

Lactation productivity of dairy cows as affected by the length of preceding dry period

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The effect was analysed of the length of preceding dry period on milk, fat and protein yield and somatic cell count (SCC) in forthcoming 305-day lactation of cows kept under the welfare condition. Four groups of dairy cows were distinguished based on length of their dry period: A – up to 30 days, B – 31-60 days, C – 31-90 days, and D – 91 and more days (25, 71, 39 and 25 lactations, respectively). The highest milk, fat and protein yield (305 – days) was observed in group C. In groups A, B and D milk yield was lower by 16.39%, 12.59% and 13.40% than in group C, respectively. Differences in milk and protein production between groups were statistically significant ($P \leq 0.01$) for group pairs with group C with highest yield. Fat production in group A was lower by 6.06%, in group D by 5.37 % and in group B by 1.01%. Protein production in group A was lower by 14.12%, while in group D and B by 12.84% and 9.78%, respectively. Effect of SCC on milk, fat and protein yield was also investigated. Decrease in milk, fat and protein yield was accompanied by the SCC increase. The level of SCC was related to the lactation parity. Shortening of the dry period below 30 days had negative effect on percentage of milk samples with SCC below 400,000/ in dairy cows with fourth and further lactations.

KEYWORDS: cow / dry period / fat / milk / protein / somatic cell count

Modern agriculture is defined as „precise agriculture” [Meier 1998]. In dairy cattle farming, it includes both production and health data recording as well as recording of feed intake and welfare indicators [Wendel, 1998 Klindtworth, 1998].

In the 12-month relation between the production and reproduction cycle, cows which yield 20–30 and more kg of milk daily can be dried off. A question arises, whether we should extend a lactation of such cows at the expense of their dry period [Szarek 1998].

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It should be supposed that shortening of the dry period will probably effect in an increase in milk yield in a present lactation (more days-in-milk), but also in decrease in milk yield in a forthcoming lactation. Simultaneously, a desirable flattening of the lactation curve, consisting in a decrease in the maximum daily yield (so-called lactation peak after calving) will be very likely. Production of high-quality milk should be considered as the most difficult of all kinds of animal production. It is determined by a multitude of factors which eventually influence the production level and physical properties as well as composition of milk, important for processing and direct consumption.

The dry („productiveless”) period is necessary for the regeneration of the udder glandular tissue [Capuco *et al.* 1997, Annen *et al.* 2004].

At the beginning of the XX century, the optimal dry period was established as 60 days. A significant increase in milk yield of the dairy cows at the end of the XX century caused a new interest in establishing the optimum dry period [Szarek, 1998]. Two months were accepted as a sufficient dry period for high-productive cows [Gullay *et al.* 2003]. A research done in Poland [Borkowska *et al.* 2006; Winnicki *et al.* 2008] indicated that in practice the dry period is extended or excessively shortened, which leads to a decrease in milk production as compared to the recommended optimum.

In the present investigation, it has been assumed that (i) in the herd in question dry period length is significantly differentiated, and (ii) length of the pre-lactation dry period affects milk, fat and protein yield and SCC in the analysed milk. In that case, following questions have been formulated:

- what is the percentage of optimum, shortened and extended dry periods in the herd in question?
- what effect the dry period length has on milk, fat and protein yield in a forthcoming 305-day lactation?
- does the length of dry period affect significantly the SCC in milk samples which can be an indicator of the udder health?

The purpose of the investigation was establishing an optimum length of dry period of cows in relation to their milk yield, determining the relation between the SCC and the length of dry period, and identification of the effect of lactation parity on SCC in the milk of cows kept in a freestall cowhouse.

Material and the methods

The study was carried out at the Kostkowice dairy farm of the Experimental Station Grodziec Śląski (Cieszyn region, South of Poland) belonging to the National Research Institute of Animal Production, Cracow. Considered were records of 200 Holstein-Friesian cows from the 4 - year period of settling in the dairy farm which was newly put into use – since December 2004 through 2008. The herd was composed of cattle of three herds (Grodziec, Kostkowice, Lipowa) and animals imported from Germany and the Netherlands as pregnant heifers. The Holstein-Friesian cows of the

Black and White (BW) variety constituted 2/3 while cows of the Red and White (RW) variety – 1/3 of the new herd. Fifty five per cent of the animals were heifers, 25% - cows in their third lactation, and the remaining had four or more lactations. Variety and age proportions corresponding to the herd's means were taken into consideration at the choice of 160 cows. Records of four following groups of cows were distinguished: group A – cows that had a pre-lactation dry period not exceeding 30 days; group B – the dry period lasting for 31-60 days; group C – the dry period lasting for 61-90 days; group D – the period exceeding 91 days.

Feed was offered 2-3 times a day to appetite and consisted of total mixed rations (TMR) formulated according to season, lactation phase and milk yield. Those criteria became the basis of creating the technological feeding groups. The concentrate was given to cows individually, in groups with an access to the feeding stations. TMRs contained feeds produced on the farm (hay, maize silage, haylage, raps cake, concentrate) or purchased (soybean meal, brewer's grain, yeast and vitamin-mineral mixes).

The cow house was of the freestall type and matched the environmental standards of animals welfare [Węglarzy *et al.* 2008].

The cows were milked twice a day in the herringbone milking parlour equipped with milking machines and stationary scales with milk sampling probes. The milking was synchronised by an 'Alpro' herd management system. An everyday amount of milk from each cow was recorded on the basis of an individual weighing, while every 30 days milk from the morning and evening milking was sampled for chemical analyses, made in the laboratory of the Experimental Station of the National Research Institute of Animal Production in Grodziec to determine:

- fat and protein content (the Funke apparatus – Gerber, Milkoscan and Lactostar)
- somatic cell count (SCC) – with the De Laval DDC somatic cell counter.

Standard 305-day lactations were analysed in relation to the length of the preceding dry period. Within each group (A, B, C and D) the forthcoming lactations were analysed – lactation II, III and, because of their small number-lactation IV, V, VI in one.

The relations between a length of dry periods preceding the subsequent lactations and an SCC and milk yield of the cows were defined.

Mean milk, fat and protein yield and SCC in milk of cows in groups A, B, C, D were analysed by a general test of single-factor variance analysis, with an assumption that the analysed variables are measurable and are normal distribution. The inter-group differences were verified by a Fisher's LSD (Least Significant Difference) test. For the milk, fat and protein yield and the SCC, arhythmical means and standard errors of means (SEM) were computed. The statistical analysis of the results was carried out with the Statistica 6.0.

Results and discussion

The results given in Table 1, indicate that less than 50% of cows were dried off in the period of 31-60 days before the calving. Every sixth cow remained dry for less than a month, the dry periods of 1/5 of the cows lasted for 61-90 days, and the remaining cows had dry periods exceeding three months. In four cows, the dry period exceeded 200 days and at start of drying off their daily milk yield ranged from 10.0 and 18.3 kg (figures not tabulated).

Table 1. Length of lactation - preceding dry period in cows in relation to lactation parity

Group	Dry period length (days)	No. of lactation	Per cent distribution			
			lactation II	lactation III	lactation IV-V	total
A	<30	25	11.25	2.50	1.87	15.62
B	31-60	71	27.50	10.62	6.25	44.37
C	61-90	39	11.25	7.50	5.64	24.39
D	>91	25	5.63	6.24	3.75	15.62
Total		160	55.63	26.86	17.51	100.00

When examining the subsequent lactations separately, it was observed that before the second calving, nearly a half of the cows (49.44%) had the dry period from 31 to 60 days long. They constituted 1/5 of groups A and C (20.23 i 20.22%) and 10.11% of D. Before lactation III, almost 1/5 of the cows (23.25%) had a dry period of over 91 days, and before lactation IV and further 21.43% of the cows had such dry period length.

The observed results indicate a wide diversity to occur in dry period length in a large herd. This is in accordance with recent reports of Polish authors [Borkowska *et al.* 2006, Winnicki *et al.* 2008]. The informatic system at the farm is designed to prevent drying a significant percentage of the herd both too late and too early.

When examining the herd, the highest mean milk yield for a 305-day lactation was obtained in group C – 9337.15 kg (Tab. 2). The yields of the cows in groups B, A and D were 1044, 1315 and 1102 kg lower, respectively.

The effect of dry period length on milk, fat and protein production was confirmed by significant differences only among those groups in which the group C with the highest yield was present. This group can be considered optimum in view of milk and protein production, whereas the dry period had no significant effect on yield of fat. If group C is excluded from the statistical computations, the obtained results confirm that there is no essential production difference between groups A, B i D.

Further, an effect was investigated of cows' dry period length on their yield within particular lactations. The results of the statistical computations in the lactation groups indicate that the preceding dry period length affected the milk and milk protein yield in the earlier lactations (lactation II and to a small extent, lactation III) but not in the

Table 2. Means and standard errors (SEM) for milk, milk fat and milk protein yields in the years 2005-2008 in cows as related to the length of pre-lactation dry period

Group	305-day lactation yield (kg)						Per cent in relation to group B		
	milk		milk fat		milk protein		milk	milk fat	milk protein
	mean	SEM	mean	SEM	mean	SEM			
A	8022.28 ^A	270.12	332.80	12.89	262.08 ^B	8.58	96.74	95.35	96.20
B	8292.93 ^A	180.03	349.03	8.11	272.44 ^B	5.50	100.00	100.00	100.00
C	9337.15 ^C	277.91	352.97	9.24	299.08 ^C	8.06	112.59	101.13	109.78
D	8235.28 ^A	306.77	334.96	16.91	265.04 ^B	9.61	99.30	95.97	97.28

^{ABC} Within column means bearing different superscripts differ significantly at $P \leq 0.01$.

Group A – dry period <30 days.

Group B – dry period 31-60 days.

Group C – dry period 61-90 days.

Group D – dry period >90 days.

IV and further lactations. Similarly, in the group of cows the length of dry period had no significant effect on fat yield in any lactation group.

It is commonly estimated that a two-month dry period provides a complete regeneration of udder glandular tissue and is favourable for the high production in the forthcoming lactation [Annen *et al.* 2004; Andersen *et al.* 2005].

The analysis of the cows' milk recording data indicated that too short (less than a month) as well as too long (over three months) dry periods have a negative effect on milk, fat and protein yield in forthcoming standard lactation. This confirms the earlier results by Borkowska *et al.* [2006] and Winnicki *et al.* [2008].

The dry period shorter than one month, as well as longer than three months, both had a negative and statistically confirmed effect on the milk, fat and protein yield over forthcoming 305-day lactation.

In the herd in question, the groups A and B have been compared. It has been found that a mean milk yield in the group A for a month before calving was high and amounted to 13.2 kg daily, whereas the milk yield in group B for a forthcoming standard lactation was by about 270 kg higher, confirming the observations by Losand *et al.* [2008].

For cows with no drying period increased milking labour in pre-calving period and worse animal welfare conditions were observed.

The hygienic quality of milk is important for the consumers as well as for manufacturers [Grodzki *et al.* 1998] and depends on physiological, genetic and environmental factors [Emanuelson *et al.* 1988, Funke *et al.* 1995]. Length of the dry period of cows can be considered as a physiological factor. The effect of drying period on somatic cells number in milk was investigated.

When examining the herd (Tab. 3), majority of the milk samples with an SCC below 400 000 /ml were collected from the cows which were dried in a period of 61-90 days, and the least number of such samples – from the cows which were dried in a period below 30 days. The analysis confirmed that in particular lactations the sequence

Table 3. Per cent of milk samples showing SCC below 400,000/ml in total number of samples as related to the length of pre-lactation dry period

Lactation	Number of samples	Per cent of milk samples showing SCC below 400,000/ml in total number of samples as related to the length of pre-lactation dry period					
		group A	group B	group C	group D	mean	SEM
II	850	72.22	76.36	73.33	64.44	73.31	16.33
III	450	70.00	62.35	75.00	70.00	68.37	21.91
IV-V	300	40.00	60.00	68.89	80.00	64.29	35.12

Group A – dry period <30 days.

Group B – dry period 31-60 days.

Group C – dry period 61-90 days.

Group D – dry period >90 days.

of the groups was similar. In the group of cows with their lactation II, the percentage of milk samples with an SCC below 400 000/ml was highest in group B (73,36%). In the remaining groups it was lower and varied between 64.44% and 72.22%. In all groups, the hygienic quality of milk in further lactations was lower than in lactation II. A continuous decrease in percentage of milk samples with an SCC below 400 000 / ml was observed in further lactations in groups A and B. An especially marked drop, accompanying the parity of lactations, was observed in group A.

The percentage of SCC below 400 000 / ml decreased along with an increase in the number of lactations, with the similar proportion in cow groups A, B and C. An improved SCC percentage in lactations IV to VI was observed in the group D only.

The results presented here confirm a known phenomenon of decrease in the hygienic quality of milk in subsequent lactations [Czaplicka *et al.* 1993]. Especially, milk quality in lactation IV and further worsened compared to lactation II. A negative effect of shortening the dry period below one month became visible in lactation III, and was even more marked in lactation IV and further. It can be assumed that the udder glandular tissue recovers quicker in younger than in older cows. Moreover, the results of the present investigation indicate that the dry period which is most favourable for production in the coming lactation should last 2-3 months.

Dry period is one of the most important factors in the entire productive life of the cows. The presented results, based upon observations made in years 2005-2008 in a dairy cattle herd Kostkowice, prove that this physiological period, preceding calving, is a significant factor that influences the dairy production and udder health.

It was show that shortening the dry period below 30 days reduces the yield of milk and its basic components - fat and protein. Such shortening of the dry period has a negative effect on udder health, especially in multiparous cows that require a longer post-lactation time for regeneration of mammary gland secretory tissue than do heifers and younger cows. The most advantageous effect on all the analysed parameters of

milk production was observed in cows with a dry period ranging between 30 and 90 days.

The dry period longer than three months is unjustified as the negative effect on the production increase of cows in forthcoming lactation has been identified and worsening of the quality parameters of milk have been observed.

As it was proved in present work, dry period is a significant, but not an only factor which can influence the productivity of the cows and udder health [Kowalski *et al.* 2001]. It is the introductory phase to a new lactation and it deserves more attention, in view of both productivity of cows and prophylaxis against the udder diseases, which are a serious problem in high-productive cattle herds.

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Wpływ długości okresu zasuszenia na produktywność krów mlecznych w nadchodzącej laktacji

Streszczenie

Analizowano wpływ długości okresu zasuszenia na wydajność mleka, tłuszczu białka oraz liczbę komórek somatycznych (SCC) w mleku w nadchodzącej 305-dniowej laktacji krów utrzymywanych w oborze wolnostanowiskowej, spełniającej wymogi dobrostanu. Zależnie od długości okresu zasuszenia, który poprzedzał laktację wyodrębniono cztery grupy krów: A – do 30 dni (25 laktacji), B – od 31 do 60 dni (76 laktacji), C – od 61 do 91 dni (39 laktacji) oraz D – od 91 dni i dłużej (25 laktacji). Najwyższą wydajność mleka, tłuszczu i białka uzyskano od krów grupy C. Wydajność mleka w grupie A była o 16,39 %, w B o 12,59%, a w grupie D o 13,40% niższa niż w C. Różnice między grupami dotyczące wydajności mleka i białka mleka okazały się statystycznie istotne ($P \leq 0,01$) tylko dla tych par grup, w których występowała grupa C, gdzie wydajność była najwyższa. Wydajność tłuszczu w grupie A była o 14,12%, a w D o 12,84%, a grupie B o 9,78% niższa niż w C.