The parameters of Montbéliarde cows milking

Parametry doju krów rasy montbeliarde

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Abstract

The present study aimed at evaluation of the influence of origin, milking hour, subsequent lactation and phase after calving on the parameters of Montbéliarde cows milking. The analysis was performed on the basis of data collected from 5284 milkings and derived from computer system of herd management ALPRO provided by DeLaval company. It was determined that parameters of Montbéliarde cows milking were influenced by subsequent lactation and phase after calving and also cow origin. The average milk flow decreased significantly (from 2.2 to 1.4 kg·min^{-1}) along with subsequent lactations and phases after calving. Higher indices of milking speed were observed for cows born in Poland as compared with those imported from France as in-calf heifers.

Keywords: milking parameters, Montbéliarde breed

Streszczenie

Oceniono wpływ pochodzenia, pory pozyskiwania mleka, kolejnej laktacji i fazy po wycieleniu na parametry doju krów rasy montbeliarde. Podstawą analizy były dane z 5284 udojów, pochodzące z komputerowego systemu zarządzania stadem ALPRO, firmy DeLaval. Stwierdzono, że na parametry doju krów montbeliarde wpływała kolejna laktacja i faza po wycieleniu, a także pochodzenie krów. W kolejnych laktacjach i fazach po porodzie istotnie zmniejszał się (od 2,2 do 1,4 kg/min) średni przepływ mleka. Wyższymi wskaźnikami szybkości oddawania mleka charakteryzowały się krowy urodzone w Polsce w porównaniu z importowanymi z Francji jako jałowice cielne.

Słowa kluczowe: parametry doju, montbeliarde

Streszczenie szczegółowe

Badania przeprowadzono w stadzie bydła montbeliarde, w którym pogłowie krów wynosiło 228 sztuk, a przeciętna wydajność 9565 kg mleka. Krowy utrzymywano w

Podstawą analizy były dane z 5284 udojów, które pozyskiwano w dniach próbnych udojów z komputerowego systemu zarządzania stadem ALPRO, firmy DeLaval. Analizie poddano następujące cechy: czas doju (s), udój rzeczywisty (kg), średni przepływ mleka (kg/min), maksymalny przepływ mleka (kg/min) oraz wydajność (w kg i %) podczas pierwszych 2. minut doju. Cechy te oceniano w obrębie następujących czynników: pochodzenie zwierząt (importowane, urodzone w kraju), pora doju (popołudnie, rano), kolejna laktacja (I, II, III, IV i dalsze), faza po wycieleniu (do 100 dni laktacji, 101-200, 201-305, >305).

Dój jednej krowy trwał przeciętnie 442 sekundy (7 min 22 s) i wydłużał się istotnie po kolejnych porodach (od 6 min 17 s u pierwiastek do 7 min 59 s w laktacji IV i dalszych), a skracał (od 8 min 18 s do 5 min 57 s) wraz z zaawansowaniem laktacji. Dłużej o 72 sekundy trwał dój krów importowanych w porównaniu z urodzonymi w kraju (P≤0,01). Nie stwierdzono istotnego wpływu pory pozyskiwania mleka na czas doju. Najwyższy przepływ mleka w kg/min (2,1-2,2) stwierdzono w przypadku krów urodzonych w kraju, reprezentujących I i II laktację oraz w pierwszym i drugim trymestrze po porodzie, a najniższy (1,4 kg/min) zanotowano w przypadkach przedłużania się laktacji ponad 300 dni. Maksymalny przepływ mleka u pierwiastek wynosił 3,4 kg/min, w laktacji II i III kształtował się na poziomie 3,9 oraz 3,7 kg, a w IV i dalszych zanotowano kolejny spadek (do 3,4 kg/min). Wielkość tego parametru zmniejszała się wraz z zaawansowaniem laktacji odpowiednio o 0,1; 0,3 oraz 0,6 kg/min.

W podsumowaniu stwierdzono, że na parametry doju krów montbeliarde wpływała kolejna laktacja i faza po wycieleniu, a także pochodzenie krów. W kolejnych laktacjach i fazach po porodzie zmniejszał się średni przepływ mleka. Wyższymi wskaźnikami szybkości oddawania mleka charakteryzowały się krowy urodzone w Polsce w porównaniu z importowanymi z Francji jako jałowice cielne. Porównując parametry doju uzyskane w badaniach własnych z wynikami innych autorów, a dotyczące ras holsztyńsko-fryzyjskiej i simentalskiej można stwierdzić, że szybkość oddawania mleka krów montbeliarde zbliżona była do wyników krów typowo mlecznych i wyższa niż u zwierząt o użytkowaniu dwukierunkowym.

Introduction

The countries leading in dairy production consider milking speed to be one of criteria for cow evaluation and selection towards suitability for mechanical milking. The aforementioned trait tends to be very variable for individual cows and is highly related to teat structure, in particular - the diameter of teat canal. Approximate milking speed of individual cows in the herd facilities creation of technological groups. Animals characterized by a low milking speed, thus delaying milking, should be eliminated from the herd (Bogucki and Neja, 2008). Despite of considerable mechanization, reaching automation level, milking continues to be the activity with the highest impact on the labor organization in dairy cattle herd and the quality of obtained milk. The suitability of individual cows for mechanical milking is determined by udder conformation and milking speed. Both of these traits are included in the evaluation of Polish population of dairy cattle, and the udder conformation is one of major selection criteria (Litwińczuk and Szulc, 2005).

Recent years in Poland have been marked with an increasing interest in the French breed - Montbéliarde, which represents combined beef-dairy type of cattle. It is included in the subpopulation of Simmental cattle together with breeds such as Simmental, Fleckvieh, and Friuli (Gołębiewski and Brzozowski, 2007). The aim of the breeding programme for Montbéliarde cattle in Poland is the genetic development leading to improvement of population of cows in the combined utility type with a predominance of dairy traits. The improvement involves traits with a significant influence on the profitability of production; namely, yield of milk, protein, and fat; characteristics of type and conformation with a particular emphasis on udder and legs, and other functional traits. Furthermore, fattening and slaughter traits are also subjected to this enhancement. The ratio between dairy and beef traits should be as 60 to 40. Due to the minor size of population of Montbéliarde cattle in Poland, breeding activities are carried out exclusively within individual herds and the semen necessary for its implementation is entirely imported (PFHBiPM, 2011b). In year 2010, average milk yield of over 1500 Montbéliarde cows included in the Milk Recording accounted for 7291 kg of milk, which was an increase by 166 kg as compared with the previous year. Moreover, the active population of cows of this breed also increased (by 222.5) throughout the year (PFHBiPM, 2011a). Cows of Montbéliarde breed produce milk characterized by a high content of dry matter (13.42%) and good cytological quality (Januś and Borkowska, 2010). Due to the fact that population of Montbéliarde cows in Poland is growing, it is necessary to undertake research studies investigating various aspects of the utility of cows of this breed.

The aim of the present study was to analyze the influence of cow origin, milking hour, subsequent lactation and phase after calving on the milking parameters of Montbéliarde cows maintained on a selected farm from Lublin region.

Material and methods

The study was carried out on a herd of Montbéliarde cows maintained on a selected farm from Lublin region, which had in-calf heifers imported from France in year 2005. The herd number has been increased in subsequent years predominantly on the basis of own material. The cow population in year 2010 accounted for 228 individuals, and the average yield was 9565 kg of milk with 3.87% of fat and 3.60% of protein (PFHBiPM, 2011a). Cows were kept in a free-stall bedded barn and fed with TMR system. Milk was collected in the "side by side" milking parlor. The basis of analysis consisted of data collected during test-day milkings from computer system of herd management ALPRO provided by DeLaval company. The data concerned 5284 milkings conducted from July 2010 to September 2011.

The analysis included the following parameters: milking duration (s), the actual milking volume (kg), average milk flow rate ($kg \cdot min^{-1}$), maximum milk flow rate (kg/min) and efficiency during the first two minutes of milking (expressed in kg and %). The aforementioned traits were evaluated in regard to the following factors of influence: animal origin (imported, born in the country), time of milking (afternoon, morning), subsequent lactation (I, II, III, IV and further), phase after calving (up to 100^{th}, 101^{st}-200^{th}, 201^{st}-305^{th}, and over 305^{th} day of lactation).

The obtained results were analyzed statistically with the use of a multi-factorial analysis variance. The significance of influence of the investigated factors was evaluated with Duncan's test.

Results and Discussion

Cow milking speed is a functional trait that has primarily economic importance. It was also determined that this trait was related to udder conformation and its health status, and time span of cow use in the herd (Duda, et al., 1996). Milking time in the herd included in the research had average value of 442 seconds (7 min 22 s). It increased along with subsequent lactations (ranging from 6 min 17 s for primiparous cows to 7 min59 s for IV and further lactations) and decreased along with the progress of lactation (from 8 min 18 s to 5 min 57 s) - Table 1. Milking of imported cows lasted longer by approximately 72 seconds as compared to cows born in the country. All means within these factors were significantly different at P≤0.01. The time (hour) of milking was not proved to have a significant influence on milking duration. The difference between morning and afternoon milking was only 4 seconds. According to research by Bogucki and Neja (2008), the milking duration was significantly increasing along with the increase of cows' milk yield. In regard to the subsequent phases after calving, this research revealed that milking duration has decreased significantly from the 1st to 3rd trimester of lactation, whereas it slightly increased in case of lactation prolonged over 300 days. Significant impact of hour on the total milking duration was stated in research of Luberański, et al. (2006).

Table 1. Milking duration and volume of obtained milk for Montbéliarde cows in relation to analyzed factors
Tabela 1. Czas trwania doju oraz ilość pozyskiwanego w jego trakcie mleka u krów montbeliarde w obrębie analizowanych czynników

Item	Milking number	Milking duration (s)		Actual milking volume (kg of milk)	
		$\bar{x}$	SD	$\bar{x}$	SD
Cow origin					
- imported	2586	479^{A}	171	14.6^{A}	5.9
- domestic	2698	407^{B}	146	14.0^{B}	5.0
Milking hour					
- afternoon	2652	440	171	14.2^{a}	5.4
- morning	2632	444	154	14.4^{b}	5.4
Subsequent lactation					
- I	1123	377^{A}	124	12.8^{A}	3.7
- II	745	411^{B}	158	14.5^{Ba}	5.6
- III	997	451^{C}	182	14.5^{Ba}	5.8
- ≥IV	2419	479^{D}	160	14.8^{Bb}	5.8
Lactation days					
- up to 100	1506	498^{A}	175	17.7^{A}	4.8
- 101-200	1472	479^{B}	162	16.3^{B}	4.3
- 201-305	1474	396^{C}	134	12.0^{C}	4.2
- >305	832	357^{D}	122	8.8^{D}	3.7
Overall and average	5284	442	163	14.3	5.4

Means in columns within a factor marked with different letter are significantly different: A,B,C,D – at p≤0.01; a,b – at p≤0.05

The average actual milking volume had a mean value of 14.3 kg of milk. Significant differences regarding this trait were observed at P≤0.01 and P≤0.05 level. The values of milking parameters have been influenced significantly by all factors examined in the present study and means of values relevant to the animal origin and lactation phase were significantly different at P≤0.01. Actual milking volume for cows born in the country was lower by 0.6 kg as compared with animals imported to Poland as in-calf heifers. The difference between these groups could have resulted from the fact that the imported cows represented subsequent further lactations, whereas a considerable proportion of domestic animals comprised primiparous and second-calved cows. Data in Table 1 indicate that less milk (in a range of 1.7 to 2.0 kg) was obtained from primiparous cows as compared with multiparous cows (P≤0.01). The actual milking volume has decreased in subsequent lactation phases by 1.4, 4.3 and 3.2 kg of milk, respectively. According to a study conducted on a population of cows of Polish Holstein-Friesian breed of Black and White variety, the total milking duration was affected by the subsequent lactation, its phase and daily milk yield. Furthermore, it was determined that milking duration had significantly positive correlation with daily milk yield, whereas the correlations with contents of fat, protein and dry matter were negative (Borkowska and Januś, 2010b).

The evaluation of milking capability that was conducted until 90's of the last century used the average milk flow rate (expressed as kg/min of milking) as the basis of calculating the average corrected milking volume, and in subsequent stage, it was also the basis for classifying animals to one of five (superior, very good, good, sufficient, insufficient) classes of milking speed (Litwińczuk and Szulc, 2005). It was determined that both primiparous and multiparous cows, characterized by a 'superior' and 'very good' milking capability, produced milk with significantly lower somatic cell count (Borkowska and Januś, 2003). Furthermore, Sewalem, et al. (2010a) and Zwald, et al. (2006) demonstrated that mastitis was occurring more frequently in cows characterized by high milk flow rates. The highest milk flow rates expressed in kg per min (2.1-2.2) in the present study were observed for domestic cows, representing the first and second lactation, and in the first and second trimester after calving (Table 2). These values were significantly (P≤0.01) higher for imported cows, that represented III and further lactations and were in period over 200 days after calving. The lowest milk flow rate (1.4 $kg \cdot min^{-1}$) was noted in cases of lactation prolonged over 300 days. The reduction of milk flow rate during the course of lactation could contribute to the increased somatic cell count in milk of Montbéliarde cows, which was determined in other studies (Borkowska and Januś, 2010a). The study performed on the population of Simmental cows (Choroszy, et al., 2010) revealed that cows in the early lactation had the lowest milking duration (up to 100^{th} day). The average milk flow rate for these animals accounted for 1.48 $kg \cdot min^{-1}$ and decreased from 1.41 to 1.27 $kg \cdot min^{-1}$ in the third lactation trimester. The presented data implies that the milking speed of Montbéliarde cows was considerably higher than value reported by Choroszy, et al. (2010) for Simmental cows and corresponding to the value noted in the study of Bogucki and Neja (2008) that was conducted on the herd of Polish Holstein-Friesian cows of Black and White variety. Dodenhoff, et al. (2000) exemplifies such differences between breeds. Their study revealed that cows of Holstein-Friesian breed milked most quickly, as it is a typical dairy breed, whereas breeds with dual direction of utilization (e.g. Simmental breed) milked most slowly. Moreover, considerable differences in regard to the milking speed were determined also between dairy breeds. Sewalem, et al. (2010b) stated

Table 2. Milking parameters of cows of Montbéliarde breed in regard to the analyzed factors
Tabela 2. Parametry doju krów rasy montbeliarde w zależności od analizowanych czynników

Item	Milking number	Average milk flow rate (kg·min^{-1})		Maximum milk flow rate (kg·min^{-1})		Efficiency of two first milking minutes			
						kg of milk		%	
		$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Cow origin									
- imported	2586	1.8^{A}	0.6	3.4^{A}	1.0	3.39^{A}	1.76	25^{A}	12
- domestic	2698	2.1^{B}	0.7	3.7^{B}	1.2	3.78^{B}	1.73	28^{B}	12
Milking hour									
- afternoon	2652	1.9	0.7	3.5	1.1	3.63	1.77	27^{A}	13
- morning	2632	1.9	0.6	3.5	1.1	3.55	1.75	26^{B}	12
Subsequent lactation									
- I	1123	2.1^{A}	0.6	3.4^{A}	0.9	3.55^{ABa}	1.59	29^{A}	12
- II	745	2.1^{A}	0.7	3.9^{B}	1.2	4.02^{C}	1.86	30^{A}	13
- III	997	1.9^{B}	0.8	3.7^{C}	1.3	3.69^{Bb}	1.83	27^{B}	13
- ≥IV	2419	1.8^{C}	0.6	3.4^{A}	1.0	3.44^{Aa}	1.75	24^{C}	12
Lactation days									
- up to 100	1506	2.2^{A}	0.7	3.8^{A}	1.1	4.32^{A}	1.79	26^{A}	11
- 101-200	1472	2.1^{B}	0.6	3.7^{A}	1.0	3.92^{B}	1.54	25^{A}	10
- 201-305	1474	1.8^{C}	0.6	3.4^{B}	1.1	3.16^{C}	1.61	27^{B}	13
- >305	832	1.4^{D}	0.5	2.8^{C}	1.0	2.45^{D}	1.51	29^{C}	16
Overall and average	5284	1.9	0.7	3.5	1.1	3.59	1.76	26	13

Means in columns within a factor marked with different letter are significantly different: A,B,C,D – at p≤0.01; a,b – at p≤0.05

that cows milking quickly and very quickly were observed more frequently within population of Ayrshire and Jersey cattle as compared with Holstein-Friesian cows.

The milking hour was the factor of the least significance on the milking parameters. The values calculated for the afternoon and morning milkings were equal or similar, whereas the significant differences were stated only for the proportion of milk collected during the first two minutes of milking.

Bogucki and Neja (2008) stated that the maximum milking rate for the Polish Holstein-Friesian cows of Black and White variety was higher for multiparous cows (4.33 $kg \cdot min^{-1}$) as compared with primiparous cows (4.17 $kg \cdot min^{-1}$). A similar relationship can be observed in the present study, where the maximum milk flow for primiparous cows accounted for 3.4 $kg \cdot min^{-1}$; in II and III lactation it was at the level of 3.9 and 3.7 $kg \cdot min^{-1}$; whereas in IV and further lactation another decrease was recorded (to 3.4 $kg \cdot min^{-1}$). The determined maximum milk flow rate of cows in subsequent periods after calving was also converse to the related study (Bogucki and Neja, 2008). The value of this parameter has decreased along with the progress of lactation; by 0.1, 0.3 and 0.6 $kg \cdot min^{-1}$, respectively. The differences between the results of the present study and those reported by Bogucki and Neja (2008) could be attributed to the breed differences and also to the milking system that was used.

Higher value (by approximately 0.3 $kg \cdot min^{-1}$ at $P \leq 0.01$) for maximum milk flow rate was calculated for animals born in the country as compared with the imported ones. Moreover, animals of domestic origin were significantly ($P \leq 0.01$) superior to imported animals in regard to the milk yield during the first two minutes of milking (by 0.39 $kg \cdot min^{-1}$ and 3%). The data presented in Table 2 indicates that the highest milking efficiency was characteristic of cows in II lactation. It was due to the highest milk volume obtained during the first two minutes of milking (>4 kg), which also comprised the highest proportion of the entire milking (30%).

Conclusions

To summarize, it can be concluded that the milking parameters of Montbéliarde cows were affected by the subsequent lactation and phase after calving, and also the cow origin. The average milk flow rate has decreased along with the subsequent lactations and phases after calving. Higher indices of milking speed were characteristic of cows born in Poland as compared with those imported from France as in-calf heifers. By comparing the milking parameters obtained in the present study with the results of other authors concerning Holstein-Friesian breed and Simmental breed, it can be concluded that the milking speed of Montbéliarde cows was corresponding to the results of typical dairy cows and higher than for cows of dual direction of utilization.

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