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ORIGINAL PAPER

THE EFFECT OF THE MONTH OF LACTATION ON THE YIELD, PROXIMATE CHEMICAL COMPOSITION AND MINERAL CONTENT OF MILK FROM PRIMIPAROUS AND MULTIPAROUS COWS*

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Abstract

The experiment was performed on a herd of high-yielding Polish Holstein-Friesian (PHF) cows. The animals were housed in a free-stall barn. They were fed a PMR (partially mixed ration) and were milked twice daily using an automatic milking system. The aim of this study was to determine the yield, proximate chemical composition and mineral content of milk from high-producing primiparous and multiparous cows in successive months of 305-day lactation. Milk yield and the concentrations of fat, protein and selected minerals (potassium – K, sodium – Na, calcium – Ca, magnesium – Mg and zinc – Zn) were analyzed in 305-day lactation. In each month of lactation, older cows were characterized by significantly higher productivity – they reached the highest milk production level (peak yield) in the 2nd month of lactation (51.5 kg of milk), and still produced 26.5 kg of milk in the 10th month of lactation. Milk from multiparous cows had higher protein content than milk from primiparous cows. The average protein content of milk from primiparous cows was lowest (3.01%) in the 2nd month of lactation, and it increased to 3.59% in the 10th month of lactation. Milk fat content was higher in primiparous cows, and it increased from 3.94% (peak yield) to 4.75% in the 10th month of lactation. A wide range of changes in the content of the examined mineral components was noted. In each month of lactation in older cows higher Na and lower Mg content was noted. The low content of Ca in the milk of

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cows may have been caused by a higher productivity of the analyzed herd. Milk was sampled in successive months after calving during 305-day lactation (360 milk samples from primiparous cows and 840 milk samples from multiparous cows). Milk samples for chemical analyses of the mineral composition (K, Na, Ca, Mg and Zn) were collected individually from cows during test milking, by the classic method - AT_4 (Polish Federation… 2017). Data on daily milk yield and the proximate chemical composition of milk were acquired from RW-2 reports (result report from the milk performance assessment). Proximate chemical composition and the concentrations of selected minerals were analyzed in milk from primiparous (group I) and multiparous (group II) cows. The content of K, Na, Ca, Mg and Zn in milk was determined in analytical samples by wet mineralization with a mixture of nitric acid and hydrochloric acid conducted in a MARS microwave digestion system. Mineralized samples were assayed for the mineral content by *atomic emission spectrometry* (AES) and atomic absorption spectrometry (AAS). Concentrations of the analyzed minerals in milk were read out from calibration curves.

Key words: cows, lactation, milk yield, mineral content.

INTRODUCTION

Diets of dairy cows with high genetic potential have to satisfy basic nutritional needs as well as vitamin and mineral requirements of the animals (Nowak et al. 2003, Beerda et al. 2007). The composition, quality and functional properties of milk are influenced by numerous factors, including a cow's breed, nutritional regime, housing and management system, as well as the age and stage of lactation (Miciński, Klupczyński 2006, Miciński et al. 2013, Teke, Murat 2013, Sobotka et al. 2014). The mineral content of milk is highly variable, and it is directly influenced by the mineral composition of animal diets. Production systems and dietary regimes that are not adapted to the physiological needs of high-yielding cows contribute to metabolic diseases (Kolard et al. 2000, Gabryszuk et al. 2008). Diets deficient in vitamin A, beta-carotene and micronutrients compromise the mammary gland's function in cattle (Klebaniuk, Grela 2008). Dietary factors determine the animals' performance as well as the chemical composition and quality of milk (White et al. 2001) and meat (Pogorzelska et al. 2013). The feed intake of dairy cattle can be significantly improved by feeding a total mixed ration, TMR (Eastridge 2006).

Milk is a highly nutritious food and a rich source of nutrients promoting the growth and development in mammals. The first milk of cows (colostrum) also contains immunoglobulins (Ig) that stimulate the immune system of young calves (Wójcik et al. 2013). In addition to protein, fat and vitamins, milk also contains essential minerals (Scherz, Kirhoff 2006, Park et al. 2007, Barłowska 2008). Milk and dairy products are irreplaceable sources of calcium in a healthy, balanced diet (Barłowska et al. 2013, Jabłoński 2001). The key mineral components of milk, which are phosphorus (P) and calcium (Ca), are essential for bone growth and healthy development of infants (Al -Wabel 2008). Dietary magnesium (Mg), potassium (K), sodium (Na) and zinc (Zn) also play important roles in safeguarding the health of dairy cattle.

Magnesium is essential for many metabolic processes. It participates in signal transduction in nerve and muscle cells, it is involved in the depolarization of cell membranes, and it activates selected enzymes. Magnesium deficiency and impaired absorption in early lactation contribute to serious health problems such as grass tetany.

Calcium, P and Mg are the basic building blocks of teeth and bones. Calcium minimizes the risk of osteoporosis, hypertension, obesity, colorectal cancer and urolithiasis. Milk has the optimal Ca to P ratio for humans, and Ca contained in milk is characterized by high availability and physiological activity. Calcium regulates nerve impulses and muscle contraction, it participates in blood clotting and minimizes the risk of cardiovascular diseases. It activates selected enzymes, including lipase and ATPase (Rodriguez et al. 2001).

Magnesium, K and Na regulate osmotic pressure in blood capillaries and muscle function. Magnesium is essential for biochemical processes in cells. It activates more than 300 different enzymes and participates in many metabolic processes, such as glycolysis, Krebs cycle, β-oxidation and ion transport across cell membranes (Pasternak et al. 2010).

Zinc participates in the conversion of proteins, carbohydrates and nucleic acids, and it activates enzymes essential for immune function. It maintains the integrity of the keratin that lines streak canals in the mammary glands of cows, and Zn deficiency can indirectly increase somatic cell counts in milk (Whitaker et al. 1997). Zinc is an essential element for all living organisms. Zinc-binding proteins produce metalloproteins which are responsible for enzymatic activity in vertebrates. Zinc is an essential trace element for the growth, development and differentiation of cells, RNA (ribonucleic acid) transcription, DNA (deoxyribonucleic acid) synthesis, cell division and activation. Zinc deficiency during embryogenesis can compromise the immune system's function in developing organisms (Poulsen et al. 2010, Blum, Hammon 2000, Blum 2006). Zinc and copper (Cu) have antioxidant properties, and they neutralize harmful free radicals (Paunier 1992, Navarro et al. 1999, Scherz, Kirchhoff 2006). In addition to K and Mg, Zn and Cu are also required for healthy reproduction in cattle (Ahola et al. 2004, Whitaker et al. 1997). In Poland, the maximum concentration of zinc in whole milk has been set at 5 mg L^{-1} (Regulation of… 2003).

Aim of the study

The aim of this study was to determine the yield, proximate chemical composition and mineral content of milk from high-producing Polish Holstein-Friesian (PHF) primiparous and multiparous cows in successive months of 305-day lactation.

MATERIALS AND METHODS

The experiment was performed on a herd of high-yielding PHF Black-and-White cows. The animals were housed in a free-stall barn. They were fed a partially mixed ration (PMR) and were milked twice daily using an automatic milking system.

The PMR, formulated based on the nutrient requirements of dairy cattle (NRIAP-INRA 2014), was composed of grass silage, maize silage, soybean meal, rapeseed meal, vitamin and mineral supplements (Biocomplex), and fodder salt. The composition of PMR is presented in Table 1. Supplemental

Table 1

Composition of partially mixed ration

Item	(g kg^{-1} DM)
Ingredients PMR	
grass silage, 1st swath	426
grass silage, 2nd swath	161
maize silage	329
soybean meal*	44
rapeseed meal**	39.5
Biocomplex	0.37
Fodder salt	0.13
Analyzed composition	
DM (g kg^{-1} of wet weight)	429
OM	923
CP	157
NDF	508
ADF	294
Calculated energy (kg of DM)	
JPM	0.93
Mineral composition	
Ca	6.9
Ca/P	1.9
Mg	2.7
Na	2.1
K	20
K/Na	9.4

*, ** nutritional value according to the National Research Institute of Animal Production – INRA, 2014, PMR – partially mixed ration, DM – dry matter, OM – organic matter, CP – crude protein, NDF – neutral detergent fiber, ADF – acid detergent fiber, JPM –feed unit energy for lactation, Ca – calcium, Ca/P – calcium/phosphorus, Mg – magnesium, Na – sodium, K – potassium, K/Na – potassium/sodium

lactation diets were Krowimix 18 Blue (applied to cows of daily performance exceeding 40 kg of milk in a maximal dose of 8 kg/individual/day) and Lacto glucostart (applied to cows until the 80th day of lactation in a dose not exceeding 1 kg).

They were fed to primiparous and multiparous cows, and feeding levels were adjusted based on milk yield within each stage of lactation. The composition and nutritional value of diets are shown in Table 2.

Table 2

Composition and nutritional value of feed (kg DM)

Item	Feed				
	maize silage	grass silage, 1st swath	grass silage, 2nd swath	soybean meal	rapeseed meal
Dry Matter (g kg^{-1})	329	485	440	976	887
JPM	0.94	0.92	0.77	1.21	0.96
Crude protein	73	171	118	494	380
Crude ash	36	101	131	74	79
WSC	-	111	87	-	-
Starch	311	-	-	-	-
NDF	396	440	490	142	319
ADF	219	237	284	85	221
Crude fat	38	38	29	-	-
pH	4	5,1	5	-	-
Lactic acid	48	30	30	-	-
Acetic acid	17	11	7	-	-
Butyric acid	-	2.1	3.3	-	-
NH_3/total N (%)	7	9	12	-	-

JPM – feed unit energy for lactation, WSC – water-soluble carbohydrates, NDF – neutral detergent fiber, ADF – acid detergent fiber, NH_3 – ammonia, N – nitrogen

Milk was sampled in successive months after calving during 305-day lactation (360 milk samples from primiparous cows and 840 milk samples from multiparous cows). Milk samples for chemical analyses of mineral composition (K, Na, Ca, Mg and Zn) were collected individually from cows during test milking, by the classic method – AT_4 (Polish Federation… 2017). Data on daily milk yield and the proximate chemical composition of milk were acquired from RW-2 reports (result report from the milk performance assessment).

The proximate chemical composition and concentrations of selected minerals were analyzed in milk from primiparous (group I) and multiparous (group II) cows. The content of K, Na, Ca, Mg and Zn in milk was determined in analytical samples by wet mineralization with a mixture of nitric acid and hydrochloric acid, conducted in a MARS microwave digestion system. Mineralized samples were assayed for the mineral content by *atomic emission spectrometry* (AES) and atomic absorption spectrometry (AAS). The concentrations of the analyzed minerals in milk were read out from calibration curves.

The results were processed statistically using Statistica ver. 10 software (StatSoft 2010). The mean values of the analyzed parameters and traits (x) and standard deviations (SD) are given in the tables. The significance of differences between mean values in groups was determined by the Duncan's test.

RESULTS

The chemical composition of cow's milk may vary widely, depending on genetic (breed), environmental (nutrition, season) and physiological (stage of lactation, udder health) factors (Elgersma et al. 2004*a*, Arnold et al. 2013, Barłowska et al. 2013).

The yield and proximate chemical composition of milk were significantly influenced by the cows' age (Table 3). The average daily milk yield of primiparous cows varied from 35.4 kg (3rd month of lactation) to 25.5 kg (9th month of lactation), and the standard deviation (SD) ranged from 2.96 to 7.83 kg. In each month of lactation, older cows were characterized by significantly higher productivity, i.e. they reached the highest milk production level (peak yield) in the 2nd month of lactation (51.5 kg of milk), and still produced 26.5 kg of milk in the 10th month of lactation. Milk from multiparous cows had a higher protein content than milk from primiparous cows. The average protein content of milk from primiparous cows was the lowest (3.01%) in the 2nd month of lactation, and it increased to 3.59% in the 10th month of lactation. An identical trend was noted in multiparous cows, and the protein content of their milk was in a range of 3.15 to 3.93%. The milk fat content was higher in primiparous cows, and it increased from 3.94% (peak yield) to 4.75% in the 10th month of lactation. The fat content of milk from multiparous cows was the lowest between the 2nd and 4th months of lactation (3.73-3.88%). Towards the end of lactation, the milk fat content exceeded 4.5% also in multiparous cows.

In the present study, the urea content of milk ranged from 177 mg L^{-1} in the 1st month of lactation to 289 mg L^{-1} in the 7th month of lactation in primiparous cows, and from 212 mg L^{-1} in the 1st month of lactation to 278 mg L^{-1} in the 8th month of lactation in multiparous cows. No significant differences in milk urea levels were found between the groups (Table 3).

Over 305-day lactation, primiparopus cows produced a total of 9 285 kg of milk with 4.29% fat content and 3.34% protein content, and multiparous cows yielded 11 812 kg of milk with 4.11% fat content and 3.44% protein content. The above results considerably exceed the values reported for PHF cows enrolled in a milk recording program in Poland in 2016, which reached 8 055 kg of milk, 4.09% of milk fat and 3.36% of milk protein (PFCBDF 2017).

The high yields of milk, milk protein and milk fat noted in our study resulted not only from the high breeding value of cows (Jończyk 2011) but also from the feeding regime which maximized the intake of high-quality feed (Tables 1, 2), meeting the nutrient requirements of high-yielding cows. Primiparous cows produced a total of 9 285 kg of milk during 305-day lactation, and their average age at first calving was 24 months. In a study by Ettema and Santos (2004), the highest economic return was achieved in Holstein heifers that first calved between 23 and 24.5 months of age.

Table 3

Daily yield and chemical composition of milk from primiparous (I) and multiparous (II) cows in successive months of lactation ($x \pm SD$)

Month of lactation	Milk (kg)		Dry matter (%)		Fat (%)		Protein (%)		Urea (mg L^{-1})	
	I	II	I	II	I	II	I	II	I	II
1	29.7 ± 5.56	43.9 ± 4.76^{xx}	13.60 ± 0.89	13.15 ± 0.96	4.75 ± 0.81^{x}	4.41 ± 0.89	3.17 ± 0.22	3.27 ± 0.29	177 ± 62	212 ± 65
2	31.5 ± 7.59	51.5 ± 7.73^{xx}	12.83 ± 0.69	12.52 ± 1.11	4.14 ± 0.65^{x}	3.81 ± 0.84	3.01 ± 0.28	3.15 ± 0.36	214 ± 49	220 ± 67
3	35.4 ± 5.73	44.8 ± 4.34^{x}	12.84 ± 0.84	12.57 ± 0.65	3.94 ± 0.67	3.80 ± 0.49	3.22 ± 0.26	3.18 ± 0.24	241 ± 69	270 ± 43
4	31.5 ± 5.44	42.2 ± 4.53^{x}	12.91 ± 0.72	12.60 ± 0.86	3.97 ± 0.65	3.88 ± 0.83	3.31 ± 0.22	3.23 ± 0.15	259 ± 64	252 ± 58
5	31.5 ± 3.89	39.3 ± 2.97^{x}	12.89 ± 0.65	12.48 ± 0.87	4.00 ± 0.49	3.73 ± 0.62	3.32 ± 0.24	3.28 ± 0.26	268 ± 44	252 ± 49
6	29.8 ± 5.14	37.2 ± 5.58	13.17 ± 1.01	12.86 ± 0.62	4.24 ± 0.84	4.02 ± 0.56	3.37 ± 0.28	3.45 ± 0.22	267 ± 44	278 ± 68
7	29.9 ± 4.25	34.7 ± 5.30	12.21 ± 0.63	13.00 ± 0.77	4.21 ± 0.50	4.03 ± 0.55	3.44 ± 0.24	3.57 ± 0.29	289 ± 34	256 ± 59
8	28.6 ± 4.74	32.5 ± 5.47	13.53 ± 0.87	13.53 ± 0.93	4.51 ± 0.77	4.53 ± 0.85	3.48 ± 0.29	3.64 ± 0.22	281 ± 45	278 ± 46
9	25.5 ± 7.83	25.0 ± 7.13	13.52 ± 1.28	13.70 ± 0.93	4.48 ± 1.22	4.52 ± 0.69	3.55 ± 0.26	3.78 ± 0.30^{x}	271 ± 40	274 ± 60
10	26.9 ± 2.96	26.5 ± 10.1	13.78 ± 0.78	13.70 ± 0.69	4.71 ± 0.68^{x}	4.33 ± 0.43	3.59 ± 0.35	3.93 ± 0.30^{x}	255 ± 55	271 ± 57

Significant differences between primiparous and multiparous cows, within rows: xx – $p \leq 0.01$; x – $p \leq 0.05$

$x \pm SD$ – standard deviation of the mean

According to Teke and Murat (2013), the optimum age at first calving for the maximum first lactation milk yield and the maximum lifetime milk yield is 23 months. In the current study, total milk yield over 305-day lactation was 2527 kg higher in multiparous cows than in primiparous cows, which was due to the high breeding value of the analyzed herd (Jończyk 2011).

Table 4 presents the average content of selected minerals in milk from primiparous and multiparous cows in successive months of lactation. The concentrations of minerals in milk, excluding Ca, remained within the normal physiological ranges (Król et al. 2006, Gustafson et al. 2007).

The average K content of milk over 305-day lactation was 166 mg 100 g^{-1} in primiparous cows, and 156 mg 100 g^{-1} in multiparous cows. Until 6 months of lactation, K levels in milk from primiparous cows varied from 165 to

Table 4

Average content of selected minerals in milk (mg 100 g) from primiparous (I) and multiparous (II) cows in successive months of lactation (x ± SD)

Month of lactation	Group of cows	K	Na	Ca	Mg	Zn
1	I II	165 ± 31 153 ± 14	34 ± 5.5 41 ± 6.7	87 ± 12.7^x 80 ± 10.5	8.9 ± 2.6 8.8 ± 1.6	0.50 ± 0.07 0.49 ± 0.06
2	I II	170 ± 27 153 ± 16	34 ± 3.7 38 ± 12.9	70 ± 11.6 67 ± 13.8	9.3 ± 2.2^x 8.5 ± 1.6	0.45 ± 1.00 0.35 ± 0.08
3	I II	175 ± 39 161 ± 18	31 ± 4.5 39 ± 10.2	69 ± 9.5 69 ± 15.0	8.8 ± 1.0 8.3 ± 1.5	0.42 ± 0.06 0.38 ± 0.09
4	I II	173 ± 27 162 ± 23	37 ± 10.6 40 ± 10.6	72 ± 9.1 70 ± 11.6	10.1 ± 1.6^x 8.1 ± 1.5	0.44 ± 0.06 0.40 ± 0.07
5	I II	175 ± 36 158 ± 13	33 ± 7.0 38 ± 6.4	78 ± 19.3 73 ± 13.6	10.5 ± 1.5^x 8.9 ± 0.9	0.42 ± 0.09 0.37 ± 0.07
6	I II	171 ± 25 156 ± 21	32 ± 3.8 43 ± 7.0	84 ± 14.6^x 75 ± 7.6	10.6 ± 1.4^x 8.9 ± 1.2	0.40 ± 0.10 0.38 ± 0.05
7	I II	158 ± 24 160 ± 15	34 ± 3.0 43 ± 9.9^x	80 ± 15.4 76 ± 13.1	10.8 ± 1.4 9.8 ± 1.3	0.40 ± 0.08 0.38 ± 0.07
8	I II	167 ± 31 161 ± 26	36 ± 5.7 47 ± 15.6	72 ± 11.1 73 ± 11.3	10.6 ± 1.6^x 8.5 ± 1.2	0.39 ± 1.00 0.39 ± 0.06
9	I II	156 ± 20 157 ± 20	35 ± 5.7 43 ± 11.8	77 ± 12.3 81 ± 9.9	10.5 ± 1.7 9.4 ± 1.7	0.43 ± 0.10 0.47 ± 0.09
10	I II	153 ± 31 142 ± 31	33 ± 4.5 53 ± 14.7^x	86 ± 22.1^x 74 ± 8.8	10.8 ± 1.7 9.5 ± 1.5	0.42 ± 0.09 0.38 ± 0.07
Mean for 305-day lactation	I II	166 ± 28 156 ± 29	34 ± 4.2 43 ± 9.3	77 ± 13.8^x 74 ± 8.4	10.1 ± 1.6^x 8.9 ± 1.4	0.44 ± 0.09 0.40 ± 0.09

Significant differences between primiparous and multiparous cows, within columns: xx – $p \le 0.01$; x – $p \le 0.05$;
x ± SD – standard deviation of the mean

175 mg 100 g^{-1}. In the second half of the lactation period, the K content of milk decreased by approximately 20 mg 100 g^{-1}. In each month of lactation, multiparous cows were characterized by lower K concentrations in milk. Until 9 months of lactation, the K content of milk in multiparous cows ranged from 153 to 162 mg 100 g^{-1}, and it decreased to 142 mg 100 g^{-1} in the last month of lactation. According to the literature data, milk K levels may vary within a wide range. Our results are consistent with the findings of Pisulewski et al. (1997) and Kuczyńska et al. (2009), and considerably exceed the values reported by Król et al. (2010), where the K content of milk from intensively fed cows reached 115.95 mg 100 g^{-1}. According to Schonewille et al. (1999), silage made from grass harvested from intensively fertilized pastures is usually rich in K. In a study by Gabryszuk et al. (2008), the K content of milk from intensively fed cows was 89.5 mg 100 g^{-1}.

In each month of lactation, the Na content of milk was higher in multiparous cows (38 to 53 mg 100 g^{-1}) than in primiparous cows (31 to 37 mg 100 g^{-1}). The highest difference in milk Na levels between the groups was observed in the 10th month of lactation when the Na content of milk was 20 mg higher in multiparous cows. Milk Na levels in multiparous cows noted in our experiment are comparable with ones reported by Gabryszuk et al. (2008), where the Na content of milk reached 47.4 mg 100 g^{-1} in an intensive production system. The low concentrations of Na in milk from primiparous cows throughout lactation are difficult to explain.

The Ca content of milk from primiparous and multiparous cows differed from the values reported by other authors (Arnold et al. 2013, Barłowska et al. 2013, Kuczyńska et al. 2009), most likely due to the fact than milk Ca levels may vary widely depending on numerous factors (Arnold et al. 2013, Elgersma et al. 2004). Over 305- day lactation, the Ca content of milk was determined at 77 mg 100 g^{-1} in primiparous cows and at 74 mg 100 g^{-1} in multiparous cows. The highest milk Ca levels were noted in the first and last month of lactation in primiparous cows, and in the first and 9th month of lactation in multiparous cows. In the above months, the Ca content of milk exceeded 80 mg 100 g^{-1} in both groups. A relatively low concentration of Ca in milk (93.45 mg 100 g^{-1}) was reported by Król et al. (2010). The cited authors compared the milk Ca content during summer (pasture) and winter feeding periods, and found that it was 22 mg 100 g^{-1} lower in winter. The concentrations of minerals in feed have a significant effect on the mineral composition of milk (Gustafson et al. 2007).

Over 305-day lactation, the average Mg content of milk was somewhat higher in primiparous cows (10.1 mg 100 g^{-1}) than in multiparous cows (8.9 mg 100 g^{-1}). The Mg content of milk was lower in multiparous cows in each month of lactation.

Zinc was another microelement analyzed in the study. Zinc is a heavy metal that can exert adverse health effects in humans and animals when the maximum tolerable *amounts* are *exceeded.* The Zn content of milk from primiparous and multiparous cows did not exceed the maximum permissible limit throughout lactation. It was only in the 1st month after calving that the Zn content was close to the threshold value, reaching 0.5 mg 100 g^{-1} in milk from primiparous cows and 0.49 mg 100 g^{-1} in milk from multiparous cows. In the remaining months of lactation, the Zn content of milk was lower in multiparous cows than in primiparous cows.

In a study by Park et al. (2007), the mineral content of cow's milk (mg 100 g^{-1}) was as follows: Ca – 122, K – 152, Mg – 12, Na – 58, Zn – 0.53. According to Arnold et al. (2013), cow's milk should contain (mg 100 g^{-1}) 47 Na, 132 K and 113 Ca. Concentrations of selected minerals of cow's milk reported by other authors are presented in Table 5.

Table 5

Concentrations of selected minerals in cow's milk reported by others (mg 100 g^{-1})

References	K	Na	Ca	Mg	Zn
Barłowska et al. (2013)	108.8-112.4	30.9-40.2	85.9-101	12.4-12.7	0.56-0.80
Kuczyńska et al.(2009)	139-152	49	118-120	12-13.4	0.38
Pisulewski et al. (1997)	158	43	120	11	0.39
Król et al. (2010)	115.9	42.4	93.4	11.7	0.48
Cerbulis and Farrell (1976)	-	-	125	11.1	-

CONCLUSIONS

1. During 305-day lactation, primiparous and multiparous cows produced 9 285 kg and 11 812 kg of milk, respectively. In each month of lactation, older cows were characterized by significantly higher productivity, i.e. they reached the highest milk production level (peak yield) in the 2nd month of lactation (51.5 kg of milk), and still produced 26.5 kg of milk in the 10th month of lactation.

2. Milk from multiparous cows had a higher protein content than milk from primiparous cows. The average protein content of milk from primiparous cows was lowest (3.01%) in the 2nd month of lactation, and it increased to 3.59% in the 10th month of lactation. Milk fat content was higher in primiparous cows, and it increased from 3.94% (peak yield) to 4.75% in the 10th month of lactation.

3. A wide range of changes in the content of the examined mineral components was noted. Higher Na and lower Mg content was noted In each month of lactation in older cows. The low content of Ca in the milk of cows may have been caused by the higher productivity of the analyzed herd.

The results of this study indicate that the yield, proximate chemical composition and mineral content of milk are significantly influenced by the cows' age and the month of 305-day lactation.

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