Tremblay, 2003; Lucy, 2007). The final result is decrease in the reproductive efficiency with an increase of number of inseminations needed for successful conception (Sheldon i Dobson, 2003). It was reported that successful CR after the first insemination decreased between 1990-2000 in most European countries from 55% to 45% (Bousquet et al., 2004). This situation had a direct influence on the increase of number of inseminations and Lucy (2001) reported that 20 years before approximately 1,75 inseminations were needed for successful conception while in the last few years it has increased to more than 3. This is important parameter of reproduction efficiency since it is inversely proportional to the reproduction efficiency and directly proportional to DO period (Esslemont et al., 2000).

In the modern high-milking dairy farms milk production is usually between 8000-10000 kg milk/cow/lactation, and it is the result of intensive selection of cows for high milk production, as well as constant improvements in the nutrition and dairy farms management. Decline in the reproductive efficiency is inversely linked to the increase of milk production, and directly connected to the negative effect of different stressors originating in inadequate housing, environmental conditions, lack of contact with fertile bulls etc. (Rodriguez-Martinez et al., 2008). However, there is a general agreement that periparturient diseases are more important factor that causes decline in reproductive efficiency than high-milk production (Lucy, 2001). Aim of this work was to investigate incidence of calving and postcalving reproduction disorders and their effect on

reproductive efficiency at one high-milking dairy cows farm in the region of Vojvodina (Republic of Serbia).

## **MATERIAL AND METHODS**

Total number of 1835 Holstein-Friesian dairy cows health records was examined at the large high-milking dairy cows farm in the region of Vojvodina (Republic of Serbia). All experimental animals health records were analyzed from one calving to the next calving and animals were divided in two groups according to the following criteria: a) animals without reproduction disorders (n=583), and b) animals with reproduction disorders (1252). The two groups of reproduction disorders were investigated: 1) health problems during calving (dead calves, dystocia, assisted calving, other) and 2) health problems after calving (placental retention, endometritis, parametritis, perimetritis, piometra, ovarian cysts, nonfunctional ovaries, other).

About 20 days after calving all investigated animals were monitored for signs of estrus during milking and feeding time. All investigated cows were artificially inseminated (AI) once or twice during the manifested estrus detected after day 40 postcalving. Pregnancy diagnosis was confirmed using rectal palpation at 45-60 days after insemination. Following reproduction parameters were determined: (1) interval between calving and the first recorded estrus, (2) interval between calving and first insemination, (3) interval between calving and successful insemination (service period, SP), (4) number of AI needed for successful conception, and (5) interval between the first and second AI.

Statistical significance of differences between means was determined using Student t-test at the level of  $P < 0.05$ .

## **RESULTS AND DISCUSSION**

From the total number of 1835 high-milking dairy cows calving and postpartal health disorders were recorded in 1252 dairy cows (72,4%), while 583 (27,6%) dairy cows were healthy. Relative numbers of high-milking dairy cows with reproduction disorders are presented in the Figure 1. The most frequent reproduction disorders after and during calving were endometritis (64%) and dystocia (62%).

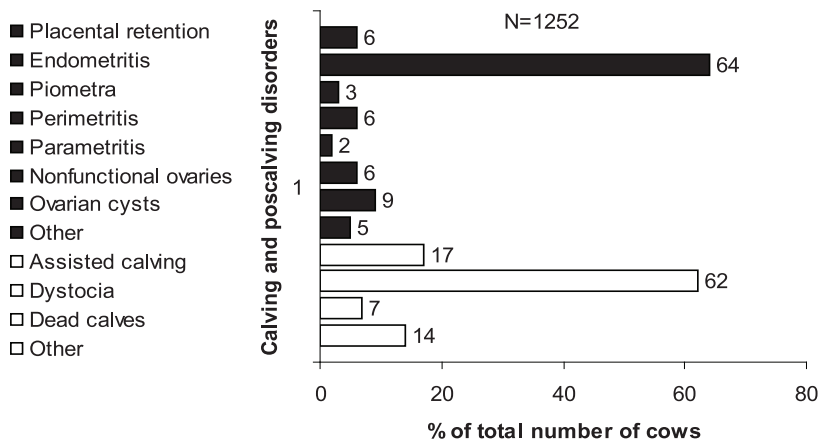


Figure 1. Relative number of high-milking dairy cows with reproduction disorders during and after calving

Relative number of dairy cows (%) with external signs of estrus detected during 45 days after calving was not significantly different between group of cows with and without reproductive disorders (Figure 2). However, it is clear that almost 50% of cows with postcalving reproduction disorders had extremely long interval between calving and the first estrus (49% of cows with postcalving disorders had interval  $\geq 92$  days). It is interesting that 38% of healthy dairy cows and similar percentage of cows with calving disorders (40%) also had very long interval between calving and first observed estrus (Figure 2).

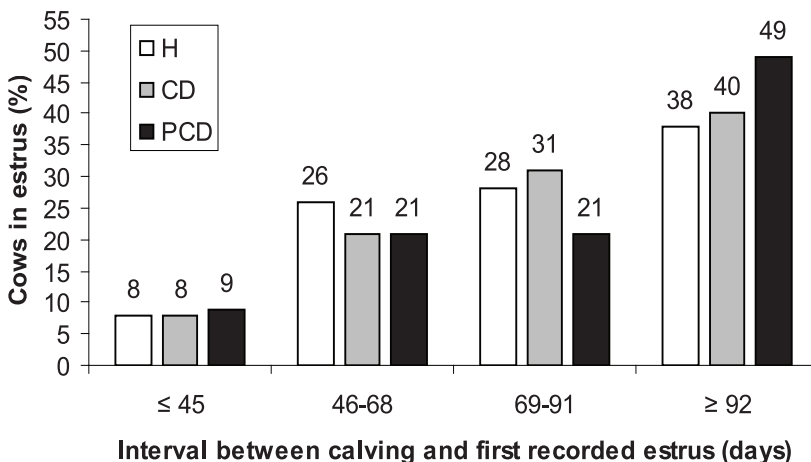


Figure 2. Relative number of dairy cows and the interval from calving to the first recorded estrus; H- healthy cows, CD – calving disorders, PCD – postcalving disorders

High incidence of postcalving disorders significantly prolongs the interval between calving and first insemination. The duration between calving and first insemination is longest in dairy cows with ovarian cysts (120 days), with similar interval in cows

with endometritis (116 days). The data about interval between calving and first insemination relative to the calving and postcalving reproduction disorders are presented in the Figure 3.

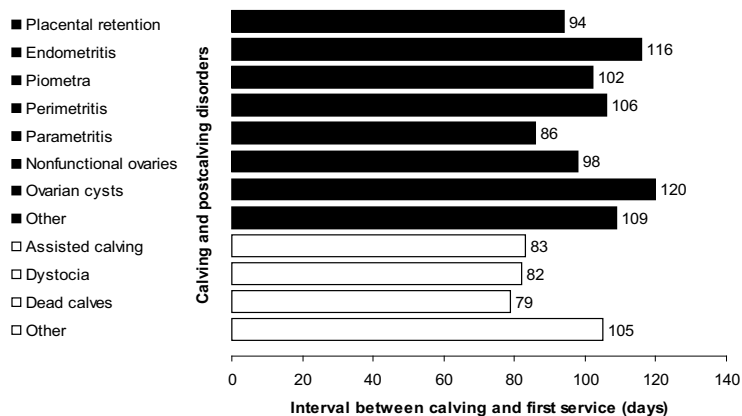


Figure 3. Interval between calving and first AI in high-milking dairy cows (days)

The effect of calving and postcalving reproductive disorders on the number of AI needed for successful insemination (insemination index), relative to the calving parity is presented in the Table 1. The average insemination index value for healthy and dairy cows with reproductive disorders was significantly different (2.7:3.5, respectively,  $P < 0.05$ ). The average insemination index value was not different between first lactation healthy dairy cows and older healthy dairy cows (2.8 : 2.7, respectively,  $P > 0.05$ ), and it was significantly higher in first lactation and older dairy cows with reproduction disorders compared to the healthy cows (3.7 and 3.4, respectively).

Table 1. The effect of calving and postcalving reproductive disorders at number of AI per successful conception, relative to the calving parity

Tabela 1. Uticaj reproduktivnih poremećaja tokom i posle tepenja na broj VO po uspešnoj koncepciji, u zavisnosti od pariteta telenja

|  |                        |   | 1 <sup>st</sup> calving cows<br><i>Prvotelke</i> |        | $\geq 2$ calving cows<br><i>Krave sa <math>\geq 2</math> telenja</i> |        | Total |        |
|--|------------------------|---|--|--------|--|--------|-------|--------|
|  |                        |   | H  | CD+PCD | H  | CD+PCD | H     | CD+PCD |
| Conception after<br><i>Vrednost koncepcije</i> | 1.AI/VO                | n | 27   | 22     | 85   | 34     | 112   | 56     |
|  |                        | % | 15,7   | 6,7    | 20,8   | 3,7    | 19,2  | 4,5    |
|  | 2.AI/VO                | n | 44   | 36     | 98   | 150    | 142   | 186    |
|  |                        | % | 25,4   | 11,0   | 23,9   | 16,2   | 24,4  | 14,8   |
|  | 3.AI/VO                | n | 39   | 66     | 69   | 147    | 108   | 213    |
|  |                        | % | 22,5   | 20,2   | 16,8   | 15,9   | 18,5  | 17,0   |
|  | $\geq 4$ .AI/VO        | n | 63   | 203    | 158  | 594    | 221   | 797    |
|  |                        | % | 36,4   | 62,1   | 38,5   | 64,2   | 37,9  | 63,7   |
|  | Total<br><i>Ukupno</i> | n | 173  | 327    | 410  | 925    | 583   | 1.252  |
|  |                        | % | 100,0  | 100,0  | 100,0  | 100,0  | 100,0 | 100,0  |

|   |                  |                  |                  |                  |                  |                  |
|---|------------------|------------------|------------------|------------------|------------------|------------------|
| Average No. of service per conception<br><i>Prosečan br. VO po koncepciji</i> | 2,8 <sup>a</sup> | 3,7 <sup>b</sup> | 2,7 <sup>a</sup> | 3,4 <sup>b</sup> | 2,7 <sup>a</sup> | 3,5 <sup>b</sup> |
|---|------------------|------------------|------------------|------------------|------------------|------------------|

H – healthy cows / *Zdrave krave*, CD – cows with calving disorders / *Krave sa poremećajima tokom telenja*,

PCD – cows with postcalving disorders / *Krave sa poremećajima posle telenja*.

<sup>a,b</sup>Values in the same row not shearing the same superscript are significantly different (P<0,05).

<sup>a,b</sup>Vrednosti sa različitim superskriptima, u istom redu, se statistički značajno razlikuju (P<0,05).

The average interval between the very first and successful AI in first lactation (H, 1<sup>st</sup> parity) and older healthy (H, ≥2 parity) dairy cows was not significantly different (57:46 days, respectively, P>0.05). This interval was significantly longer (P<0.05) in FL and Old dairy cows with calving and postcalving disorders (93, 106, 110, and 102 days, respectively). Similar relationship exists regarding average servis period that was significantly shorter (P<0.05) in FLH and OldH dairy cows (146 and 137 days, respectively), compared to the same categories of dairy cows with calving and postcalving reproductive disorders (202, 214, 188 and 186 days, respectively). There were no significant differences between two groups of dairy cows with reproductive disorders (calving and postcalving) regarding the interval between calving and first AI and servis period (Table 2 and Figure 4).

Table 2. Interval between the first and successful AI and the service period duration

*Tabela 2. Interval između prvog i uspešnog VO i trajanje servis perioda*

|   | 1 <sup>st</sup> calving cows<br><i>Prvotelke</i> |                  |                  | ≥2 calving cows<br><i>Krave sa ≥ 2 telenja</i> |                  |                  |
|---|--|------------------|------------------|--|------------------|------------------|
|   | H  | CD               | PCD              | H  | CD               | PCD              |
| Aver. interval between the first AI and successful AI (days)<br><i>Pros. interval od prvog VO do uspešnog VO (dani)</i> | 57 <sup>a</sup>                                  | 93 <sup>b</sup>  | 106 <sup>b</sup> | 46 <sup>a</sup>                                | 110 <sup>b</sup> | 102 <sup>b</sup> |
| Aver. service period duration (days)*<br><i>Pros. trajanje servis perioda (dani)*</i>                                   | 146 <sup>b</sup>                                 | 202 <sup>a</sup> | 214 <sup>a</sup> | 137 <sup>b</sup>                               | 188 <sup>a</sup> | 186 <sup>a</sup> |

H – healthy cows / *Zdrave krave*, CD – cows with calving disorders / *Krave sa poremećajima tokom telenja*,

PCD – cows with postcalving disorders / *Krave sa poremećajima posle telenja*.

<sup>a,b</sup>Values in the same row not shearing the same superscript are significantly different (P<0,05).

<sup>a,b</sup>Vrednosti sa različitim superskriptima, u istom redu, se statistički značajno razlikuju (P<0,05).

\*Interval from the calving to successful AI / Interval od telenja do uspešne koncepcije

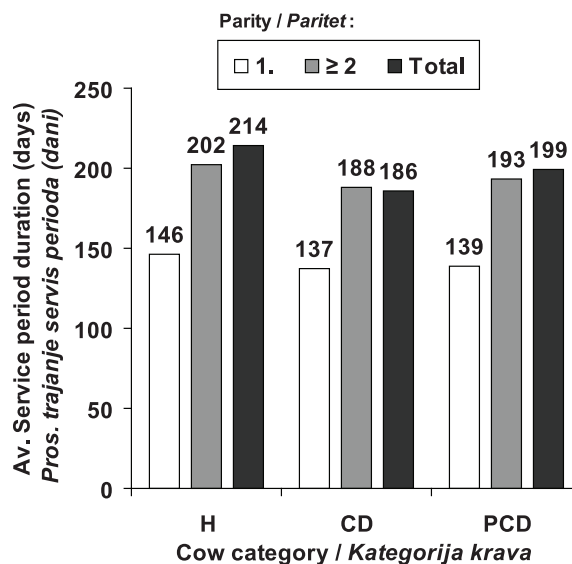


Figure 4. Service period duration in different dairy cows categories (H – healthy cows, CD – calving disorders, PCD – postcalving disorders)

One of the major parameter of reproduction efficiency is calving interval. Many authors have indicated that 12-13 months calving interval enables maximal milk and calves production (Stančić, 1989; Walker, 1997; Wattiaux, 2006). Calving interval is determined by the two factors: (1) gestation duration and (2) service period (SP) duration (interval between calving and successful conception). Since gestation duration is biologically constant, the calving interval is influenced by the factors determining service period duration. Prolongation of the SP is the result of long interval between calving and first estrus, as well as the interval between the first AI and successful AI. Both intervals could be extended because of the numerous non infective and infective etiologic factors (Gordon, 1997; Stančić and Košarčić, 2007).

Our research results indicate that dystocia and assisted calving are the most frequent calving disorders (79% of all calving disorders). The potential causes for this situation could be poor body condition of cows or increased newborn calves body weight. After calving the most frequent reproductive organs disorders were inflammatory processes affecting uterus (endometritis, piometra, perimetritis), with about 75% affected dairy cows. However, inflammatory diseases are direct consequence of complicating calving or postcalving disorders. Between 30-50% of dairy cows could be affected with some kind of calving and postcalving disorder resulting in the decrease of their reproductive efficiency or culling (Fourchon et al., 2000; Grögn and Rajala-Schultz, 2000; Beaver, 2004; Dobson et al., 2007).

Our data indicate that average interval between calving and the first registered estrus was 95, 93 and 97 days in H, CD and PCD dairy cows, respectively. This unfortunate finding is the result of small number of dairy cows from all three groups with estrus detected within 68 days post partum (36%, 29% and 30% in H, CD and PCD groups of cows). This was the reason that about 2/3 of cows could not be successfully inseminated within 90 days post partum. In a good managed dairy herds the first post partal

estrus should be detected within 60 days after calving in 90% of dairy cows (Walker, 1997). Estrus detection procedure in our dairy farm is based on checking of estrus signs manifestation in dairy cows, twice daily (during morning and evening milking time), that is probably inadequate, preventing better reproduction efficiency. This estrus detection practice is not able to detect animals in „silent“ heat and ovulation, where estrus is not followed with manifest outer signs of sexual receptivity. However, first postpartal estrus is without manifest clinical signs in about 70% of dairy cows, declining to 50% during second postpartal estrous cycle (Peters et al., 1987; Stančić, 1989; Stančić, 1995; Crowe, 2008). In healthy dairy cows cyclic ovarian activity and ovulation should be established 2-4 weeks after calving (First, 1979), and between 80-90% of dairy cows normally should become cyclic within 30 days after calving (Lamming et al., 1981; Stančić, 1995; Crowe, 2008). Combining careful detection of manifest signs of estrus with rectal palpation it is possible to register first postpartal estrus in more than 90% of dairy cows with initiated cyclic ovarian activity (Petrović, 1976).

Periparturient disorders significantly extended interval between calving and first AI in our research results (between 79 and 120 days, depending on the disorders type). Standard concerning this interval in good dairy herds is between 45-60 days. If the interval between calving and first AI is longer than 60 days there are serious reproduction problems in those herds, and detailed management analysis is needed in order to identify the problems and suggests appropriate corrective measures (Walker, 1997; Stančić, 1989; Petrujkić et al., 1993; Kasimanickam et al., 2002). The decline of first AI conception rate has been reported many times during last 50 years. Data from numerous countries (England, Holland, Canada, USA, Spain, Ireland) indicate that first AI conception rate was about 65% in mid 20<sup>th</sup> century and decreased between 10-15% during the last few decades. Authors from USA suggested different reasons for this decline, starting from the extended use of deep frozen bulls semen, enlargement of dairy herds, significant increase of milk production, increased number of dairy cows with short luteal phase of the estrous cycle, increased embryonic mortality, decrease immune response and increased frequency of reproduction disorders (Sreenan and Diskin, 1983; Diskin, 1987; Gordon, 1997; Beam and Butler, 1999; Royal et al., 2000a; Lucy, 2001; Bousquet et al., 2004).

Another direct evidence of the decreased reproduction efficiency in postpartal dairy cows is increased number of AI needed for successful conception (Esslemont & Kossabati, 2000). Lucy (2001) reported that average number of AI for successful conception increased from 1,75 to more than 3. The research in Canada has also indicated decrease in dairy cows fertility rate from 44% in 1990. to 39% in the year 2003, that increased number of AI per conception for 0,48/lactation (Bouchard and Du Tremblay, 2003). Similar situation has been reported for Ireland by Mee et al., (2004), where number of services per conception has increased between the years 1990-2000 from 1,54 to 1,75. Maximal success of services (conception) is achieved between days 60-90 postcalving (Salisbury et al., 1978). Our research has also indicated significant increase of number of services per conception, especially in dairy cows with calving and post-calving reproduction disorders (number of services/conception was 3,5).

Service period (SP) is one of the major parameters of reproduction efficiency that directly influences calving interval (Wattiaux, 2006; Stančić, 2008). In the well managed dairy herds average SP is optimally between 85-110 days, with no more than 10% of cows having SP period longer than 120 days. In the case that SP period is above 140



days, or number of cows with SP period longer than 120 days is more than 15% there are serious reproduction issues on that dairy farm (Walker, 1997). In our research we have determined the average SP period of 146 days in the first parity cows and 137 days in older and healthy cows. The days open period was significantly longer ( $P < 0.05$ ) in the first parity and older dairy cows with peripartur reproduction disorders (202-214 and 186-188 days, first parity and older CD and PCD cows, respectively). Our results indicate that reproduction disorders after calving significantly extended SP period and calving interval. The most important reproduction disorders were uterine inflammatory diseases, as well as ovarian dysfunctions (ovarian cysts). Similar results concerning decrease of number of dairy cows successfully inseminated in the first postcalving service and extended SP period are reported by other authors (Quin et al., 2002; Lewis, 2003; Peter, 2004; Gvozdić et al., 2004; O'Connor et al., 2006; Wattiaux, 2006).

### CONCLUSION

Our present results clearly indicate serious problem with the decreased reproductive efficiency at the examined dairy farm, where we have detected more than 70% of cows with calving and postcalving reproductive system disorders. The result of this situation was significant increase of calving to first recorded estrus interval, number of services/conception and extended SP period. Further research regarding complex etiology and possible corrective management and veterinary measures are needed, in order to decrease SP period, number of services/conception and calving interval.

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## **REPRODUKTIVNA EFIKASNOST VISOKO-MLEČNIH KRAVA POSLE TELENJA**

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### **Izvod**

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su ustanovljeni kod 1.252 krave (72,4%). Najčešće ustanovljeni peripartalni poremećaji kod visoko mlečnih krava su teško teljenje (62%) i endometritis (64%). Peripartalni poremećaji imaju statistički značajan uticaj ( $P < 0,05$ ) na povećanje indeksa osemenjavanja (3,5 prema 2,7), produženje intervala od prvog do fertilnog osemenjavanja (57 prema 110 dana), kao i na produženje trajanja servis perioda (146 prema 214 dana), u poređenju sa kravama bez poremećaja. Dobijeni rezultati pokazuju da na farmama visoko mlečnih krava povišena učestalost peripartalnih reproduktivnih poremećaja koji značajno utiču na smanjenje reproduktivne efikasnosti krava nakon partusa.

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