

Milk production of dairy cows as affected by the length of the preceding dry period

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Abstract

The objective of the study was to determine the effect of the duration of the dry period (DP) on the milk yield and milk composition during the following lactation. Milk performance records of 561 Holstein cows, with a previous DP from the Elsenburg Research Farm obtained from the National Milk Recording Scheme, were used in the study. Four groups of dairy cows were identified, based on the duration of their dry period, i.e. cows with a DP of less than 60 days, DP of 61 to 90 days, DP of 91 to 120 days and DP of more than 121 days. The number of records for each group was 76, 162, 83 and 240 lactations, respectively. An ANOVA was conducted using the Generalized Linear Model of SAS to compare milk yield and milk composition according to the DP length. Almost 43% of cows had a DP longer than 121 days, while less than 14% of cows had a DP of less than 60 days. The milk yield was positively affected by DP length. Cows with a DP of less than 60 days produced less milk than cows with longer (more than 61 days) dry periods, e.g. 6462 ± 321 vs. 7393 ± 99 kg. Results were similar for cows in their second and fourth parity. In addition, the milk composition of cows was also affected by DP length, i.e. higher fat and protein levels in the milk from cows with a short DP. Cows in the third lactation with a DP above 121 days produced more milk than the other DP groups. However, the milk composition of cows in the third lactation was not affected by DP length. A DP of less than 60 days reduced milk yield, while an extended DP of more than 121 days would be costly for the dairy farmer even though milk yield was higher. A long dry period may also result due to an excess body condition and calving complications during the subsequent lactation.

Keywords: Dry period, milk yield, milk composition, dairy cows

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Introduction

The dry period (DP) is a crucial phase in the lactation of the dairy cow (Pezeshki *et al.*, 2007). About 305 days of lactation, associated together with 60 days of a DP, has been considered as a tool in the management for most dairy farms since the 1950's (Bachman & Schairer, 2003). This was implemented to provide maximum milk production and accelerate genetic progress during a time of food shortage (Knight, 1998). However, a significant increase in milk yield of dairy cows at the end of the previous century caused a new interest in establishing the optimum DP, as evidenced by research reports (Annen *et al.*, 2004; Kuhn *et al.*, 2006; Pezeshki *et al.*, 2007; Pinedo *et al.*, 2011). Today, some cows can still produce a considerable quantity of milk at profitable production levels 60 days prior to calving and this represents a challenge for the producer trying to dry the cows off. As a result of this increased genetic progress, a question arises: Should the farmer extend the current lactation period to increase the income from milk at the expense of the DP? Information regarding the effect of DP on subsequent milk production is non-existent among South African dairy farmers. Therefore, the aim of this study was to determine the effect of the length of the DP on the milk yield and milk composition of the following lactation, in Holstein dairy cows.

Material and Methods

Records of multiparous Holstein dairy cows ($n = 561$) obtained from the National Milk Recording Scheme were used in the study. All animals were maintained from 1995 to 2012 at the Elsenburg Research Farm, under similar welfare and nutritional conditions. Four groups of dairy cows were identified, based on length of their dry period: (i) cows with a DP of less than 60 days, (ii) cows with a DP of 61 to 90 days, (iii)

cows with a DP of 91 to 120 days, and (iv) cows with a DP of above 120 days (76, 162, 83 and 240 lactations, respectively). Within each group, the forthcoming lactations were analysed according to the parity - second lactation, third lactation or fourth lactation and above. The latter was combined because of the small number of cows with more than four lactations. The linear interpolation was used to standardize the milk yield at 305 DIM. The analysis of variance (ANOVA) was performed using the procedure generalized linear model of the SAS enterprise guide 5.1 package (SAS, 2013) to compare milk yield and milk composition for the different DP durations. Differences between means were obtained using the pair-wise comparison of the Bonferroni t-test. Significance was noted at a confidence level of $P < 0.05$.

Results and Discussion

The results set out in Table 1 indicate that less than 15% of cows were either dried off in the period of less than 60 days or had a DP from 90 to 120 days in length, before calving. In contrast, 28.9% and 42.8% of cows had a DP length of 61 - 90 and over 120 days, respectively, before calving. A DP for pregnant dairy cows is important between consecutive lactations, based on the nutritional needs of the late pregnant cow and to allow proper involution of the mammary gland epithelium to maximize milk yield during the subsequent lactation (Annen *et al.*, 2004; Church *et al.*, 2008). This non-lactating period also permits extended intramammary antibiotic therapy to reduce the prevalence of existing infections and reduce the incidence of new infections, without the risk of breakdown products of milk residues (Eberhart, 1986). The optimal duration of the DP has been a subject of debate, with a period of 51 to 60 days given as the general acceptable and recommended length (Bachman & Schairer, 2003; Church *et al.*, 2008). However, because of management decisions related to gestation length and milk yield, it is common on many farms for cows to have involuntary long or short dry periods (Pinedo *et al.*, 2011). The observed results in this study indicate a wide diversity with DP length in the herd occurring in different parities, possibly due to management decisions.

Table 1 Distribution of dairy cows with different dry period (DP) lengths in relation to parity

Length of DP	Distribution (%)				Total
	No of lactations	2 nd lactation	3 rd lactation	4 th + lactation.	
< 60 days	76	5.17	4.81	3.57	13.55
61-90 days	162	11.76	8.02	9.09	28.88
91-120 days	83	6.60	3.39	4.81	14.80
> 120 days	240	15.86	11.41	15.51	42.78
Total	561	39.39	27.63	32.98	100.00

Table 2 sets out the effect of different DP lengths on milk yield and composition. Results showed that cows with a DP of less than 60 days yielded less milk ($P < 0.05$), with high fat and protein contents compared to other groups during the second lactation. In the third lactation, the milk yield of cows with a DP of over 120 days differed ($P < 0.05$) from the other groups. However, the milk composition in the third lactation cows was not affected in all groups. Furthermore, cows produced less ($P < 0.05$) milk with a high protein content when with a DP of less than 60 days preceding the fourth lactation and above.

Recently, several designed studies have evaluated the DP lengths on milk production (Remond *et al.*, 1997; Annen *et al.*, 2004, Pezeshki *et al.*, 2007; Pinedo *et al.*, 2011). Consistent with findings of this study, these studies have reported that a DP of less than 60 days reduced milk yield during the subsequent lactation. Milk loss, compared to the standard DP of 6 - 8 weeks, can reach 10% if the DP is reduced to a month and 20% if the DP is omitted (Remond *et al.*, 1997). Grummer & Rastani (2004) reported that cows can lose 20% to 25% of the milk yield during the next lactation, when continuously milked. Pinedo *et al.* (2011) studied the relationship between different dry period lengths and milk yield in Holstein cattle (90%) and crossbred Black-Pied × Holstein (10%). The relationship revealed lower milk production at 305 DIM for cows with a previous short DP (0 - 30 days) or an extended DP (143 - 250 days), compared to the reference period of 53 - 76 days. Annen *et al.* (2004) argued that the milk loss with short dry periods may be explained by: (i) inadequate time for complete replenishment of body reserves, (ii) reduced mammary epithelial regeneration and (iii) incomplete endocrine events near parturition. Another study showed that a DP that was

too short (less than a month), or too long (over three months) had a negative effect on milk yield (Weglarzy, 2009). Kuhn *et al.* (2006) studied the effects of the DP to maximize milk production in subsequent lactations and lifetime production. It was found that a DP of less than 30 days should be avoided because of its detrimental effect on the lifetime milk yield. In addition, Kuhn *et al.* (2006) reported that a DP longer than 90 days resulted in over 4000 kg less lifetime milk production than a DP of 40 to 60 days. The longer DP than the standard can increase the cost of production (feed, veterinary cost, labour for care, etc.) of the dairy farmer to even mask the high milk yield in the subsequent lactation observed in this study. Consistent with other studies, lengthening the DP (to >60 days) tended to result in over-conditioned dry cows (Kuhn *et al.*, 2006) and a high cost of maintenance (Hurley, 1998). Roche *et al.* (2009) found that an excess body condition at calving (BCS ≥ 3.5 in a 5-point scale) was related in the subsequent lactation to a reduction dry matter intake and milk production in early lactation and an increased risk of metabolic disorders.

Table 2 Mean (\pm SE) milk yield at 305 DIM and milk composition of dairy cows with different dry period (DP) lengths

Length of DP	<60 days	61 - 90 days	91 - 120 days	>120 days	P values
2 nd lactation (N = 221)	N = 29	N = 66	N = 37	N = 89	
Age at calving (years)	3.34 \pm 0.06	3.33 \pm 0.05	3.21 \pm 0.08	3.65 \pm 0.04	
Milk yield for 305 DIM (kg)	6490 ^b \pm 301	7020 ^a \pm 126	7240 ^a \pm 193	7505 ^a \pm 141	0.0017
Milk composition:					
Fat (%)	4.11 ^a \pm 0.06	3.93 ^{ab} \pm 0.03	3.83 ^b \pm 0.04	3.81 ^b \pm 0.03	<.0001
Crude protein (%)	3.34 ^a \pm 0.06	3.19 ^b \pm 0.02	3.15 ^b \pm 0.03	3.11 ^b \pm 0.02	<.0001
Lactose (%)	4.76 \pm 0.02	4.73 \pm 0.02	4.71 \pm 0.05	4.75 \pm 0.01	0.5972
3 rd lactation (N = 155)	N = 27	N = 45	N = 19	N = 64	
Age at calving (years)	4.66 \pm 0.09	4.41 \pm 0.07	4.49 \pm 0.12	4.83 \pm 0.07	
Milk yield for 305 DIM (kg)	7131 ^a \pm 288	7176 ^a \pm 154	7248 ^a \pm 301	7819 ^b \pm 176	0.0323
Milk composition:					
Fat (%)	3.97 \pm 0.05	3.94 \pm 0.05	4.01 \pm 0.08	3.96 \pm 0.04	0.8704
Crude protein (%)	3.18 \pm 0.04	3.16 \pm 0.03	3.17 \pm 0.06	3.13 \pm 0.03	0.7357
Lactose (%)	4.68 \pm 0.03	4.71 \pm 0.02	4.66 \pm 0.04	4.73 \pm 0.02	0.2331
4 th & + lactation (N = 185)	N = 20	N = 27	N = 27	N = 87	
Age at calving (years)	6.43 \pm 0.33	6.57 \pm 0.20	6.95 \pm 0.24	7.03 \pm 0.16	
Milk yield for 305 DIM (kg)	6434 ^b \pm 342	7485 ^a \pm 191	7296 ^a \pm 294	7570 ^a \pm 152	0.0159
Milk composition:					
Fat (%)	4.15 \pm 0.16	4.04 \pm 0.04	3.96 \pm 0.06	3.97 \pm 0.03	0.1994
Crude protein (%)	3.23 ^a \pm 0.07	3.16 ^{ab} \pm 0.03	3.10 ^{ab} \pm 0.03	3.07 ^b \pm 0.03	0.0214
Lactose (%)	4.64 \pm 0.04	4.67 \pm 0.02	4.64 \pm 0.03	4.66 \pm 0.02	0.7920

^{a,b,c} Values within a row bearing different superscripts differ significantly ($P \leq 0.05$).

As many milk pricing programmes and quota systems pay the dairy producer not only for the quantity of milk produced, but also for the composition of that milk, the effects of a DP length on milk composition are important. The low milk yields recorded in this study with cows exposed to less than 60 days of a DP before calving were associated with high fat and protein levels during the second lactation and high protein level in the fourth lactation and above. In agreement with this study, Grummer & Rastani (2004) reported that lower milk yields following a short DP or its omission are associated with higher concentrations of milk components. Remond *et al.* (1997) revealed that a reduced milk yield most likely improved the energy balance and decreased the mobilization of adipose tissue, thus reducing the incorporation of long-chain fatty acids into milk fat and increasing the de novo synthesis of short- and medium-chain fatty acids. Similar to fat, an increase in milk protein level may also be the result of reduced milk yield, improving the energy balance and thereby saving amino acids and energy for protein synthesis (Remond *et al.*, 1997).

Conclusion

The dry period is an important resting period for the dairy cow. It has been established as a necessary management practice to maintain profitable milk production. A DP of less than 60 days reduced milk yield, while an extended DP of more than 121 days may result in over-conditioned dry cows and therefore be costly for the dairy farmer even although milk yield is higher in the next lactation.

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References

- Annen, E.L., Collier, R.J., McGuire, M.A. & Vicini, J.L., 2004. Effects of dry period length on milk yield and mammary epithelial cells. *J. Dairy Sci.* 87, E66-E76.
- Bachman, K.C. & Schairer, M.L., 2003. Invited review: Bovine studies on optimal lengths of dry periods. *J. Dairy Sci.* 86, 3027-3037.
- Church, G.T., Fox, L.K., Gaskins, C.T., Hancock, D.D. & Gay, J.M., 2008. The effect of a shortened dry period on intramammary infections during the subsequent lactation. *J. Dairy Sci.* 91, 4219-4225.
- Eberhart, R.J., 1986. Management of dry cows to reduce mastitis. *J. Dairy Sci.* 69, 1721-1732.
- Grummer, R.R. & Rastani, R.R., 2004. Why re-evaluate dry period length? *J. Dairy Sci.* 87 (E. Suppl.), E77-E85.
- Hurley, W.L., 1989. Mammary gland function during involution. *J. Dairy Sci.* 72, 1637-1646.
- Knight, C.H., 1998. Extended lactation. Pages 30-39 in Hannah Research Institute Yearbook 1998, Hannah interactions, Glasgow, UK.
- Kuhn, M.T., Hutchison, J.L. & Norman, H.D., 2006. Dry period length to maximize production across adjacent lactations and lifetime production. *J. Dairy Sci.* 89, 1713-1722.
- Pezeshki, A., Mehrzad, J., Ghorbani, G.R., Rahmani, H.R., Collier, R.J. & Burvenich, C., 2007. Effects of short dry periods on performance and metabolic status in Holstein dairy cows. *J. Dairy Sci.* 90, 5531-5541.
- Pinedo, P., Risco, C. & Melendez, P., 2011. A retrospective study on the association between different lengths of the dry period and subclinical mastitis, milk yield, reproductive performance, and culling in Chilean dairy cows. *J. Dairy Sci.* 94, 106-115.
- Remond, B., Kerouanton, J. & Brocard, V., 1997. Effets de la reduction de la durée de la periode seche ou de son omission sur les performances des vaches laitieres. *INRA Prod. Anim.* 10, 301-333.
- Roche, J.R., Friggens, N.C., Kay, J.K., Fisher, M.W., Stafford, K.J. & Berry, D.P., 2009. Invited review: Body condition score and its association with dairy cow productivity, health and welfare *J. Dairy Sci.* 92, 5769-5801.
- SAS, 2013. Statistical Analysis Systems (SAS Enterprise guide Software). SAS® Institute Inc., Cary, N.C., USA.
- Weglarzy, K., 2009. Lactation productivity of dairy cow as affected by the length of preceding dry period. *Anim. Sci. Papers Reports* 27, 303-310.