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Composition and properties of mare's milk of Croatian Coldblood horse breed

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Abstract

Mare's milk has always been appreciated due to its medicinal properties for which it has been more and more used in food, cosmetic and pharmaceutical industry and as a replacement for human milk in the diet of newborns. The aim of this study was to establish the chemical composition, physical properties and hygienic quality of mare's milk of C*roatian Coldblood horse* breed. On the average, mare's milk contained: 10.2 % total solids, 1.23 % milk fat, 1.76 % proteins, 0.71 % casein and 6.26 % lactose. The average pH value was 7.0, titratable acidity 2.51 °SH and freezing point -0.5318 °C. The total bacterial count was less than 58.000/mL and the somatic cell count $47x10^3$/mL. The mare's udder volume, environmental conditions and the presence of a foal (without a physical contact) showed a significant effect on the milk secretion. Based on the obtained results, criteria of physical-chemical and hygienic parameters of mare's milk quality could be suggested. Possibilities of using the milk of C*roatian coldblood* horse breed are numerous, but until now it has almost not been used in Croatia due to the lack of information and knowledge of potential customers.

Key words: mare's milk, albumin milk, chemical composition, physical properties, hygienic quality

Introduction

The lactation of a mare starts by colostrum secretion during the first seven days after birth, when the composition of milk changes regarding the quantity and content of certain nutritive elements and lasts until weaning of foals at the age of 5 to 8 months (Ivanković, 2004). The limiting factor in manufacturing of mare's milk is small volume of a mammary gland (<2 L), which requires several daily milkings (5-7 times/day) distributed in intervals from 2 to 3 h (Salimei, 2011).

Lipids in mare's milk are emulsified in a form of fat globules with an average diameter of 2-3 μm (Welsch et al., 1988). Doreau and Martuzzi (2006) stated that the content of milk fat in mare's milk is quite low and decreases during the lactation period, from the initial 15-25 g/kg to 5-15 g/kg at the end of lactation. In comparison to human milk, lipids of mare's milk contain less triacylglycerol, about 80 % (Jensen et al., 1992) but more phospholipids (about 5 %) and free fatty acids (about 9 %). Additionally, when compared to human milk phospholipids of mare's milk contain more phosphatidylethanolamine (31 %) and phosphatidylserine (16 %), but less phosphatidylcholine (19 %) (Jensen et al., 1990). Mare's milk contains more sterols than human and cow's milk, while sterol fractions of mare's, human and cow's milk consist partly of cholesterol (Jensen et al., 1990).

Significant differences were determined between the quantity and composition of mare's and cow's milk casein. Mare's milk belongs to the group of albumin milk, since it contains about 50 % of casein and about 39 % of whey protein, while cow's milk contains about 80 % of casein. The basic whey

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proteins in mare's milk are β-lactoglobulin (β-Lg), α-lactalbumin (α-La), immunoglobulins (Ig), blood serum albumins, lactoferrin (LF) and lysozyme (Lyz) (Bell et al., 1981). Whey proteins differ among certain types of milk. In comparison to cow's milk, mare's milk contains less β-Lg and more α-La and Ig. Due to the high content of milk serum proteins, mare's milk is a rich source of essential aminoacids and is suitable for food nutrition (Malacarne et al., 2002). Whey proteins are sensitive to denaturation by heat action. β-lactoglobulin and α-lactalbumin in mare's milk are more stable at higher temperatures unlike these proteins in cow's milk (Bonomi et al., 1994). Casein of most types of milk consists of four genetic fractions: α_{s1}, α_{s2}, β and κ-casein, out of which the first three are sensitive to calcium. It can be found in milk in a form of casein micelles, which are the source of aminoacids, calcium, phosphate and bioactive peptides for foals (Shekar et al., 2006).

Non-protein nitrogen (NPN) in mare's milk consists of urea, peptides, aminoacids and ammonium. Out of the total nitrogen in mare's milk, 10-15 % goes to NPN (Walstra et al., 2006) and is increased by less than 2 % during birth and by more than 10 % in the first two weeks after birth (Zicker and Lönnerdal, 1994).

The content of lactose in mare's and human milk is very similar and is higher than the content in the ruminant's milk, which indicates a great similarity between mare's and human milk (Potočnik et al., 2011). Mare's milk is rich in lactose (64 g/kg) (Di Cagno et al., 2004), and since most of the population in Asia suffers from lactose malabsorption, mare's milk is mostly used as fermented milk, called *kumis* (Eastern Europe), *airag* (Mongolia) or *chigee* (Mongolia, China). During fermentation, lactose ferments into milk acid, ethanol and carbon dioxide and milk becomes accessible source of food for people intolerant to lactose.

The density of mare's colostrum is higher than that of mare's milk (1028 to 1035 kg/m^3) primarily due to significantly higher protein content (Uniacke-Lowe, 2011). Density is the highest immediately after birth and rapidly decreases during the first 12 hours.

Some authors emphasised considerable changes in pH value of mare's milk. Mariani et al., (2001) mentioned that pH value of mare's milk increases from 6.6 (4 days after birth) to 6.9 (after 20 days) i.e. 7.1 (180th day after birth). Kücükcetin et al., (2003) quoted the value of 7.0 as an average pH value of mare's milk, while Pagliarini et al., (1993) mentioned pH value of 7.2. Variable pH values are probably the result of different contents of protein and salt concentrations.

Freezing point of milk is directly connected to the concentration of water-soluble substances. Fat globules and proteins do not affect the freezing point, while lactose and minerals have the main influence. Freezing point of mare's milk is -0.554 °C (Pagliarini et al., 1993). Lower freezing point of mare's milk probably refers to its higher lactose content. In comparison to cow's milk, mare's milk has higher pH value (7.1-7.3), and lower freezing point (-0.525 °C).

There are numerous criteria for the evaluation of hygienic quality of milk, i.e. use of milk and dairy products as food. The total bacterial count and somatic cells count in milk are accepted as most efficient hygienic criteria at the national and international level. All hygienic criteria are based on principles of health preservation of human population (Samaržija, 2011).

Mare's milk is usually of a very good microbiological quality and has a low somatic cells count probably due to the rather small udder and a low number (only two) of teats. Therefore, it is much less exposed to possible infections and consequentially to mastitis.

Microflora which can be found in mare's milk consists mostly of species like *Lactobacillus delbrueckii* subsp. *bulgaricus*, *Lactococcus lactis* subsp. *lactis*, *Kluyveromyces fragilis* and *Saccharomyces unisporus* (Di Cagno et al., 2004). Dankow et al., (2003) quoted that mare's milk is characterised by a lower somatic cells count unlike the milk of healthy cows (~100x10^3/mL), goats (~1x10^6/mL) and sheep (~300x10^3/mL). Manteufel (1989) stated that the total bacterial count in raw mare's milk corresponds to the average total bacteria number in pasteurised cow's milk. Such findings could be related to the extremely high content of lysozyme (the enzyme with antibacterial features) in mare's milk in comparison to other types of milk.

The concentration of minerals in mare's milk is lower than in milk of other animal species. Csapo et al., (2009) determined the ash content in mare's milk from 0.3 to 0.5 %. The content of milk ash in the colostrum is somewhat higher with an average value about 0.592 % (in the first 48 h of lactation), 0.513 % (from the 3rd to the 5th day of lactation) and 0.405 % (from the 8th to the 45th day of lactation).

C*roatian coldblood horse* is an original, autochthonous horse breed. The creation of this breed started at the end of the 19th century, first in the area of Međimurje and spread to other parts of low-lying regions of Croatia. Today, the C*roatian coldblood horse* is primarily breed for manufacturing of meat and specific meat products. It is also suitable for manufacturing of mare's milk which is a very valuable raw material in the cosmetics industry. According to the *Annual report of horse-breeding in the Republic of* C*roatia* (2011) 6.158 heads of the C*roatian coldblood horses* are present in Croatia, out of which 3.228 mares, which are the most represented category.

Materials and methods

Mare's milk sampling

During the research period, three samplings of C*roatian coldblood* mare's milk were carried out in three different regions: the Bjelovarsko-bilogorska county (BBC), the Krapinsko-zagorska county (KZC) and the Sisačko-moslavačka county (SMC). Samples of mare's milk were taken during March and April 2013 in various stages - from the first (SMC and BBC) to the sixth month of lactation (BBC). The minimum quantity of milk sample from each mare was 200 mL. The collected number of milk samples was comparatively small as it is very difficult to take milk sample from mares if foals are not in their immediate vicinity (but without a physical contact and possibility to suck milk). Since foals suck quite often, mostly every 15 min, it is very difficult to gather a higher milk quantity by one milking, which would be sufficient for a great number of analyses.

Analyses of mare's milk and methods

Samples of mare's milk for the analysis of chemical composition, physical properties and hygienic quality were collected from the total of 11 mares. The analyses of milk chemical composition included determining the content of: total solids (HRN ISO 6731:1999), milk fat (HRN EN ISO 1211:2010), proteins (HRN EN ISO 8968-2:2003), caseins (HRN ISO 17997-2:2010) and lactose (HRN ISO 5765-1:2003). All mentioned analyses were determined by reference methods in order to calibrate the instrument MilkoScan FT 120 (Foss Electric, Denmark) according to norm HRN ISO 9622:2001. The content of whey protein and non-protein nitrogen in milk was determined by calculating the difference in the total protein and casein content.

Among physical properties, titratable and ionometric acidity, as well as freezing point (HRN EN ISO 5764:2010) of mare's milk were determined. Titratable acidity of milk was carried out according to Soxhlet-Henkel method (RU 4.2-1-FA-02:2013) and pH value of milk by ionometric method (RU 4.2-1-FA-03:2013), according to accredited working instructions of the Reference laboratory for milk and dairy products, since there are no standardised methods for them.

Among hygienic quality parameters, the total bacterial count (HRN EN ISO 4833:2008) and the somatic cells count (HRN EN ISO 13366-2:2007) were determined. The logarithm of the total bacterial count as well as somatic cells count in mare's milk was taken ($\log_{10}$), in order to get normal distribution of values.

Statistical data processing

Statistical data processing was performed by implementing the GLM procedure and the SAS programme system (1999). The following were calculated: least square means (LSM), minimum (Min.) and maximum (Max.) values, standard deviations (SD), standard errors (SE) and coefficient of variation (CV) for individual ingredients and characteristics. Correlation coefficients, using CORR procedure (SAS, 1999) were calculated among individual ingredients and milk characteristics.

Results and discussion

Mare's milk quality was determined by the chemical composition, the physical properties and the hygienic quality. Table 1 contains results considering the chemical composition, more precisely the

Table 1. Chemical composition of mare's milk (n=11)

Sample (month of lactation)	TS (g/100 g)	F (g/100 g)	P (%)	C (%)	C* (%)	CP-NPN (%)	SP-NPN** (%)	L (g/100 g)	TSNF (g/100 g)
1 (1st)	10.27	1.24	1.80	1.03	57.22	0.77	42.78	6.28	8.91
2 (1st)	12.29	3.02	1.99	0.51	25.63	1.48	74.37	6.05	8.89
3 (1st)	10.44	1.21	2.03	0.99	48.77	1.04	51.23	6.09	9.02
4 (1st)	9.91	1.17	1.61	0.18	11.18	1.43	88.82	6.02	8.56
5 (2nd)	10.51	1.42	1.73	1.00	57.80	0.73	42.20	6.27	8.88
6 (2nd)	10.10	0.64	1.83	1.03	56.28	0.80	43.72	6.54	9.18
7 (2nd)	10.73	1.37	1.86	0.96	51.61	0.90	48.39	6.49	9.15
8 (2nd)	10.86	1.72	1.72	0.90	52.33	0.82	47.67	6.38	8.97
9 (3rd)	9.12	0.76	1.82	0.97	53.30	0.85	46.70	6.51	9.12
10 (6th)	9.13	0.38	1.64	0.13	7.93	1.51	92.07	6.13	8.63
11 (6th)	8.91	0.57	1.31	0.11	8.40	1.20	91.60	6.09	8.28
LSM	10.21	1.23	1.76	0.71	39.13	1.05	60.87	6.26	8.87
Min.	8.91	0.38	1.31	0.11	7.93	0.73	42.20	6.02	8.28
Max.	12.29	3.02	2.03	1.03	57.80	1.51	92.07	6.54	9.18
SD	0.96	0.72	0.20	0.39	21.15	0,30	21.15	0.20	0.28
SE	0.29	0.22	0.06	0.12	6.38	0.09	6.38	0.06	0.08
CV	9.45	58.93	1.20	55.47	54.06	28.97	34.75	3.14	3.13

*Share of casein in relation to the total protein content in mare's milk
**Share of whey protein and non-protein nitrogen in relation to the total protein content in mare's milk
TS = total solids; F = milk fat; P = proteins; C = casein; CP-NPN = crude protein - non-protein nitrogen; L = lactose; TSNF = total solids non fat
LSM = least squares mean; n = number of samples; Min. = minimum value; Max. = maximum value; SD = standard deviation; SE = standard error; CV = coefficient of variation

content of total solids, milk fat, proteins, casein, lactose and total solids non-fat. Also, contents of whey protein and non-protein nitrogen are presented.

Mare's milk contained 10.21 % of total solids on the average. The lowest content of total solids (8.91 %) was determined in the 6th month of lactation, and the highest (12.29 %) in the 1st month of lactation. Additionally, in the 1st month of lactation, milk samples contained on the average more total solids in relation to the rest of lactation.

Milk fat is the most variable milk ingredient which was also confirmed by a high variation coefficient (≈59 %) in this research. On the average, milk contained 1.23 % of milk fat, ranging from 0.38 % to 3.02 %. Most of the authors stated lower contents of milk fat in the milk of Halfinger mares 1.04 % (Salamon et al., 2009), Hucul mares 0.92 % (Pieszka et al., 2011) and in Wielkopolski mares 0.8 % (Pieszka et al., 2011). In this paper, decrease in the milk fat content of mare's milk was determined towards the end of lactation. However, a relatively low number of samples were analysed. In the research conducted by Doreau and Martuzzi (2006) the content of milk fat in mare's milk also decreased during lactation, from the initial value of 1.5-2.5 % to 0.5-1.5 % at the end of lactation.

The average content of proteins in the *Croatian coldblood horse* milk (1.76 %) was higher than the protein content of 1.17 % in Wielkopolski breed (Pieszka et al., 2011), of 1.15 % in Polish konik breed (Pieszka et al., 2011), i.e. of 1.6 % in Polish coldblood breed (Markiewicz-Kęszycka et al., 2013). Additionally, the protein content in the 1st month of lactation was somewhat higher than in other

Table 2. Physical properties of mare's milk (n = 11)

Sample (month of lactation)	Titratable acidity (°SH)	pH-value	Freezing point (°C)
1 (1st)	2.94	6.91	-0.5343
2 (1st)	3.61	6.90	-0.5423
3 (1st)	3.41	6.95	-0.5391
4 (1st)	1.69	7.17	-0.5317
5 (2nd)	2.23	7.04	-0.5221
6 (2nd)	2.63	7.00	-0.5344
7 (2nd)	2.43	7.09	-0.5338
8 (2nd)	2.80	6.94	-0.5286
9 (3rd)	2.83	6.96	-0.5337
10 (6th)	1.69	6.91	-0.5266
11 (6th)	1.35	7.08	-0.5237
LSM	2.51	7.00	-0.5318
Min.	1.35	6.90	-0.5423
Max.	3.61	7.17	-0.5221
SD	0.72	0.09	0.006
SE	0.22	0.03	0.002
CV	28.68	1.27	-1.16

LSM = least squares mean; n = number of samples; Min. = minimum value; Max. = maximum value; SD = standard deviation; SE = standard error; CV = coefficient of variation

part of lactation. The content of casein in mare's milk was very low (0.71 %), which is most probably the reason why mare's milk in included in so-called albumin milks. Casein content ranged from 0.11 % to 1.03 % (Table 1). The variation coefficient for casein content was quite high (55.47 %).

Mare's milk belongs to albumin milks, since the casein content in relation to the total protein content is less than 75 %. From Table 1 it is clear that the lowest obtained content of casein was 7.93 % and the highest was not more than 57.8 %. The share of whey protein and non-protein nitrogen in the total protein content varied from 42.2 % to 92.7 %. The highest average content of whey protein and non-protein nitrogen (91.84 %) was determined in the 6th month of lactation. C*roatian coldblood horse* milk contained 1.05 % of whey proteins and non-protein nitrogen which corresponded to the (content) share of 60.87 %. Malacarne et al., (2002) obtained lower share of the total whey proteins and non-protein nitrogen (50 %) in mare's milk in comparison to the results of this research. According to Malacarne et al., (2002) mare's milk is a rich source of essential aminoacids and is suitable for human nutrition due to the higher content of whey protein. The same authors also stated that the content of whey protein in mare's milk was higher in comparison to cow's milk, but lower than in human milk. However, the concentration of whey protein was higher in mare's than in human milk, due to the higher content of crude proteins.

The basic carbohydrate in mare's milk is lactose, with the average content of 6.26 %, which is much higher than in cow's, goat's or sheep's milk. Due to the high content of lactose, mare's milk has considerably sweeter taste than other milk types usually intended for human consumption.

The average content of total solids in mare's milk was 8.87 %, which is similar to the content in cow's milk although the average content of total solids was considerably lower (10.21 %). The high content of lactose significantly contributes to the high content of total solids non-fat. Results considering the physical properties of mare's milk are presented in Table 2.

As previously discussed, mare's milk is characterised by sweet taste, which was also confirmed by low values of titratable acidity ranging from 1.35 °SH to 3.61 °SH. Since the samples of mare's milk were taken in various lactation stages, variations in lactose content were significant, which was also confirmed by a high variation coefficient (28.68 %). At the beginning of lactation (1st month), the average milk acidity was higher (2.91 %) in comparison to the rest of the lactation period. Ionometric acidity shown as pH-value of milk was uniform, which was confirmed by a low value of variation coefficient (1.27 %). In this research, the average pH value of 7.00 was determined, which corresponds to the results mentioned by Kücükcetin et al., (2003), while Pagliarini et al., (1993) determined somewhat higher pH value (7.2). In the studies carried out by Mariani et al., (2001) pH value of mare's milk gradually increased during lactation, from 6.6 (immediately after birth) to 6.9 (on the 20th day), i.e. up to 7.1 (on the 180th day). According to the obtained results and considering the necessity of carrying out additional analyses on a greater number of samples, it might be possible to suggest standard marginal pH values for mare's milk.

There is very little data on the freezing point of mare's milk in the available technical literature. Therefore, based on the results of this research it could be concluded that obtained values were quite uniform. Determining the marginal value of a freezing point of mare's milk is very significant, due to its high price (33 EUR/L), which is even ten times higher than the price of cow's milk (0.33 EUR/L). Owing to that it is possible to mix mare's and cow's milk. Freezing point of milk is directly connected with the concentration of water soluble substances (lactose, citrates, phosphates). The average value of freezing points in samples of mare milk analysed in this research was -0.5318 °C, ranging from -0.5423 °C to -0.5221 °C. Based on the variation coefficient (1.16 %), it could be concluded that the freezing point in mare's milk was quite uniform.

Table 3. Hygienic quality of mare's milk (n=11)

Samples (month of lactation)	TBC (x 10^3/mL)	Log_{10}TBC	SCC (x 10^3/mL)	Log_{10}SCC
1 (1st)	1.2	3.08	10	4.00
2 (1st)	6.75	3.83	22	4.34
3 (1st)	58	4.76	12	4.08
4 (1st)	19	4.28	27	4.43
5 (2nd)	23	4.36	19	4.28
6 (2nd)	9	3.95	12	4.08
7 (2nd)	16	4.20	29	4.46
8 (2nd)	35	4.54	25	4.40
9 (3rd)	19	4.28	25	4.40
10 (6th)	0.3	2.48	20	4.30
11 (6th)	0.5	2.70	47	4.67
LSM	17.07	3.86	22.55	4.31
Min.	0.3	2.48	10	4.00
Max.	58	4.76	47	4.67
SD	17.38	0.77	10.35	0.20
SE	5.24	0.23	3.12	0.06
CV	101.81	19.87	45.90	4.57

TBC = total bacterial count; Log_{10}TBC = logarithm value of total bacterial count; SCC = somatic cell count; Log_{10}SCC = logarithm value of somatic cell count

LSM = least squares mean; n = number of samples; Min. = minimum value; Max. = maximum value; SD = standard deviation; SE = standard error; CV = coefficient of variation

A very important parameter of milk quality is its hygienic quality determined by the total bacterial count and the somatic cell count. Results considering the hygienic quality of mare's milk are presented in Table 3.

It can be observed that the total bacterial count varied from 300/mL to 58.000 CFU/mL. In comparison to other types of milk (cow's, goat's and sheep's), these are very low values, which indicates a good microbiological milk quality. Variation coefficient for the total bacterial count in mare's milk was significantly higher (101.81 %) than the one for the somatic cell count (45.90 %), which is probably influenced by hygiene conditions during milking. Some authors obtained similar values for total bacteria count in mare's milk, ranging from 42 to 54x10^3/mL immediately after birth (on the 5th day), up to even lower values of 37x10^3/mL measured from 15th to 150th day (Dankow et al., 2006). The reason of a very low total bacterial count in mare's milk is definitely lower size of an udder in comparison to cow's udders and the lower number of teats in mares (2), which are less exposed to possible infections and consequentially, mastitis.

Somatic cell count in mare's milk was also very low, from the minimum 10x10^3/mL to the maximum of 47x10^3/mL. Taking into consideration the somatic cell count in other milk types (cow's, goat's and sheep's), it could be concluded that their count in mare's milk was much lower. Dankow et al., (2003) obtained very similar values (46x10^3/mL) in mare's milk, while the highest count (19x10^3/mL) was determined immediately after foaling.

Significant and positive correlation coefficients were determined between the content of total solids and milk fat (0.94) i.e. protein (0.66). Also, positive correlations were determined between protein and casein content (0.66) and between the content of lactose and the total solids non-fat (0.74). Due to puffer milk capacity, the relation between titratable (°SH) and ionometric (pH) milk acidity was inversely proportionate, which was also confirmed by a negative correlation coefficient (-0.63). In order to determine the freezing point of milk, the sample had to be in fresh condition, so the correlation coefficient between titratable (°SH) acidity and freezing point of milk was -0.80. Significant and positive correlation coefficients were determined between the total bacterial count and their logarithm number (0.81) as well as between the somatic cell count and their logarithm count (0.96).

Conclusion

Based on the results of the research, it can be concluded that the milk of the C*roatian coldblood* contained on the average 10.21 % of total solids, 1.23 % of milk fat, 1.76 % of proteins, 0.71 % of casein, 6.26 % of lactose and 8.87 % of total solids non fat. The content of whey protein and non-protein nitrogen in milk was 1.05 % which was 60.87 % in the total content of protein. Average values of titratable and ionometric acidity of mare's milk were 2.51 °SH and 7.00 pH and freezing point -0.5318 °C. Mean logarithm value (log_{10}) 3.86, was determined for the total bacterial count in milk and for somatic cell count (log_{10}) 4.31. Significant positive, i.e. negative correlation coefficients were determined between certain ingredients and milk characteristics. In the last five years, the interest for using mare's milk is increasing so based on the obtained research results and additional analyses, standard values of the composition and characteristics of mare's milk could be suggested and made an integral part of one of regulations.

Sastav i svojstva kobiljeg mlijeka pasmine hrvatski hladnokrvnjak

Sažetak

Kobilje mlijeko oduvijek je bilo cijenjeno zbog svojih ljekovitih svojstava, zbog čega se danas sve više koristi u prehrambenoj, kozmetičkoj i farmaceutskoj industriji, te kao zamjena humanom mlijeku za prehranu novorođenčadi. Tijekom 2013. godine provedeno je istraživanje koje je imalo za cilj utvrditi kemijski sastav, fizikalna svojstva i higijensku kvalitetu kobiljeg mlijeka, za pasminu hrvatskog hladnokrvnjaka. Kobilje mlijeko u prosjeku je sadržavalo: 10,21 % suhe tvari, 1,23 % mliječne masti, 1,76 % proteina, 0,71 % kazeina, 6,26 % laktoze. Prosječna pH vrijednost iznosila je 7,0, titracijska kiselost 2,51 °SH i točka ledišta -0,5318 °C. Ukupan broj mikroorganizama bio je manji od 58.000/mL, a broj somatskih stanica manji od 47x10^3/mL. Volumen kobiljeg vimena, okolišni uvjeti i prisutnost ždrjebeta (bez fizičkog kontakta),

značajno utječu na sekreciju mlijeka. Na osnovu rezultata istraživanja mogu se predložiti kriteriji fizikalno-kemijskih i higijenskih parametara kvalitete kobiljeg mlijeka. Mogućnosti primjene mlijeka hrvatskog hladnokrvnjaka su mnogobrojne, ali se ono za sada u Hrvatskoj gotovo i ne koristi zbog nedovoljne informiranosti i educiranosti potencijalnih potrošača.

Ključne riječi: kobilje mlijeko, albuminsko mlijeko, kemijski sastav, fizikalna svojstva, higijenska kvaliteta

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