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COW'S MILK QUALITY AND ENERGY VALUE DURING DIFFERENT LACTATION STAGES

Ewa Salamończyk✉

Department of Cattle Breeding and Milk Evaluation, Siedlce University of Natural Sciences and Humanities
Prusa 14, 08-110 Siedlce, **Poland**

ABSTRACT

Background. The quality of dairy products, raw milk in particular, depends on many factors. Low bacterial and somatic cell counts are basic determinants of the appropriate raw milk quality. The objective of the work was to assess the effect of selected factors, that is, the age of cows and their daily milk performance, on cytological quality (somatic cell count) and energy value of milk produced at individual stages of lactation.
Material and methods. Somatic cell count and energy value of cow's milk were assessed. A total of 229 792 milk samples were examined. Data for analysis were taken from milk records of 350 dairy herds
Results. It was demonstrated that, of all the lactations studied, the first lactation (from calving to the 100th day of lactation) was characterised by the highest daily milk performance (25.1 kg) and the lowest somatic cell count (356 thous./1 ml), fat, protein and dry matter contents (4.06, 2.96 and 12.41%, respectively) and milk calorific value (732 kcal/kg). The highest energy value was recorded in cow's milk produced towards the end of lactation, that is from day 300 till the end of lactation (842 kcal/kg).
Conclusions. High milk calorific value in late lactation and high fat and protein contents were accompanied by low raw milk quality.

Key words: dairy cows, somatic cells, energy value of milk

INTRODUCTION

Food selection is mainly governed by food taste. Milk is the nutrient source in human diet which nothing else can replace. It contains valuable exogenous amino acids, vitamins and minerals – especially calcium which plays an important role in many metabolic processes occurring in the human body and is, similarly to phosphorus, an inorganic component of bone tissue and teeth. The quality of dairy products, raw milk in particular, depends on many factors. Since 1st January 2007, milk can by sold only by dairy farmers who comply with the requirements of hygiene of milk production and storage laid down in Commission Regulation (EC) No 1662/2006 of 6 November 2006 amending Regulation (EC) No 853/2004 of the European Parliament and of the Council establishing a specific hygiene rules for food of animal origin. Milk delivered to the collection point cannot contain more than 100 th microbes and 400 th somatic cells per ml. These two parameters are basic determinants of the appropriate raw milk quality. In turn, low bacterial and somatic cell counts in milk are influenced by many factors, including: hygiene of dairy cow housing, milking parlour and milking machines, cow cleanliness, health status of animals with particular stress on the udder, and appropriate pre- and post-milking practices [Barłowska et al. 2003, Bogucki and Sawa

✉ewa.salamonczyk@uph.edu.pl

2004, Bogucki et al. 2008, Fiedorowicz and Ważna-Zwierzyńska 2007].

Increased somatic cell counts in cow's milk is a symptom of an inflammation of the mammary gland (*mastitis*) in the cow. As reported in the literature, 50% cows in Poland suffer from (clinical or subclinical) *mastitis* at least once during lactation [Sawa and Piwczyński 2003]. Subclinical mastitis is particularly dangerous because there are no macroscopic changes in milk whereas its physical and chemical properties change in addition to increased somatic cell and bacterial counts, including pathogens [Majewski and Tietze 2002]. Unfavourable compositional changes include lower levels of elements synthesised by milk-producing cells of the cow's udder: lactose, fat, casein, minerals, and increased levels of components passing from blood to milk: immunoglobulins, especially IgG and BSA, chlorine and sodium [Sawa and Piwczyński 2002].

Nutritional value, including the energy value of food is an important element for improving diet and processing. Energy value of 1 litre of milk primarily depends on its fat content and ranges from 500 to 700 kcal, which corresponds to 20-25% adult human energy requirement. A unique characteristic of bovine milk fat is the presence of short chain fatty acids, which are readily available source of energy necessary for the operation of such heart, liver, kidneys, platelets, nervous system, muscles. These acids do not cause an increase in blood lipid levels, and therefore do not contribute to obesity. The energy in milk comes from its fat (49% energy), lactose (40%) and protein (11%) [Pijanowski 1980]. In turn, chemical composition of milk and, as a result, its special properties are influenced by genetic characteristics of cows and their nutrition [Barłowska et al. 2011, Brodziak et al. 2012, Czaplicka et al. 2002, Jasińska et al. 2010, Sablik et al. 1999].

The objective of the work was to assess the effect of selected factors, that is, the age of cows and their daily milk performance, on cytological quality (somatic cell count) and energy value of milk produced at individual stages of lactation.

MATERIAL AND METHODS

Raw milk was examined from cows raised on private farms which participate in a milk recording scheme. A total of 24 468 full lactations were analysed; the lactations were at least 306 days long and the cows calved between 1995 and 2008. The overall number of milk samples assessed was 229 792. Data for analysis were taken from milk records of 350 dairy herds kept by the Polish Federation of Cattle Breeders and Dairy Farmers in Warsaw which performs milk recording of dairy and dual purpose breeds in Poland. The organization is a member of International Committee for Animal Recording (ICAR), World Holstein-Friesian Federation (WHFF) and European Holstein & Red-Holstein Confederation (EHRC). The evaluation employs method A and is carried out by authorized Federation employees. Physical and chemical milk evaluation includes the following parameters: percentage fat content, percentage protein content, percentage lactose content, percentage dry matter content, urea level and somatic cell count. It is performed by laboratories accredited by the Polish Accreditation Centre which apply the quality system in accordance with the Standard PN-EN ISO/IEC 17025 and operate following ICAR guidelines.

The effect of the following factors was analysed: lactation length (≤100 days; 101-200 days; 201-300 days; >300 days), age of the cow (parity: 1; 2 and 3; 4 and older) and average daily milk yield per lactation (≤ 10.0; 10.1-20.0; 20.1-30.0; >30.0 kg), on somatic cell count (th per ml and SCS), as well as energy value of milk of the Polish Holstein-Frisian black and white cows, (PHF bw).

Milk energy value (E) was calculated according to the following formula [Kleiber 1961]:

$$E\ (kcal/kg) = (\%\ fat \times 92) + (\%\ protein \times 58.6) + (\%\ lactose \times 39.5).$$

In order to normalize the distribution, milk somatic cell counts (SCC) were log transformed and somatic cell scores (SCS) were obtained according to the following formula:

$$SCS = \log_2 (SCC / 100\ 000) + 3.$$

The results were then subjected to statistical analysis by means of the SAS software (ver. 9.3) according to the following linear model:

$$Y_{ijkl} = \mu + a_i + b_j + c_k + (ab)_{ij} + (ac)_{ik} + e_{ijkl}$$

where:

Y_{ijkl} – phenotypic value of a trait studied,

μ – overall mean of the trait studied,
a_i – lactation length (≤100 days; 101-200 days; 201--300 days; >300 days),
b_j – age of cow (parity 1; parity 2 and 3; parity 4 and older),
c_k – average daily milk yield per lactation (≤ 10.0; 10.1-20.0; 20.1-30.0; >30.0 kg),
$(ab)_{ij}$ – interaction: lactation length × age of cow,
$(ac)_{ik}$ – interaction: lactation length × average daily milk yield per lactation,
e_{ijkl} – residual error.

Significance of differences between means was checked using Duncan's test ($P < 0.05$). Results are presented as mean values ±standard deviation (SD).

RESULTS AND DISCUSSION

The standard lactation of a cow lasts 10 months. The Holstein-Frisian breed, which has been raised for dairy purposes in Poland since 1970s, has been associated with increased milk production and extended lactations. The average daily milk yield calculated based on 229 792 samples obtained in 1998-2008 was 19.1 kg. The highest daily milk yield was recorded for cows in their first 100 days of lactation (Table 1). The yield was gradually increasing during the next weeks of lactation (next periods). Daily performance started to decrease about 3-4 months after calving, which was associated with the next pregnancy and apoptosis of milk-producing cells in the udder [Wilde et al. 1999]. Chemical composition of the milk analysed was significantly different ($P \leq 0.05$) at individual lactation stages. The highest milk contents of fat, protein and dry matter were recorded in milk produced at the last lactation stage, that is >300 days. In contrast, lactose content was the only parameter whose value decreased as lactation advanced. The highest lactose content was recorded at the first two lactation stages, that is the periods of 1-100 and 101-200 days (4.70%). The lowest content was found at the stage which was longer than 300 days (4.59%) (Table 1). Raw milk calorific value tended to increase as there was determined a statistically significant increase in milk content of fat and protein in late lactation (201-300 and >300 days). The calorific value of 1kg of milk produced during the aforementioned phases was: 802 and 842 kcal, respectively.

Table 1. General characteristics of the quality and composition of milk from cows in different periods of lactation (mean ±standard deviation)

Specification	Lactation stage, days				Number of values	Average
	≤ 100	101-200	201-300	> 300		
Average daily milk yield, kg	25.1^{a} ±6.49	20.7^{b} ±5.70	16.7^{c} ±4.77	13.3^{d} ±4.83	24 468	19.1 ±4.7
Somatic cell count, thous./ml	356^{d} ±759.0	411^{c} ±810.7	444^{b} ±763.5	487^{a} ±959.1	24 468	426 ±573
Somatic cell score	3.41^{d} ±1.91	3.74^{c} ±1.84	4.15^{b} ±1.61	4.27^{a} ±1.61	24 468	3.86 ±1.43
Content in milk, %						
fat	4.06^{d} ±0.74	4.15^{c} ±0.71	4.49^{b} ±0.86	4.82^{a} ±0.93	24 468	4.30 ±0.54
protein	2.96^{d} ±0.37	3.23^{c} ±0.34	3.57^{b} ±0.36	3.92^{a} ±0.45	24 468	3.32 ±0.24
lactose	4.70^{a} ±0.53	4.70^{a} ±0.42	4.64^{b} ±0.39	4.59^{c} ±0.47	24 468	4.73 ±0.17
dry matter	12.41^{d} ±1.40	12.81^{c} ±1.12	13.36^{b} ±1.16	13.96^{a} ±1.20	24 468	13.09 ±0.69
Energy value of milk, kcal/kg	732^{d} ±89.8	756^{c} ±86.3	803^{b} ±86.0	842^{a} ±106.3	24 468	777 ±65.9

a, b, c, d – means values in rows differ statistically significantly at $P < 0.05$.

The lactation stage significantly influenced somatic cell counts, too. The lowest SCC per 1 ml of milk, which increased its processability, was recorded only in early lactation, that is during the first 100 days after calving. The value was 356 th cells per 1 ml indicating an "class extra" milk quality at the collection centre. Milk collected during the remaining lactation stages had the average somatic cell counts which by 11 th to 87 th exceeded the somatic cells count specified in the Commission Regulation (EC) No 1662/2006 of 6 November 2006. According to Bertilsson et al. [1997], milk produced during final stages of longer lactations makes a poor raw material for processing. Although, as milk performance decreases protein content increases, caseins are progressively degraded by proteolytic enzymes. This process, occurring in late lactation, indicates limited survival of secretory epithelium. Towards the end of lactation, the level of sodium increases and smaller fat globules are formed, which is accompanied by increased milk contents of fat.

Detailed analysis to assess the effect of parity and cow's daily milk yield on somatic cell count revealed that the two factors affected milk cytological quality at individual lactation stages (Table 2). The youngest cows, that is primiparous cows during the whole lactation, and parity 2 and 3 cows at the first two lactation stages (≤100 days and 101-200 days) were found to produce milk with the lowest SCC and SCS per 1 ml.

Table 2. The mean and standard deviation of the somatic cell count (SCC) and somatic cell score (SCS) in the milk of cows, depending on the lactation stages, age of cow (lactation) and the average daily milk yield in lactating

Factor	Lactation stage, days								Number of values	Average	
	≤ 100		101-200		201-300		> 300				
	SCC thous./ ml	SCS	SCC thous./ ml	SCS	SCC thous./ ml	SCS	SCC thous./ ml	SCS		SCC thous./ ml	SCS
Lactation											
1	274^{c} ±618	3.12^{c} ±1.77	294^{c} ±647	3.25^{c} ±1.75	317^{c} ±634	3.62^{c} ±1.61	302^{c} ±641	3.60^{c} ±1.56	7 420	304^{c} ±423	3.38^{c} ±1.31
2-3	326^{b} ±694	3.29^{b} ±1.92	389^{b} ±770	3.72^{b} ±1.80	432^{b} ±714	4.17^{b} ±1.56	476^{b} ±991	4.35^{b} ±1.50	9 410	407^{b} ±538	3.83^{b} ±1.38
4th and above	470^{a} ±927	3.83^{a} ±1.98	554^{a} ±966	4.25^{a} ±1.85	583^{a} ±902	4.65^{a} ±1.54	698^{a} ±1143	4.91^{a} ±1.52	7 638	569^{a} ±698	4,35^{a} ±1.43
Daily milk yield level, kg											
≤ 10.0	571^{a} ±1483	3.63^{a} ±2.16	577^{a} ±1421	3.91 ±2.01	615^{a} ±1301	4.26 ±1.85	646 ±1414	4.32 ±1.86	261	647^{a} ±1103	3.99^{a} ±1.63
10.1-20.0	374^{b} ±820	3.43 ±1.94	421^{b} ±844	3.75 ±1.85	454^{b} ±802	4.15 ±1.64	497 ±965	4.27 ±1.65	14 802	441^{b} ±600	3.87^{ab} ±1.44
20.1-30.0	322^{c} ±618	3.37 ±1.87	394^{b} ±737	3.72 ±1.82	429^{b} ±684	4.16 ±1.59	468 ±943	4.28 ±1.54	8 919	401^{b} ±505	3.84^{ab} ±1.40
> 30.0	278^{d} ±528	3.24^{b} ±1.76	349^{b} ±560	3.66 ±1.80	357^{c} ±497	4.00 ±1.52	410 ±661	4.22 ±1.47	486	338^{c} ±413	3.71^{b} ±1.36

SCC – somatic cell count (thous./ml).
SCS – somatic cell score.
a, b, c, d – means values in columns differ statistically significantly at $P < 0.05$.

The somatic cell counts determined in the milk of these cows were by 11 th to 126 th lower than 400 th per 1 ml. As cows got older (parity increased) and lactation progressed, milk quality worsened. The highest average SCC per 1 ml was determined in milk from the oldest parity cows, that is from parity 4 on, and at the final stage of lactation (more than 300 days). The average SCC in milk, which determines raw milk quality and affects health status of the cow, was 698 th per ml for the aforementioned animals.

It is common knowledge, confirmed by research, that milk somatic cell count increases as cows get older and lactation progresses [Gnyp et al. 2006, Górska et al. 1998, Litwińczuk et al. 2006, Stenzel et al. 2001]. In the study by Górska et al. [1998], the milk of the youngest animals (aged 3.5 or less) contained merely 177.7th cells whereas the oldest animals, which were more than 10 years of age (the oldest group investigated), had milk SCC averaging 850.9th per ml. In turn, Stenzel et al. [2001] demonstrated that SCC was by 50% higher after month 10 compared with the first months of lactation. However, according to Malinowski [2001], the effect of environmental factors such as lactation stage or age of cow on SCC is relatively small if cows are healthy, and udder health appears to be the main factor affecting milk SCC.

It was also found in the study discussed that the cytological quality of cow's milk is significantly affected by the daily milk yield of cow. The lowest SCC in the first 300 days of lactation was recorded in the milk of cows whose average daily milk performance was higher than 300 kg over the whole lactation. Somatic cell counts of high-yielding cows at successive lactation stages were as follows: 278th (≤100 days); 349th (101-200 days) and 357th (201-300 days). Assessment of the remaining animals divided into groups according to their daily milk performance revealed that as lactation advanced and less milk was being produced, milk quality decreased, too.

Similar findings were reported by Guliński et al. [2007] who found that the highest and lowest somatic cell counts were determined in the milk of cows with standard lactation characterised by milk production of, respectively, less than 4000 (617.8 th/ml) and more than 8000 kg milk.

Data in Table 3 show that milk produced at the last lactation stage, that is >300 days, had the highest energy value. Milk calorific value in late lactation was found to be similar irrespective of the age of cow (parity) and ranged between 829 and 851 kcal/kg. Similar high energy value over the same period was observed for cows whose average daily milk yield per lactation was 10.1-20.0 and 20.1-30.0 kg (844 and 841 kcal/kg). Lower energy values in late lactation (11^{th}-18^{th} month) were reported by Januś and Borkowska [2011]: 718.4 kcal for Polish Holstein-Frisian black and white cows and 733.8 kcal/kg for Montbeliarde cows. The authors found in their study that milk energy value was significantly influenced by breed. Milk of Montbeliarde cows had by 40.9 kcal/kg higher calorific value than PHF bw animals.

Milk obtained during the first 100 days of lactation had a significantly ($P \leq 0.05$) lower milk calorific value, probably due to lower fat content. Similar findings were reported by Januś and Borkowska [2011], Neja et al. [2002] and Tomaszewski et al. [1998].

As assessment of the effect of average daily milk performance per lactation on energy value revealed that significantly more calorific milk was produced by average-yielding cows, compared with animals which had daily milk yields of less than 10.0 and more than 30.0 kg. One kilo of milk produced by cows which had daily milk yields of 10.1 to 20.0 and 20.1 to 30.0 kg contained 780 and 775 kcal, respectively.

In their studies, Januś and Borkowska [2011], as well as Neja et al. [2002] found that the more milk cows produced, the lower its energy value was. The values of 706.9 and 651.8 kcal/kg were associated with the daily milk yields of under 20.0 and over 30.0 kg, respectively [Januś and Borkowska 2011].

CONCLUSIONS

1. Milk quality (somatic cell count) and energy value were significantly influenced by age and lactation stage of the cow, as well as daily milk performance per lactation.

2. The highest energy value was determined for milk produced at the end of lactation, that is from day 300 till the end of lactation (842 kcal/kg).

3. High milk calorific value in late lactation and high fat and protein contents were accompanied by low raw milk quality.

Table 3. The energy value of cow milk, depending on the age of cows (lactation), lactation stages and the average daily milk yield in lactation (mean ±standard deviation)

Factor	Lactation stage, days				Number of values	Average
	≤ 100	101-200	201-300	> 300		
Lactation						
1	731 ±90	752[b] ±84	799[b] ±83	844[b] ±102	7 420	776[b] ±64
2-3	734[a] ±90	761[a] ±90	811[a] ±89	851[a] ±108	9 410	783[a] ±67
4[th] and above	730[b] ±90	754[b] ±83	798[b] ±84	829[c] ±107	7 638	772[c] ±65
Daily milk yield level, kg						
≤ 10.0	713[c] ±107	758[b] ±75	796[b] ±89	819[c] ±98	261	767[b] ±69
10.1-20.0	729[b] ±91	759[a] ±88	808[a] ±87	844[a] ±107	14 802	780[a] ±67
20.1-30.0	736[a] ±87	753[b] ±84	797[b] ±83	841[b] ±105	8 919	775[a] ±64
> 30.0	737[a] ±79	733[c] ±74	767[c] ±77	808[c] ±108	486	755[c] ±60

a, b, c, d – means values in columns differ statistically significantly at $P < 0.05$.

REFERENCES

Barłowska J., Litwińczuk Z., Król J., Florek M., Teter U., 2003. Wpływ sezonu i rejonu produkcji na skład chemiczny, zawartość mocznika i jakość cytologiczną mleka krów z rejonu Lubelszczyzny i Bieszczad [Influence of season and production region on chemical composition, urea content and cytological quality of milk from Lublin and Bieszczady regions]. Zesz. Nauk. PTZ 68 (1), 175-182 [in Polish].

Barłowska J., Szwajkowska M., Litwińczuk Z., Matwijczuk A., 2011. The influence of cow breed and feeding system on the dispersion state of milk fat and content of cholesterol. Rocz. Nauk. PTZ 7 (3), 57-65.

Bertilsson J., Berglund B., Ratnayake G., Svennersten-Sjaunja K., Wiktorsson H., 1997. Optimizing lactation cycles for the high-yielding dairy cow. A European perspective. Livest. Prod. Sci. 50, 5-13.

Bogucki M., Sawa A., 2004. Schorzenia gruczołu mlekowego w aspekcie wybranych czynników [Diseases mammary gland in terms of some factors]. Acta Sci. Pol., Zoot. 3 (2), 41-48 [in Polish].

Bogucki M., Sawa A., Neja W., Ksobiech L., 2008. Wpływ preparatów dippingowych na jakość cytologiczną mleka [Effect of dipping solutions on the cytological quality of milk]. Med. Wet. 64 (4A), 469-472 [in Polish].

Brodziak A., Litwińczuk A., Topyła B., Wolanciuk A., 2012. Wpływ interakcji sezonu produkcji z rasą i systemem żywienia krów na wydajność i właściwości fizykochemiczne mleka [Influence of production season x breed and feeding system interactions on daily yield and milk physical-chemical composition]. Rocz. Nauk. PTZ 8 (1), 19-27 [in Polish].

Czaplicka M., Czerniewicz M., Puchajda Z., Kruk A., Szalunas T., 2002. Ocena ilości i jakości mleka pozyskanego od krów holsztyńsko-fryzyjskich i czarno-białych [Evaluation quantity and quality of milk obtained from HF and Black-and-White cows]. Zesz. Nauk. PTZ 62, 183-191 [in Polish].

Fiedorowicz G., Ważna-Zwierzyńska G., 2007. Wpływ stanu technicznego urządzeń do pozyskiwania i schładzania oraz transportu mleka na jego jakość [The impact of the acquisition of the equipment and cooling and transport of milk on the quality]. Probl. Inż. Rol. 3, 83-93 [in Polish].

Gnyp J., Kowalski P., Tietze M., 2006. Wydajność mleka krów, jego skład i jakość cytologiczna w zależności od niektórych czynników środowiskowych [Efficiency of the cow milk, its composition and cytological quality in relations to some environmental factors]. Ann. UMCS Lublin 24, 3, 17-25 [in Polish].

Górska A., Litwińczuk Z., Niedziałek G., 1998. Wpływ wieku krów na zawartość komórek somatycznych w mleku

[Effect of age on somatic cells in cow's milk]. Zesz. Nauk. AR Wroc. 331, 125-128 [in Polish].

Guliński P., Salamończyk E., Giersz B., 2007. Wpływ buhaja na liczbę komórek somatycznych w mleku krów czarno-białych [Effect of bull on the milk somatic cell count of Black-and-White cows]. Rocz. Nauk. Zoot. 34 (1), 33-44 [in Polish].

Januś E., Borkowska D., 2011. Wpływ wybranych czynników na wartość energetyczną mleka krów rasy polskiej holsztyńsko-fryzyjskiej odmiany czarno-białej oraz montbeliarde [Effect of selected factors on milk energy value of cow's milk from PHF BW and Montbeliarde breeds]. Żywn. Nauka Techn. Jakość 5 (78), 141-149 [in Polish].

Jasińska M., Dmytrów I., Mituniewicz-Małek A., Wąsik K., 2010. Cow feeding system versus milk utility for yoghurt manufacture. Acta Sci. Pol., Technol. Aliment. 9 (2), 189-199.

Kleiber M., 1961. Ogień życia. Zarys bioenergetyki zwierząt [The fire of life. Outline of the bioenergetics of animals]. PWRiL Warszawa [in Polish].

Litwińczuk Z., Teter U., Teter W., Stanek P., Chabuz W., 2006. Ocena wpływu niektórych czynników na wydajność i jakość mleka krów utrzymywanych w gospodarstwach farmerskich [The effect of some factors on yield and milk quality of cows from family farms]. Rocz. Nauk. PTZ 2, 1, 133-140 [in Polish].

Majewski T., Tietze M., 2002. Wpływ stanów subklinicznych mastitis na jakość higieniczną mleka [Effect of subclinical mastitis on the state hygienic quality of milk]. Biul. Inf. Inst. Żywn. 2, 181-186 [in Polish].

Malinowski E., 2001. Komórki somatyczne mleka [Somatic cells in milk]. Med. Wet. 57 (1), 13-17 [in Polish].

Neja W., Sawa A., Piwczyński D., 2002. Wpływ wybranych czynników na wartość energetyczną mleka [Effect of the selected factors on energetic value of milk]. Zesz. Nauk. Przegl. Hod. 62, 160-174 [in Polish].

Pijanowski E., 1980. Zarys chemii i technologii mleczarstwa [Outline of the chemistry and technology of dairy]. PWRiL Warszawa [in Polish].

Rozporządzenie Komisji (WE) nr 1662/2006 z dnia 6 listopada 2006 r. zmieniające rozporządzenie (WE) nr 853/2004 Parlamentu Europejskiego i Rady ustanawiające szczególne przepisy dotyczące higieny w odniesieniu do żywności pochodzenia zwierzęcego [Commission Regulation (EC) No 1662/2006 of 6 November 2006 amending Regulation (EC) No 853/2004 of the European Parliament and of the Council establishing a specific hygiene rules for food of animal origin]. 2006.

Sablik P., Szarkowski K., Czerniawska-Piątkowska E., Kasica A., 1999. Porównanie jakości higienicznej mleka przy doju bańkowym i przewodowym w gospodarstwie rolnym w Wiejkowie [Comparison of hygienic quality of milk in con milking and in-line milking system at agricultural farm Wiejkowo]. Zesz. Nauk. PTZ 44, 215-224 [in Polish].

Sawa A., Piwczyński D., 2002. Komórki somatyczne a wydajność i skład mleka krów mieszańców cb x hf [Somatic cell count and milk yield and composition in Black and White x Holstein-Friesian cows]. Med. Wet. 58, 636-640 [in Polish].

Sawa A., Piwczyński D., 2003. Częstotliwość występowania krów z utrzymującym się niskim poziomem komórek somatycznych w mleku w laktacji pełnej [Frequency of the occurrence of cows with low somatic cell levels in milk during full lactation]. Med. Wet. 59, 630-633 [in Polish].

Stenzel R., Chabuz W., Pypeć M., Pietras U., 2001. Wpływ pory roku, przebiegu laktacji i wieku krów na liczbę komórek somatycznych w mleku [Influence of season, during lactation and age of cow on the number of somatic cells in milk]. Zesz. Nauk. PTZ 55, 173-178 [in Polish].

Tomaszewski A., Hibner A., Chudoba K., 1998. Kształtowanie się wartości energetycznej mleka krów w trakcie laktacji [Cows' milk energy value during lactation]. Zesz. Nauk. AR Wroc. 331, 209-214 [in Polish].

Wilde C.J., Knight C.H., Flint D.J., 1999. Control of milk secretion and apoptosis during mammary involution. J. Mammary Gland. Biol. Neoplasia 4, 129-136.

JAKOŚĆ I WARTOŚĆ ENERGETYCZNA MLEKA KRÓW W RÓŻNYCH OKRESACH LAKTACJI

STRESZCZENIE

Wprowadzenie. Jakość produktów mlecznych zależy od wielu czynników, ale przede wszystkim od jakości surowca. Mała zawartość bakterii oraz komórek somatycznych są podstawowymi elementami określającymi odpowiednią jakość mleka surowego. Celem badań była ocena wpływu wybranych czynników, tj. wieku

krów oraz ich wydajności dobowej mleka na jakość cytologiczną (zawartość komórek somatycznych) oraz wartość energetyczną mleka pozyskiwanego w poszczególnych okresach laktacji.
Materiał i metody. Badano zawartość komórek somatycznych oraz wartość energetyczną mleka krów. Łącznie oceniano 229 792 próbki mleka. Dane do badań pozyskano z wyników oceny wartości użytkowej 350 stad bydła mlecznego.
Wyniki. Wykazano, że w pierwszym okresie laktacji (tj. od porodu do 100 dnia laktacji) wystąpiła najwyższa wydajność dobowa mleka (25,1 kg) oraz najniższa zawartość komórek somatycznych (356 tys./1 ml), zawartość tłuszczu, białka i suchej masy (odpowiednio: 4,06%, 2,96%, 12,41%) i najniższa kaloryczność mleka (732 kcal/kg) spośród wszystkich analizowanych okresów laktacji. Największą wartością energetyczną charakteryzowało się mleko wyprodukowane przez krowy w końcowym okresie laktacji, tj. od 300 dnia do końca laktacji (842 kcal/kg).
Wnioski. Wysoka kaloryczność mleka w końcowym okresie laktacji, w tym duża zawartość tłuszczu i białka, niestety wiązała się z niską jakością surowca.

Słowa kluczowe: krowy mleczne, komórki somatyczne, kaloryczność mleka

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