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PHENOTYPE VARIABILITY OF BASIC COMPONENTS OF COW`S MILK IN CONVENTIONAL CONDITIONS OF PRODUCTION

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Abstract

Aim of this research was to estimate the variability of basic components of cow`s raw milk (dry mater, proteins, milk fat, lactose and mineral maters) during four seasons (winter, spring, summer and autumn) and two milking terms (morning and evening milking). Total number of analyzed samples was 1568 (784 samples from morning and evening milking, and 196 samples for each season) from seven conventional farms that were uniform according to the breed, housing, diet and healthcare. By statistical data processing it has been established that season and milking time very significantly influenced the share of basic milk components, while interactive influence of mentioned factors was not same for all components. Milk collected in the evening was richer in dry mater without fat (8.61%), proteins (3.27%), milk fat (3.66%) and lactose (4.58%) compared to the milk collected in the morning which had 8.55%; 3.23%; 3.59%; 4.56% respectively for all components above mentioned. Based on what is quoted above we have concluded that quantitative variability of milk components is expressed during season and depends on milking term.

Keywords: *raw milk, season, morning, evening, milking*

Introduction

Milk as one of the basic products of cattle breeding belongs to nutritional products of high biological value which is used in human diet. Nutritional value of milk depends above all, on the content of its basic components, the proteins, milk fat, lactose, mineral maters. These compounds together represent the dry mater (DM) of the milk. Amount of DM of the milk decreases at spring and it touches its maximum during winter period (Ostojić, 2007). Similar state is with proteins and milk fat, while mineral maters are equally distributed throughout the year. Same author points out to relatively constant content of lactose in the milk throughout the year, with slight increase of the content during spring and summer. Ozrenk and Selcuk Inci, (2008). have established by chemical analysis that during winter period content of DM, proteins and milk fat is increased compared to summer content. Moreover they quote that amount of dry mater without fat (DMWF) and mineral matter content is increased in the milk produced during summer period. Jež *et al.* (2011) quote that seasonal variability of the chemical composition of the milk is the consequence of joint influence of several factors, especially diet, lactation phase and susceptibility to diseases, which vary throughout the year. Above mentioned authors researched the influence of the season to the milk quality and established that milk produced in autumn period has richest content of proteins, milk fat and dry mater without fat (DMWF), and that least amount of these components is in milk produced in warmer period of the year (spring/summer). Milk chemical composition is different also depending on milking time. According to research by Buenger *et al*. (2002), milk drawn in the evening is richer in proteins and milk fat. Similar

tendencies are present with goat milk, which has been partially proven in the research by Kastelic and Kompman (2006). These authors researched quality of goat milk taken in the morning and evening and found that milk that has been taken in the evening contains statistically very significantly higher amount of milk fat, proteins, lactose, DM and DMWF. Ostojić (2007) points out at the differences in milk chemical composition between morning and evening milking, with increase of milk fat by 0.5-0.8% and proteins by 0.2% in the evening milk, which is partially influenced by time interval between two milking. In agreement with this, Chládek *et al.* (2011) have concluded that when milking interval is 11 and 13h milk drawn in the evening is richer in chemical composition, but that with change of milking interval to 10 and 14h presence of milk fat in evening milk is insignificantly lower.

According to the literature review (Ostojić 2007, Ozrenk and Selcuk Inci 2008, Buenger *et al* 2002, Chládek *et al* 2011) it could be note that content of basic milk components and its chemical composition is changeable under influence of many factors. In this research we have examined the influence of season and milking timings (morning and evening milking) in the conditions which are present on conventional farms in Serbia. Another contribution of the conducted research lies in the fact that we have perceived the variability of the milk chemical composition from the point of interactive influence of researched factors.

Material and methods

In this assay result of the influence of the season and milking term on chemical composition of the milk and interaction of these two factors is shown. This analysis included samples of collected milk produced in spring (March 21st-June 22nd), summer (June 22nd – September 23th), autumn (September 23th – December 22nd) and winter (December 22nd-March 21st) period of the year, with equal sample amounts of morning and evening milking. From total number of 1568 samples 784 were taken after morning milking (196 samples per season) and same number after evening milking. Research was conducted on collected milk from seven big dairy farms (Mladost, Lepusnica, Pionir, P. prelaz, Kovilovo, Padinska skela and Dunavac, all from Serbia) where black and white cattle is being held with high intake of Holstein Frisian breed genes, they were uniform concerning conditions, diet and healthcare.

Milk chemical composition (proteins, milk fat, lactose and DMWF) was determined by spectrophotometric method in infra red area of radiation, and by instrumental method on Milkoscan S 50, amount of certain milk components is expressed in percents. Amount of mineral maters (ash) was calculated as difference between DMWF, lactose and proteins (% ashes = % DMWF - % laktose - % proteins).

Statistic data rendering was done by standard statistic methods *(Latinović, 1996)* and software package STATISTICA 5.5, Stat.Soft,Inc was used.

Results and discussion

Average chemical composition of the researched milk and parameters of descriptive statistics for entire analyzed period and both milking terms are given in table1.

Table1. Average chemical composition and variability of milk components

Component	Statistic parameters					
	n	$\bar{x}$	SD	Cv (%)	min	max
M.fat (%)	1568	3.62	0.22	6.19	2.87	4.48
Proteins (%)	1568	3.25	0.14	4.40	2.73	3.72
Lactose (%)	1568	4.57	0.07	1.53	4.00	4.74
Minerals (%)	1568	0.76	0.03	3.94	0.66	0.86
DMWF (%)	1568	8.58	0.15	1.77	7.48	8.98

By analysis of average values of certain components it is evident that milk fulfills conditions given in the Rule book (Gazette of RS, No. 21/2009), special reference to the amount of milk fat, proteins and DMWF. Greatest variability is present in amount of milk fat (Cv=6.19%), which is in accordance with research by Ostojić (2007). This author cites that milk fat is the most variable component of the milk, so that is the reason why DMWF term was included, as its composition is more representative indicator of the milk quality. Value of the standard deviation (SD) for amount of milk fat and proteins in milk is significantly lower than what Bouloc *et al.* (2002) concluded in their research, which can be consequence of the cattle influence. The above mentioned authors researched the chemical composition of the milk from totally 27933 cattle and established SD for milk fat content of 0.74 and 0.38 for protein content, from which the conclusion that variability of milk composition is more expressed on single cattle level than on collected milk. Least variability was expressed for lactose contents. This component shows least oscillations concerning quantity, depending on the year, season and lactation period respectively (Ostojić, 2007).

Considering the season when milk was produced, it had different amount of certain components (table 2). Season as one of the analyzed factors had statistically very significant influence ($p<0.001$) on milk chemical composition.

Table 2. Average chemical composition of the milk per season

season / component	Winter			Spring			Summer			Autumn		
	N	$\bar{x}$	SD	n	$\bar{x}$	SD	n	$\bar{x}$	SD	n	$\bar{x}$	SD
M.fat(%)	392	3.80	0.18	392	3.54	0.19	392	3.51	0.23	392	3.64	0.18
Proteins (%)	392	3.26	0.10	392	3.23	0.13	392	3.15	0.13	392	3.35	0.14
Lactose (%)	392	4.53	0.06	392	4.62	0.05	392	4.56	0.07	392	4.56	0.07
Minerals (%)	392	0.75	0.03	392	0.74	0.02	392	0.77	0.02	392	0.78	0.03
DMWF (%)	392	8.54	0.11	392	8.59	0.12	392	8.48	0.14	392	8.68	0.15

Influence of the season on the amount of milk fat was statistically very significant ($p<0.001$), to the similar conclusion *Botaro et al. (2008)* came to. Highest difference in amount of milk fat (0.29%) was noted between milk produced in winter and summer period ($p<0.001$), which is in accordance with research by Ozrenk and Selcuk Inci (2008) and Jež *et al*.(2011). Moreover, significant differences in amount of milk fat were noted in dependence of the milking term (figure 1). Therefore, milk taken in the evening had higher amount of milk fat compared to milk taken in the morning ($p<0.001$). Similar tendencies, with little less variability (Cv 3.07-4.18%), was present for the protein amount, where greatest difference (0.20%) was noted between milk produced in autumn and summer period of the year ($p<0.001$). Congruence in changes of amounts of the milk fat and proteins during the season and in dependence of the milking term is consequence of very positive correlation of this two milk components (Ozrenk and Selcuk Inci, 2008), because the increase of the amount of milk fat contents was followed by the increase of the protein content in the milk. Interaction of the analyzed factors (season x milking term) have not expressed any influence ($p>0.05$) on the milk fat and protein contents in milk (figure 1).

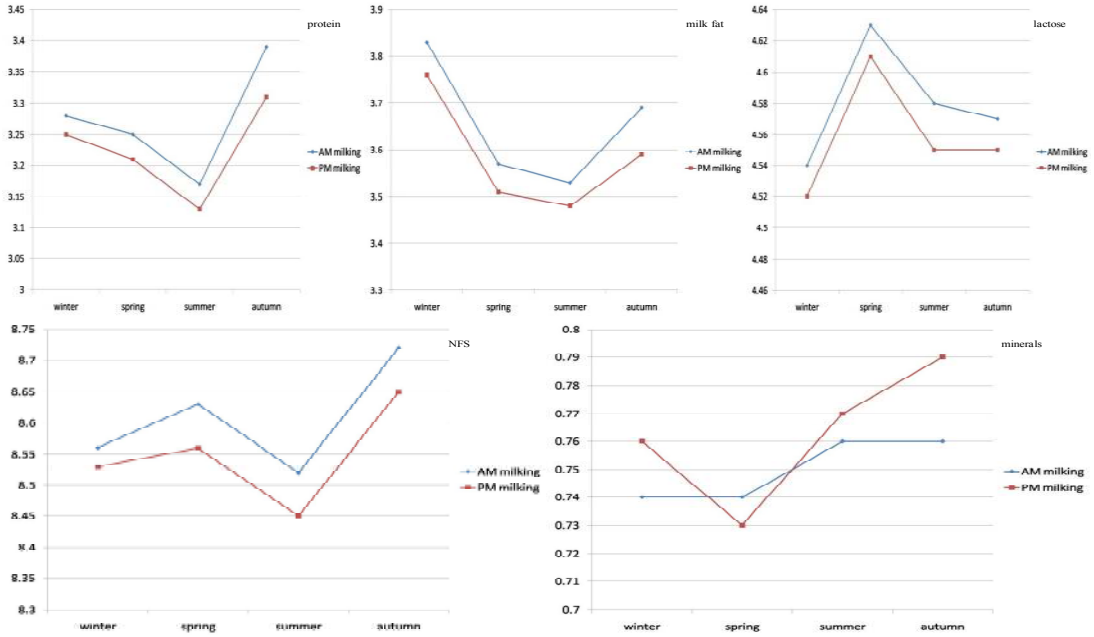

Figure 1 Variability of chemical composition of the milk depending on season and milking term

Lactose content was relatively constant throughout the year (table 2), with slight increase during spring season which is in accordance to research by Ostojić, 2007. Milk produced during the spring season had more lactose compared to other three seasons, and differences were significant at the 99% level. The milking term did not have any effect on the amount of lactose in the milk, even though the evening milk was richer with lactose. Difference of the evening and morning lactose level was not statistically significant ($p>0.05$). Milk produced in the autumn period is characterized by the highest amount of DMWF (table 2), and difference compared to other three seasons is statistically very highly significant ($p<0.001$). Moreover, milking term has expressed influence at the amount of DMWF, and milk collected in the evening had significantly higher ($p<0.01$) amount of above mentioned components, while interactive influence of the season and milking term was not significant (figure 1). The only milk component which was influenced by the interaction of these two factors is mineral maters. This result, however, should be accepted with reserve considering the ways of calculating the amount of mineral maters.

Conclusion

Analyzing the results given in this assay, it can be concluded that there is variability of the milk basic components depending on season and milking term, which is in accordance with data from literature. Season influence manifests by increase of proteins, milk fat and DMWF in autumn/winter period compared to spring/summer period. Evening milk is characterized with richer chemical composition, the increased amount of basic milk components compared to the morning milk, while interactive influence of the researched factors was not expressed on analyzed milk components.

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