ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN – POLONIA
VOL. XXVII (2) SECTIO EE 2009

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Milk yield and chemical composition in ewes kept in pasture and indoor system of maintenance

Wydajność i skład chemiczny mleka owiec utrzymywanych w systemie pastwiskowym i alkierzowym

Summary. The research was carried out in 2006 and 2007 on two genotypes of ewes: PLS (Polish Lowland sheep) and BCP (synthetic line), which were kept in two systems, namely on pasture and in an indoor system of maintenance. The ewes in the indoor system of maintenance were kept in a building while being allowed to run outside, whereas in the pasture system they were kept in the open air all year round, while having access to a roofed shed. The aim of the research was to determine the influence of the system of maintenance on both the milk yield and its chemical composition. The research conducted reveals certain changes between these two systems as regards the 24-hour milk yield and the chemical composition of the ewes' milk in subsequent control milking sessions. It was revealed that the number of somatic cells was higher in the groups of ewes with a higher 24-hour yield, and that the PLS ewes kept on pasture, as opposed to the BCP ewes, were characterised by a higher 24-hour yield. The milk yield for the lactation period of 70 days was comparable for the ewes kept in the two systems of maintenance under analysis.

Key words: sheep, system of maintenance, milk, milk yield, somatic cells, chemical composition of milk

INTRODUCTION

In the flocks of sheep kept for the production of lambs for slaughter, lactation yield has a considerable impact on the outcome of this production [Niżnikowski 1994, Gruszecki *et al*. 2002]. As indicated by the Załuska [1978], the level of lactation is lower in]sheep kept on pasture, where they are exposed to extensive precipitation and lower temperatures. The authors further indicate that the alimentary doses for lactating ewes should include lactagogue fodders, such as fresh browse. That is why the influence of the pasture environment on the lactation yield in the sheep which lamb in the spring is significant. Both the milk yield and its chemical composition depend, to a large extent, on

how the animals are maintained and fed [Żebrowska *et al*. 1990, Pakulski *et al*. 1999, Pięta and Patkowski 2001].

This study aimed to assess the level of lactation and the chemical composition of milk given by BCP line ewes, and by the Polish Lowland sheep Uhruska variety (PLS), kept all year round in two different systems of maintenance, namely on pasture and indoors.

MATERIAL AND METHODS

The research was carried out in the Research Experimental Station in Bezek, in the sheep fold owned by the Department of Sheep and Goat Breeding of the University of Life Sciences in Lublin. The process of monitoring and data collection was conducted in 2006 and 2007. The BCP and PLS genotype ewes kept in two different systems, namely on pasture and indoors, constituted the research material.

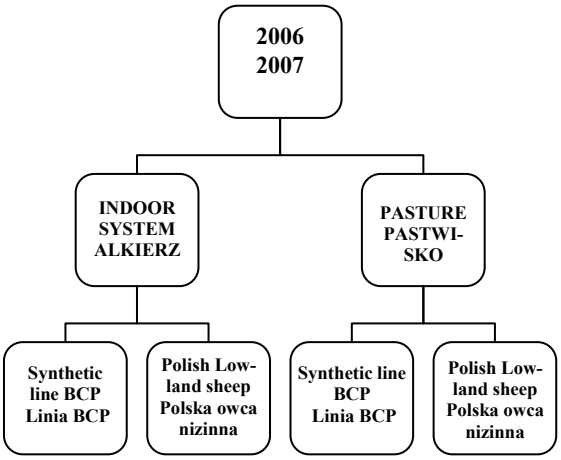
The ewes within the pasture system were kept in the open air all year round. They had access to a shed, and the door was always wide open. In the summer, they could use a fenced pasture with unlimited access. Additionally, they were fed with a slight amount of hay and straw. In the winter, they were fed with hay-silage with the addition of *Festulolium* and Alfalfa. This was provided in unlimited amounts, in the form of whole ballots, and in the appropriate feeding trays. The ewes were additionally fed with some hay and straw. During pregnancy and lactation, they were given a slight amount of concentrated fodder, usually bran.

The indoor system is viewed as a traditional system of maintenance. The sheep were kept in a sheep fold but they still could use a run. In the summer, they were fed with green forage consisting of grass mixture with Alfalfa, and with a slight amount hay and straw. In the winter, they were fed like the ewes kept on pasture, i.e. they received identical hay-silage, as well as hay and straw. During pregnancy and lactation, they were additionally given a slight amount of concentrated fodder, usually bran.

The mating of these two groups of ewes was carried out from the end of November through December; as a result of which lambing proceed by the end of April and in May.

In each research year, 10 ewes with a similar term of lambing were selected from each genotypic group and system of maintenance and then control milking was performed every 14 days. During lactation, the control milking session was carried five times, each time recording the hour of lamb disconnection, as well as the exact hour of milking performed. The milk obtained was then weighed and samples were collected to assess the chemical composition. The amount of milk obtained allowed for the 24-hour yield to be determined, which then served as the basis for determining the yield for 14 lactation days. The total yield in five consecutive periods corresponded to the yield for 70 lactation days. Based on the milk samples, the somatic cell content (SCC), as well as the percentage content of protein, lactose and fat in one millilitre of milk, were determined. A logarithmic transformation was additionally performed for the number of somatic cells (Ln SCC). The experimental procedure is shown in diagram.

The results obtained were statistically compiled using the multi-factor analysis of variance (SAS 2003) for the orthogonal data. The tables include the average values (x) and standard deviations (SD).



RESULTS AND DISCUSSION

A slightly higher 24-hour yield in the first control milking session was recorded for the ewes kept on pasture. In the next control milking session, the level of yield was equal. However, the ewes maintained indoors showed a higher yield in the fifth milking session, their 24-hour yield amounting to 1.89 kg, compared to 1.48 kg for the ewes kept on pasture (Tab. 1). The difference in the 24-hour yield between ewes maintained in the two systems under discussion turned out to be statistically significant. These results are supported in the research by Joy *et al*. [2008].

Lower somatic cell content in the milk obtained from the ewes kept on pasture was recorded in the first and second control milking session, while in the subsequent sessions the reverse situation occurred. The third milking session revealed a statistically significant difference between the two groups in question as regards the somatic cell content (Tab. 1). Tietze *et al*. [2001] found that the somatic cells content in the milk obtained from the ewes kept in the extensive system was lower.

The protein and lactose content in the milk was, in general, comparable in the two groups analysed. Only the first and second milking session indicated higher protein content in the milk obtained from the ewes kept on pasture. As regards the fat content, higher levels were observed in the ewes kept indoors (Table 2). The results obtained are consistent with those provided by Morand-Fehr *et al*. [2007], Joy *et al*. [2008] and Tsiplakou *et al*. [2008].

Based on the data shown in Figure 1, it transpires that the 24-hour yield depends not only on the system of maintenance, but that there are also noticeable differences between the genotypes. In terms of this feature, the PLS ewes kept on pasture outperformed the ewes kept indoors in the first four control milking sessions (Fig. 1). However, the content of the somatic cells recorded in the milk of these ewes was higher (Fig. 2). The BCP ewes kept on pasture indicated a higher 24-hour milk yield in the second to fifth milking sessions, compared with the ewes kept indoor (Fig. 1).

The 24-hour yield in the second to fourth milking sessions was higher in 2006 than in 2007, irrespective of the system of maintenance (Fig. 4). Also, the somatic cell content in milk recorded in 2006 was higher (Fig. 5).

Table 1. Test-day milk yield (in kg) and the somatic cells count (SCC) in the milk in successive control milking sessions dependent on the system of maintenance
Tabela 1. Wydajność dobowa (kg) i liczba komórek somatycznych w mleku w poszczególnych udojach kontrolnych w zależności od systemu utrzymania

Successive milking Kolejny udój	Traits Cechy	Maintenance system – System utrzymania			
		indoor – alkierz		pasture – pastwisko	
		mean – średnia	SD	mean – średnia	SD
1	test-day milk yield wydajność dobowa	2.87	1.13	3.20	1.29
	somatic cells count ($10^3 \cdot dm^{-3}$) liczba komórek somatycznych (Ln SCC)	462.3 4.78	1938.0 1.10	367.4 4.92	875.5 1.18
2	test-day milk yield wydajność dobowa	2.63	1.04	2.65	1.15
	somatic cells count ($10^3 \cdot dm^{-3}$) liczba komórek somatycznych (Ln SCC)	300.6 4.58	904.0 1.12	261.9 4.77	484.7 1.09
3	test-day milk yield wydajność dobowa	2.13	0.71	2.25	0.77
	somatic cells count ($10^3 \cdot dm^{-3}$) liczba komórek somatycznych (Ln SCC)	163.5^{x} 4.41^{xx}	439.0 0.85	666.7^{x} 5.40^{xx}	1218.7 1.38
4	test-day milk yield wydajność dobowa	1.71	0.65	1.73	0.80
	somatic cells count ($10^3 \cdot dm^{-3}$) liczba komórek somatycznych (Ln SCC)	319.9 5.03	521.1 1.05	449.7 4.92	1159.9 1.21
5	test-day milk yield wydajność dobowa	1.89^{xx}	0.87	1.48^{xx}	0.55
	somatic cells count ($10^3 \cdot dm^{-3}$) liczba komórek somatycznych (Ln SCC)	172.3 4.53	284.7 0.98	462.7 5.07	1233.6 1.14
Milk yield during 70 days of lactation Wydajność za 70 dni laktacji		157.1	48.1	158.4	51.7

^{x} $P \leq 0.05$, ^{xx} $P \leq 0.01$

Table 2. Chemical composition of the milk in successive control milking sessions dependent on the system of maintenance (in %)
Tabela 2. Skład chemiczny mleka w poszczególnych udojach kontrolnych w zależności od systemu utrzymania (%)

Successive milking Kolejny udój	Traits Cechy	Maintenance system – System utrzymania			
		indoor – alkierz		pasture – pastwisko	
		mean – średnia	SD	mean – średnia	SD
1	protein – białko	4.31^{xx}	0.35	4.77^{xx}	0.42
	lactose – laktoza	5.34^{xx}	0.28	5.52^{xx}	0.35
	fat – tłuszcz	6.32^{xx}	1.17	5.20^{xx}	1.29
2	protein – białko	4.68	0.41	4.60	0.59
	lactose – laktoza	5.64	0.30	5.66	0.31
	fat – tłuszcz	5.78	1.14	5.55	1.23
3	protein – białko	4.66^{xx}	0.50	4.99^{xx}	0.67
	lactose – laktoza	5.57^{xx}	0.23	5.14^{xx}	0.47
	fat – tłuszcz	6.38	1.07	6.25	1.25
4	protein – białko	4.83	0.61	4.76	0.50
	lactose – laktoza	5.39	0.19	5.32	0.22
	fat – tłuszcz	6.53	0.94	6.23	1.13
5	protein – białko	5.19	0.56	4.99	0.42
	lactose – laktoza	5.21	0.20	5.13	0.24
	fat – tłuszcz	6.80	1.03	6.56	1.12

^{xx} $P \leq 0.01$

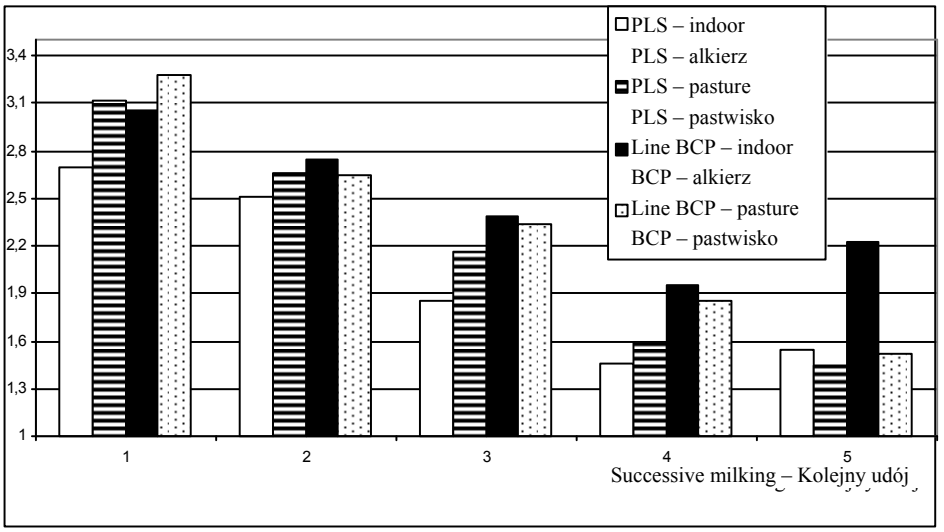


Fig. 1. Test-day milk yield of the ewes (in kg) dependent on the genotype and system of maintenance

Rys. 1. Wydajność dobowa mleka maciorek (kg) w zależności od genotypu i systemu utrzymania

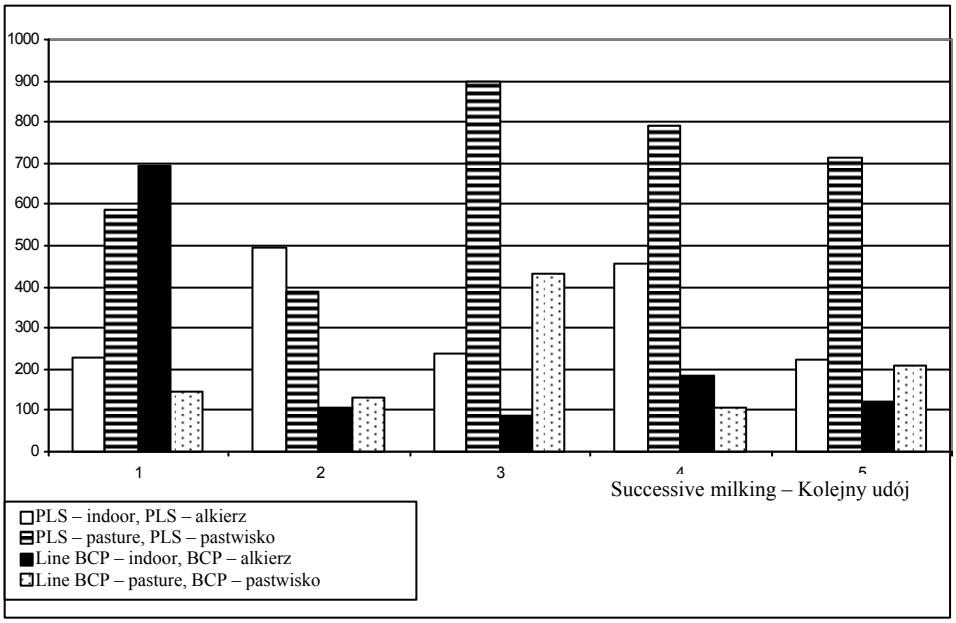


Fig. 2. The somatic cell count (SCC) in the ewes' milk dependent on the genotype and system of maintenance

Rys. 2. Liczba komórek somatycznych w mleku maciorek w zależności od genotypu i systemu utrzymania

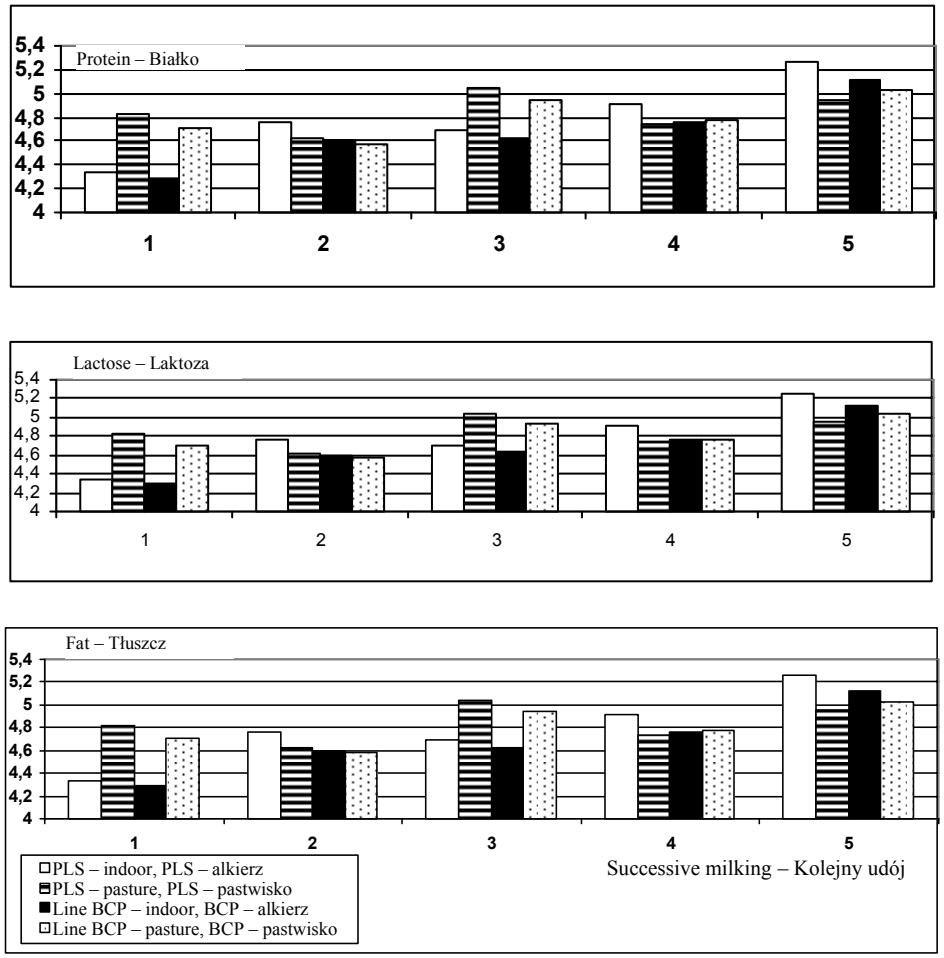


Fig. 3. Chemical composition of the ewes' milk (in %) dependent on the genotype and maintenance system

Rys. 3. Skład chemiczny mleka maciorek (%) w zależności od genotypu i systemu utrzymania

Irrespective of the ewe genotype, in the first control milking session the content of protein, lactose and fat observed in the milk obtained from the ewes kept indoors was low. Completely different results were obtained in the fifth milking session. At the same time, the data indicate that the content of protein, lactose and fat was slightly higher in the PON ewes' milk, especially in the group kept on pasture (Fig. 3). The protein content in the ewes' milk was generally higher in 2007, irrespective of the system of maintenance, which was observed especially in the third to fifth milking sessions (Fig. 6).

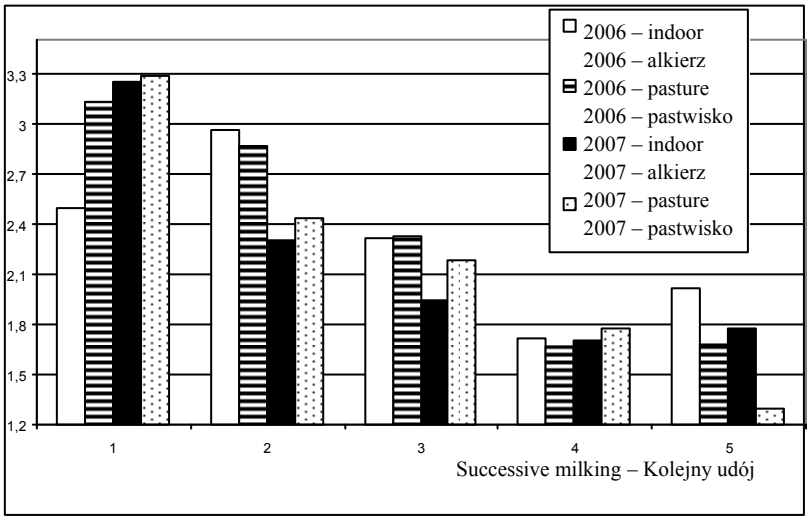


Fig. 4. Test-day milk yield of the ewes (in kg) dependent on the investigation year and system of maintenance
Rys. 4. Wydajność dobowa mleka maciorek w zależności od roku badań i systemu utrzymania

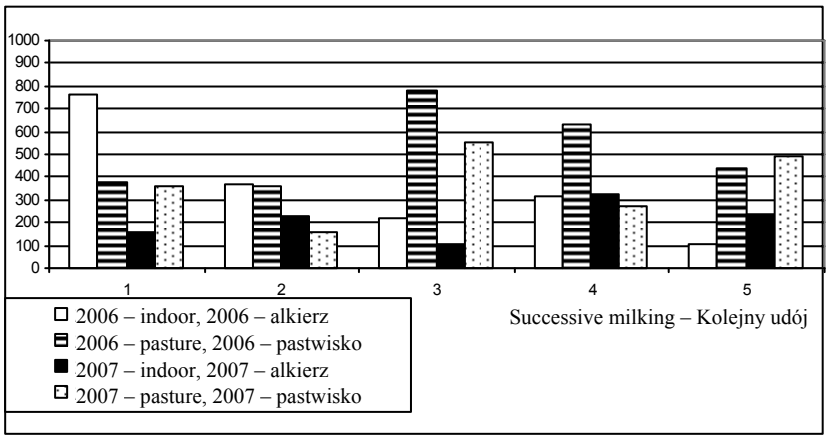


Fig. 5. The somatic cell count (SCC) in the ewes' milk dependent on the investigation year and system of maintenance
Rys. 5. Liczba komórek somatycznych w mleku maciorek w zależności od roku badań i systemu utrzymania

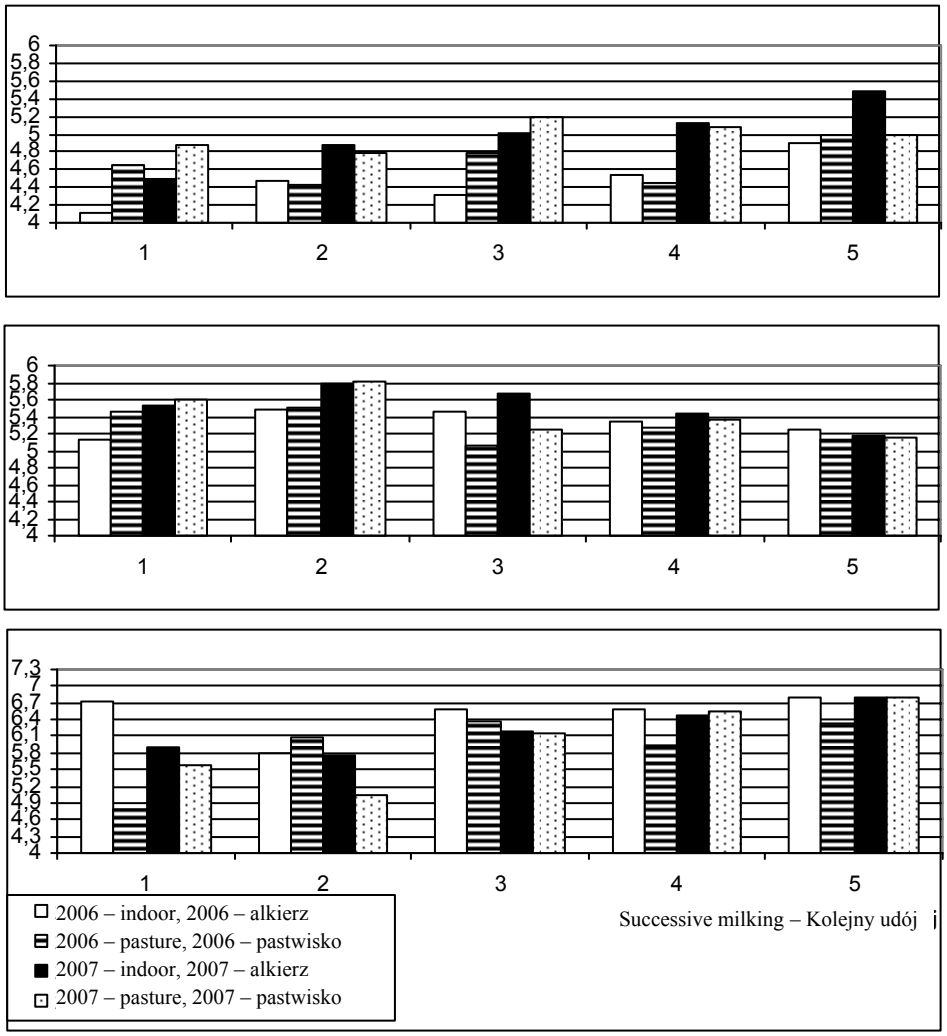


Fig. 6. Chemical composition of the ewes' milk (in %) dependent on the investigation year and system of maintenance
Rys. 6. Skład chemiczny mleka maciorek (%) w zależności od roku badań i systemu utrzymania

The ewes' milk yield for 70 lactation days was comparable, irrespective of the system of maintenance (Tab. 1). The highest milk yield was observed in the BCP ewes kept indoors, with the BCP ewes kept on pasture showing only a slightly lower yield. As regards the PLS ewes, a higher yield was recorded in those kept on pasture, compared to the ewes in the indoor system (Fig. 7). In the first research year (2006), the milk yield recorded was slightly higher than in the second one (2007), as shown in Fig. 8.

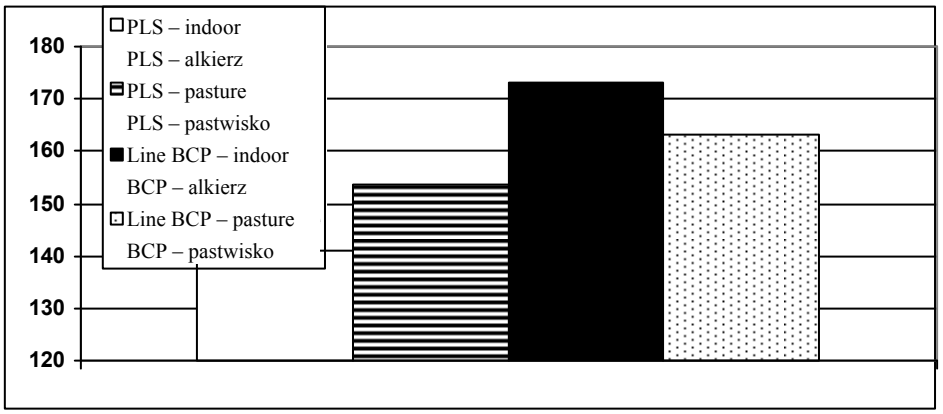


Fig. 7. The milk yield of the ewes (in kg) during 70 lactation days dependent on the genotype and system of maintenance
Rys. 7. Wydajność mleka maciorek (kg) za okres 70 dni laktacji w zależności od genotypu i systemu utrzymania

Fig. 8. The milk yield of the ewes (in kg) during 70 lactation days dependent on the investigation year and system of maintenance
Rys. 8. Wydajność mleka maciorek (kg) za okres 70 dni laktacji w zależności od roku badań i systemu utrzymania

According to Caroprese [2008], the system of maintenance exerts an influence not only on the productivity of animals, but also on their behaviour. Sheep, as ruminants, should have access to pasture. However, the yield and chemical content of the milk depends very much on the quality of the pasture.

CONCLUSIONS

1. Certain changes were observed in the 24-hour yield and in the chemical composition of milk obtained in subsequent control milking sessions from ewes kept in various systems of maintenance.

2. Higher somatic cell content was recorded in the groups of ewes with a higher 24-hour yield.

3. The PLS ewes which were kept on pasture, as opposed to the BCP ewes, were characterised by a higher 24-hour yield. This suggests that the PLS ewes are more predisposed to be kept on pasture.

4. The milk yield for 70 lactation days was comparable for the ewes kept in both systems under analysis.

Scientific study financed by science funds in 2005–2008 under the title of Project No. 2P06Z01029

REFERENCES

Caroprese M., 2008. Sheep housing and welfare. Small Rum. Res., 76, 21–25.

Gruszecki T., Szymanowska A., Lipecka C., Markiewicz J., 2002. Produkcyjność owiec utrzymywanych w warunkach chowu ekstensywnego. II. Obserwacje nad mlecznością maciorek. Annales UMCS, sec. EE, Zootechnica 20, 193–197.

Joy M., Alvarez-Rodriguez J., Revilla R., Delfam R., Ripoll G., 2008. Ewe metabolic performance and lamb carcass traits in pasture and concentrate-based production systems in Churra Tensina breed. Small Rum. Res. 75, 24–35.

Morand-Fehr P., Fedele V., Decandia M., Le Frileux Y., 2007. Influence of farming and feeding systems on composition and quality of goat and sheep milk. Small Rum. Res., 68, 20–34.

Niżnikowski R., 1994. Chów owiec. PWRiL, Warszawa.

Pakulski T., Osikowski M., Borys B., 1999. Badania nad wpływem sposobu utrzymania i genotypu owiec dojonych na jakość mleka. Zesz. Nauk. PTZ, 43, 219–227.

Pięta M., Patkowski K., 2001. Mleczność matek i wzrost jagniąt w zależności od zróżnicowanego żywienia w czasie laktacji. Annales UMCS, sec. EE, Zootechnica 19, 147–152.

Tietze M., Gruszecki T.M., Lipecka C., Szymanowska A, Markiewicz J., Bryll M., 2001. Level of selected biochemical indices in blood serum and health state of mammary glands in sheep under different environment systems. Arch. Tierz., 44, 219–223.

Tsiplakou E., Kominakis A., Zervas G., 2008. The interaction between breed and diet on CLA and fatty acids content of milk fat of four sheep breeds kept indoors or at grass. Small Rum. Res., 74 179–187.

Załuska J., Załuska K., 1978. Żywienie owiec. PWRiL, Warszawa.

Żebrowska K., Maciejewska K., Lipecka C., Gruszecki T., Szymanowski M.,1990. Wydajność i skład chemiczny mleka owiec nizinnych żywionych w okresie zaawansowanej ciąży i laktacji zróżnicowaną ilością kiszonki w dawce pokarmowej. Annales UMCS, sec. EE, Zootechnica, 8, 91–95.

Streszczenie. Badania wykonano w 2006 i 2007 r. na dwu genotypach owiec – PLS (polska owca nizinna) i linii syntetycznej BCP. Utrzymywane były w dwu systemach: alkierzowym oraz pastwiskowym. W systemie alkierzowym owce utrzymywano w budynku z dostępem do wybiegu, a w systemie pastwiskowym – przez cały rok na wolnym powietrzu, miały one jedynie dostęp do zadaszonej wiaty. Celem badań było określenie wpływu systemu utrzymania na wydajność mleczną i skład chemiczny mleka. Wyniki wskazują na zmiany w wydajności dobowej oraz składzie chemicznym mleka w kolejnych udojach kontrolnych maciorek utrzymywanych w różnych systemach. Wyższą zawartość komórek somatycznych notowano w grupach maciorek o wyższej wydajności dobowej. Stwierdzono, że maciorki PLS (polskiej owcy nizinnej) utrzymywane na pastwisku, w przeciwieństwie do maciorek BCP, miały wyższą wydajność dobową. Świadczy to o lepszym przystosowaniu maciorek PLS do utrzymania pastwiskowego. Wydajność mleka za okres 70 dni laktacji była zbliżona u maciorek utrzymywanych w analizowanych dwu systemach.

Słowa kluczowe: owce, system utrzymania, mleko, wydajność mleczna, komórki somatyczne, skład chemiczny mleka