



DRY PERIOD LENGTH AS RELATED TO MILK YIELD AND SCC DURING THE FIRST MONTH OF SUBSEQUENT LACTATION*

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Abstract

Analysis was made of the effect of dry period length in primiparous and multiparous cows on daily milk yield during the first month of subsequent lactation and on milk somatic cell count (SCC) on the basis of the information about the test-day milkings of 59 138 cows. The GLM and FREQ procedures of the SAS package were used in the statistical calculations. Dry period length in the primiparous and multiparous cows had a significant effect ($P \leq 0.01$) on daily milk yield and udder health, determined based on SCC. In terms of milk yield, the most favourable dry period would be 51–70 days for both primiparous and multiparous cows. Depending on udder health, a dry period of 51–90 days can be suggested. Shorter dry periods had more undesirable effects than longer dry periods. Excessively shortened dry period (≤ 10 days) caused the daily milk yield to decrease by 17% in primiparous and by 13% in multiparous cows while increasing the risk of clinical changes of the cow's udder, regardless of age. The proportion of milk samples that showed evidence of clinical mastitis also increased when the dry period was excessively long (>90 days), especially in multiparous cows.

Key words: dry period, primiparous, multiparous, milk yield, somatic cells

The dry period is the nonlactating stage of the cow's productive cycle, during which intensive changes in the anatomy, histology and physiology of the mammary gland take place (Church et al., 2008). Research with cow populations shows that in terms of next lactation yield, the most favourable dry periods are 40–60 (Kuhn et al., 2005; Sawa et al., 2012) or 60–90 days for Holstein-Friesian cows (Węglarzy, 2009), and 22–41 days for Montbéliarde cows (Januś and Borkowska, 2013). A review of research on the optimal dry period length (Bachman and Schairer, 2003) suggests that for cows that have no or shorter dry periods, milk yield in the next lactation will vary from a 10% decrease to a 1% increase. Summing up the results of other studies, Kuczaj et al. (2009) concluded that dry periods should not be eliminated or shortened in cows after their first calving because of considerable decreases in milk yield, body

*Work financed from BS 7/2011.

condition and growth. The results concerning the effect of extending the dry period to more than standard 60 days suggest that this procedure contributes to a decrease in animal performance (Kuhn et al., 2007; Sawa et al., 2012; Januś and Borkowska, 2012; Monroe and Amaral-Philips, 2005). The dry period plays a major role not only in preparing the cow for high production in subsequent lactation but also in the dynamics of intramammary infections (Green et al., 2007), which are considered the most common and costly cow disease (Krukowski, 2006; Halasa et al., 2007). Somatic cell count (SCC) is a widely used measure of milk quality and udder health. In udder milk, SCC in excess of 100,000 per ml is considered to be indicative of inflammation (Deluyker et al., 1993; Laevens et al., 1997). Because the dry period is the time when the cow's mammary gland is particularly susceptible to new infections, it is necessary to take preventive measures against mastitis. The findings of Capuco et al. (1997) and Enevoldsen and Sørensen (1992) show that dry period length is related to clinical cases of mastitis and health problems in the subsequent lactation. The effect of dry period length in cows on milk somatic cell count has been analysed in many studies (Rémond et al., 1997; Rastani et al., 2005; Watters et al., 2008) with inconclusive results. According to Rémond et al. (1997) and McGuire et al., (2004), somatic cell count tended to increase in cows having no or shorter dry periods. On the other hand, Gulay et al. (2003), Annen et al. (2008) and Rastani et al. (2005) reported that shortening or eliminating the dry period has a positive effect on the somatic cell count. The lack of a relationship between shorter dry period and somatic cell count in milk obtained during the first 100 days of lactation and the incidence of mastitis during a 300-day lactation was reported by Watters et al. (2008). Likewise, Annen et al. (2004 b) observed that shortening or eliminating the dry period has no effect on the somatic cell count obtained after calving. The objective of the study was to analyse the effect of dry period length in primiparous and multiparous cows on daily milk yield during the first month of subsequent lactation and on milk somatic cell count, an important indication of the health status of the udder.

Material and methods

Data for the study were obtained from SYMLEK database on cow milk performance and concerned daily milk yield and somatic cell count (SCC) in test-day milk collected during the first month of lactation of Polish Holstein-Friesian cows from the active population in Pomerania and Kuyavia regions (around 10% of the national milk recorded population). The cows, which first calved in 2006–2011 and were used or culled until the end of 2012, originated from 1848 farms and had an average production level of about 7000 kg of milk.

The length of 59 138 dry periods was calculated and the cows were classified according to the duration of the dry period (≤ 10 , 11–30, 31–50, 51–70, 71–90, >90 days). After grouping the milk samples according to the classification of Renner (1975) modified by Sawa and Piwczyński (2003), udder health was classified as very good ($\leq 100\ 000$), good (100 001–200 000), threatened (200 001–400 000), latent

changes (400 001–500 000), subclinical changes (500 001–1 000 000) and clinical changes (>1 000 000 SCC per ml). Chi square test of independence (SAS, 2011) was used to analyse the percentage of milk samples indicative of udder health during the first month of lactation, depending on dry period length in the previous production cycle. The statistical calculations did not account for test-day milk yields in lactations after pregnancy loss. Because SCC shows considerable variation and is not normally distributed, a natural logarithmic transformation of SCC (LN SCC) was performed. Analysis of variance (GLM procedure of SAS, 2011) was used to evaluate the effect of dry period length in primiparous and multiparous cows on daily milk yield and LN SCC, and the following linear model was used:

$$Y = \mu + a_i + b_j + (ab)_{ij} + e_{ijk}$$

where:

μ is the overall mean,

a_i is the effect of i -th age (primiparous, multiparous),

b_j is the effect of j -th duration of the dry period (≤ 10 , 11–30, 31–50, 51–70, 71–90, >90 days),

$(ab)_{ij}$ is the age \times dry period length interaction,

e_{ijk} is the random error of observations.

Significant differences were determined using the Scheffe test. The statistical calculations did not account for test-day milk yields in lactations after pregnancy loss.

Results

Dry period length in primiparous and multiparous cows had a significant effect ($P \leq 0.01$) on their daily milk yield during the first month of subsequent lactation (Table 1). Considering the milk yield at the beginning of the next lactation, the most desirable dry periods were 51–70 days for primiparous and multiparous cows (32.4 kg/day). It was found that compared to extended dry periods, shortened dry periods caused a greater decrease in milk yield during the first month of subsequent lactation, with greater differences found for youngest cows. Limiting the dry period to ≤ 10 days reduced daily milk yield by about 17% in primiparous cows and by about 13% in multiparous cows. The present study demonstrated that the lowest milk somatic cell count during the first month of the next lactation was found for dry periods of 51–70 days in primiparous cows and 71–90 days for multiparous cows (Table 1). Shortening or extending the dry period of 51–70 days in primiparous cows caused an increase ($P \leq 0.01$) in somatic cell count, which was particularly significant for periods of less than 30 days and more than 90 days. For multiparous cows, the lowest cytological quality was characteristic of the milk from animals with dry periods of less than 30 and more than 90 days. The lowest cytological quality was characteristic of the milk from cows with both the longest and shortest dry periods. Dry period length

was found to have a significant effect ($P\leq0.01$) on udder health during the first month of subsequent lactation (Table 2), and chi square values indicate that the effect of dry period is stronger in primiparous than in multiparous cows. The greatest differences between the extreme values occurred for the proportion of samples indicative of very good udder health ($\leq100\,000$ SCC/ml). The highest percentage was observed when the dry period was between 51 and 90 days (over 43% for primiparous and around 37% for multiparous cows), and the lowest percentage (33.3% for primiparous and 29.9% for multiparous cows) when the dry period was ≤10 days. It was also found that in primiparous cows dried off for 51–70 days, the proportion of milk samples indicative of clinical mastitis ($>1\,000\,000$ SCC/ml) during the first month of the subsequent lactation was the lowest (about 11%). Shortening the dry period of primiparous cows (especially to ≤30 days) increased the proportion of milk samples with SCC higher than 1 000 000 per ml to 14.5–15.1%. Equally unfavourable was the extension of the dry period in primiparous cows to more than 90 days. Similar trends were noted for multiparous cows, but the proportion of milk samples that showed evidence of clinical mastitis was much higher (almost 22% for a dry period of 11–30 days and about 19% for >90 days). SCC-based analysis of the proportion of samples representing other udder health classes revealed no regular increases or decreases as the dry period was extended or shortened.

Table 1. Milk yield and somatic cell count depending on dry period length

Dry period length (days)		Milk yield (kg/day)	SCC (thous./ml)	LNSCC
Primiparous				
≤10	1	26.9	644	12.25
11–30	2	29.2	601	12.15
31–50	3	31.9	569	12.00
51–70	4	32.4	505	11.92
71–90	5	32.2	532	11.94
>90	6	29.9	601	12.16
Significance		1–2.3.4.5.6xx 2–3.4.5xx 3–6xx 4–5.6xx 5–6xx		1–3x.4.5xx 2–4.5xx 3–6x 4–6xx 5–6xx
Multiparous				
≤10	1	28.1	890	12.43
11–30	2	30.3	915	12.47
31–50	3	32.1	762	12.30
51–70	4	32.4	659	12.30
71–90	5	31.2	655	12.20
>90	6	30.4	794	12.37
Significance		1–2x.3.4.5.6xx 2–3.4xx 3–5x.6xx 4–5x.6xx	2–4.5xx 3–4xx 4–5xx	2–4.5xx 3–4x 4–6xx 5–6x

Table 2. Frequency of milk samples with different levels of SCC

Dry period length (days)	Number of milk samples	Percentage of milk samples with SCC (thous./ml) of:					
		≤100	100–200	200–400	400–500	500–1000	>1000
Primiparous $\chi^2 = 140$ xx							
≤10	816	33.3	20.2	16.5	3.6	11.9	14.5
11–30	1982	38.7	18.2	14.8	3.7	9.5	15.1
31–50	9896	43.6	16.5	13.7	3.6	9.2	13.4
51–70	13165	45.7	16.5	13.4	3.6	8.9	11.9
71–90	3803	45.7	16.9	13.2	3.3	9.5	11.4
>90	2306	37.2	17.3	16.3	3.9	10.8	14.5
Total	31968	43.69	16.81	13.88	3.57	9.30	12.75
Multiparous $\chi^2 = 104$ xx							
≤10	509	29.9	18.7	20.4	3.3	9.8	17.9
11–30	1174	32.8	15.8	13.0	6.5	10.3	21.6
31–50	7160	35.1	16.3	14.7	4.6	11.7	17.6
51–70	11348	36.8	16.6	15.4	4.1	11.3	15.8
71–90	4021	37.4	17.3	13.7	4.5	11.1	16.0
>90	2958	32.5	17.7	14.6	4.2	12.0	19.0
Total	27170	35.66	16.74	14.88	4.39	11.38	16.95

xx – $P \leq 0.01$.

Discussion

The observed effect of dry period length on the milk yield of the cows (Table 1) falls within the range reported by other authors (Bachman and Schairer, 2003; Annen et al., 2004 a; McGuire et al., 2004; Monroe and Amaral-Philips, 2005; Rastani et al., 2005; Philpot et al., 2006; Church et al., 2008; Sawa et al., 2012). Shortened or omitted dry periods cause the milk yield to vary from a 10% decrease to a 1% increase (Bachman and Schairer, 2003). Some authors (Annen et al., 2004 a; McGuire et al., 2004; Monroe and Amaral-Philips, 2005; Rastani et al., 2005; Philpot et al., 2006; Sawa et al., 2012) reported milk losses of 12–40%, and over 50% in primiparous cows (Annen et al., 2008). In contrast, other authors (Bachman, 2003; Gulay et al., 2003) showed no effect of shortening the dry period from 60 to 30 days for milk yield.

The results of many studies (Bachman and Schairer, 2003; Monroe and Amaral-Philips, 2005; Rastani et al., 2005; Church et al., 2008; Soleimani et al., 2010; Sawa et al., 2012; Januś and Borkowska, 2013) suggest that a dry period of 40–60 days is still believed to be the most favourable for milk production in the subsequent lactation. Our study revealed that shortening the dry period especially of primiparous cows to 31–40 days has an adverse effect on their milk yield in the subsequent lactation. This agrees with the findings of other authors (Pezeshki et al., 2007; Church et al., 2008). According to Kuhn et al. (2005), dry periods shorter than 40 days are more detrimental to primiparous than multiparous cows, which is due to differences in physiological maturity. Shortened or omitted dry periods may impede mammary

development in primiparous cows, causing the milk yield to decrease in subsequent lactations (Annen et al., 2004 b). In the case of multiparous cows, it appears that a dry period of 31–50 days can be employed without considerable milk losses in the subsequent lactation. Likewise, Overton (2005) considers that the dry period of multiparous cows can be shortened to 30–40 days without influencing productivity in the subsequent lactation. In terms of milk yield, extending the dry period was found to be more favourable than shortening. This corroborates the findings of other authors (Kuhn et al., 2005; Sawa et al., 2012). According to Sawa et al. (2012), extending the dry period to 61–80 (and even to 81–100) days reduces milk yield to a small extent (by about 1 and 4%, respectively), with greater losses (5%, 14% and 25%) observed when this period was shortened to 21–40 and 1–20 days, or completely omitted. According to Pinedo et al. (2011), excessively short (0–30 days) and long dry periods, compared to those of 53–76 days, have a negative effect on both early lactation and 305-day milk yield. The results of studies on the relationship between dry period length and milk SCC in cows are inconsistent (Rémond et al., 1997; Rastani et al., 2005; Watters et al., 2009). Kuhn et al. (2006) suggest that dry periods of 20 days or shorter are most detrimental, stressing that herds with mastitis problems should be cautious in shortening days dry because short dry periods led to higher cell scores in the subsequent lactation compared with 60-day dry. Rastani et al. (2005) demonstrated that shortening of the dry period from 56 to 28 days was associated with decreased SCC values. Similarly, Gulay et al. (2003) showed lower SCC for 30-day compared to 60-day dry periods during the first 10 weeks of lactation. No correlation between short dry period and SCC during the first 100 days of lactation was reported by Watters et al. (2009). As milk yield increases, SCC decreases in quarters without infection (Schepers et al., 1997), which may be due to a dilution effect. Green et al. (2006) and Steeneveld et al. (2013) investigated the association between SCC and milk yield more thoroughly and concluded that a dilution effect of milk yield on SCC exists. Analysis of the results shown in Table 2 indicates that considering udder health after calving, preference should be given to dry periods of 51–90 days. According to Enevoldsen and Sørensen (1992), dry periods of about 7 weeks appear to involve the lowest risk of clinical mastitis, but consideration should be given to other factors such as milk yield and the presence of mastitis prior to drying off, which make the cow more prone to udder inflammations. In our study, we found a greater proportion of milk samples that showed evidence of clinical mastitis ($>1\ 000\ 000$ SCC/ml), especially in multiparous cows dried for less than 30 days. One study suggests that SCC increases in the subsequent lactation in cows with shorter or omitted dry periods (Rémond et al., 1997). It is speculated that because of the lack of enough time for antibiotic therapy in shorter dry periods, there may be a higher risk of mastitis for cows given short dry periods. Rémond et al. (1997) found SCC to increase in cows with shorter and omitted dry periods, but this increase was unrelated to increased incidence of clinical mastitis. According to the same authors, continuous milking of cows could reduce the incidence of clinical mastitis by eliminating new infections associated with cessation of milking and drying off of the cows. Also other authors (Enevoldsen and Sørensen, 1992; Capuco et al., 1997; Gulay et al., 2003) point out that dry period had an effect on the incidence of mastitis and health problems. Pinedo

et al. (2011) found that dry periods extended to 143–250 days increase the risk of subclinical mastitis in early lactation. The lack of a relationship between short dry period and the incidence of mastitis during 300 days of lactation was also reported by Watters et al. (2009). Likewise, Church et al. (2008), when analysing the cases of udder infections and SCC failed to find negative consequences of shortening the dry period to 30 days. The inconsistent results concerning the effect of dry period length on milk yield and milk SCC may be due, among others, to experimental approach (planned or retrospective analysis of the collected data) and the management strategies for herds taking part in the experiments (Bachman and Schairer, 2003; Annen et al., 2004 b; Soleimani et al., 2010).

Conclusions

Dry period length in the primiparous and multiparous cows had a significant effect ($P \leq 0.01$) on their daily milk yield and udder health, determined based on SCC. In terms of milk yield, the most favourable dry period would be 51–70 days. Depending on udder health, a dry period of 51–90 days can be suggested. Shorter dry periods had more undesirable effects than longer dry periods. Excessively shortened dry period (≤ 10 days) caused the daily milk yield to decrease by 17% in primiparous and by 13% in multiparous cows while increasing the risk of clinical changes of the cow's udder, regardless of age. The proportion of milk samples that showed evidence of clinical mastitis also increased when the dry period was excessively long (>90 days), especially in multiparous cows.

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Received: 6 II 2014

Accepted: 19 V 2014