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RESEARCH ON CHEMICAL COMPOSITION OF COW RAW MILK

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Abstract: *Milk is considered to be food-medicine and mythological subject which nowadays has a lot of praise,as it had in the past, praise, brought not only by ordinary people but also by scientists, doctors,, pharmacists, zootechnicians, etc. This paper was prepared for a study on the quality of cow raw milk in northern Romania. The study was based on the influence of age, lactation period and the diet of cattle on some qualitative components of raw milk coming from the households. The physico-chemical properties determined were density, dry substance, acidity, fat and lactose. Standardized tools and methods were used. There were noticed significant variations of qualitative characteristics of raw milk in winter. It was obtained a very significantly positive correlation between dry substance and fat content, r = 0.899*** *. Also, lactose is significantly positively correlated with the fat content, r = 0.628*** *but also with the dry substance content, r = 0.564** *. The age and the lactation period don't influence the variation of the physical and chemical constituents.*

Keywords: *cow milk, physicochemical characteristics*

1. Introduction

Milk is considered to be food-medicine and mythological subject which nowadays has a lot of praise, as in the past, brought not only by ordinary people but also by researchers, doctors, pharmacists, zootechnicians, etc. In recent decades, milk began to be appreciated, but also contested, being subject of dispute, especially between the alternative and allopathic medicine [1-3]. In such a range of interest and controversy, it is natural that milk should be given special attention both internationally and nationally, in terms of commercial,industrial and medical perspective [4-6]. In 2001 it was established World Milk Day - World Milk Day, which Romania joined in 2009. TETRA PAK in partnership with APRIL, proposed the day of 20th June to be celebrated as World Milk Day in our country. Milk is an indication of healthy eating, the government after 1989 found it necessary to implement in schools the program,''Milk and bread roll". This paper was prepared for a study on the quality of cow raw milk in northern Romania. The study was based on the influence of age, lactation and the diet of cattle on the qualitative components of raw milk coming from the households [7].

2. Experimental

The material used in the study was the raw milk samples from two sources from individual households in Suceava. The analysis period of milk samples took place in the months January-June 2013, once a week. The samples were collected from the morning milk, an amount of 500 mL and were accompanied by a register card which had the following data: the source and milk

sample number; the name of the person who brought the milk sample; the identification number of the cattle, the date and time of milk collection; the age and the lactation period of the cattle. The samples were brought to the laboratory for the qualitative determination in max. 45 minutes from the milking. With regard to hereditary and technological factors, of physiological nature of the external environment that may have an influence on milk quality, we'll make the following comments : the cattle are not of pure breed being hybrids of Black-and-White variety; in terms of the age of the cattle, the no. 6007one is 4 years old and is at the second birth and no. 0978 cattle which is 9 years old had the seventh calf. The study was conducted in the first months of lactation, the samples were taken only in the morning, being considered the first milking. From the information received it resulted that milking was done three times /day. It is worth mentioning that milk was collected from perfectly healthy animals, that were not under medical treatment and were fed with specific fodder season to which was added root plants (beet) and potatoes. Physicochemical determinations were made in the chemistry laboratory with standardized apparatus and methods. The statistical data processing was done by the program XLSTAT 2013.

3. Results and Discussion

Figure 1 shows the variation of physico-chemical quality of milk samples collected from source 1.

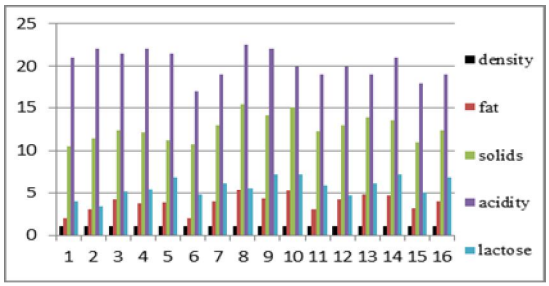

Figure 1. Changes in the physical and chemical characteristics of the samples of milk taken from source 1

The samples of milk taken from source 1 show a high content of fat, the percentage of 5.3% and 5.4% in March, confirms the good quality of raw milk. The high level of dry content is another indicator of the quality which supports the hypothesis of some milk samples with high quality features. The lactose content of 7.2% and 7.3% of milk samples also show a strong potential for both processing and for the production of cream and cheese [4-6].

The fat content of the milk samples from source 1 have fluctuations both in the winter period, January-March, and in the spring-summer period. At intervals of about 3 weeks, the milk fat content recorded significant decreases.

In Table 1 we can see correlations between physicochemical characteristics of milk from source 1.

Table 1.

Pearson correlation matrix between the physical and chemical quality characteristics of the milk samples collected from source 1

	Density, g/cm^3	Fat, %	Dry substance, %	acidity, °T	lactose, mg%
Density, g / cm^3	1				
Fat, %	0.1993	1			
Dry substance	0.5719	0.8998	1		
Acidity, °T	0.1050	0.3599	0.3017	1	
Lactose, mg%	0.2400	0.6285	0.5641	0.0006	1

The samples of milk from source 1 show physical-chemical characteristics which are positively correlated, the milk density increases in the same time with the growth of dry substance content. Pearson correlation index, r =0.571* indicates significant positive correlation. It is also noted a correlation index very significantly positive between dry substance and fat content, r = 0.899 ***.

Lactose is significantly positively correlated with fat content, r = 0.628** and also with the dry substance content, r = 0.564*. In Table 2 there are presented correlations between physicochemical characteristics of milk from source 1 with the lactation period and the age.

Tabel 2.

Pearson correlation matrix between the dependent variables and the lactation period, respectively the age of the cattle at the milk samples collected from source 1

	Density, g/cm^3	Fat, %	Dry substance%	Acidity, °T	lact., mg%	Lactation periodg	Age
Density, g/cm³	1						
Fat, %	0.1993	1					
Dry substance, %	0.5719	0.8998	1				
Acidity °T	0.1050	0.3599	0.3017	1			
Lactose, mg%	0.2400	0.6285	0.5641	0.0006	1		
Lactation period, months	-0.1930	0.3455	0.2515	-0.4813	0.4535	1	
Age, year	-0.1930	0.3455	0.2515	-0.4813	0.4535	1	1

Pearson correlation index show a weak significant negative correlation between the period of lactation and the milk acidity in the milk samples taken from source 1. The weak significant positive influence is seen on the lactose content, r= 0.453* [4]-[8]. In conclusion, it is considered that the age and lactation period do not influence a lot the variation of physical and chemical constituents. The samples of milk taken from source 2 had the lowest fat content of raw milk.

Initially, it was suspected the forgery of the sample by adding water, but in other determinations the fat content was much lower than the other samples. By analyzing the lactose content it was discovered that the milk has an increased and constant lactose content throughout the study period. In addition, the total dry substance has higher values, the highest value being 14.9% a lot more than other milk samples analyzed [9-11]. The acidity of milk is low, milk has an acidity of 16-18 degrees Thörner most of the time in the determinations that I made [7-9]. The milk collected from source 2, recorded the highest variations of density. The values of density are the highest of 1.034 following the ones of 1.033g/cm³. The lowest density value was recorded in April, 26.

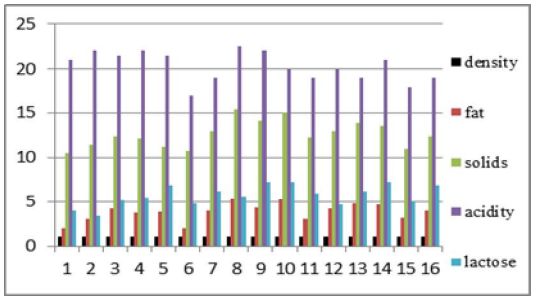

Figure 2. Shows the variation of physico-chemical characteristics of milk samples collected from source 2

In Table 3 we find the variation of physicochemical quality characteristics of milk from source 2.

Table 3.
Pearson matrix between the physico-chemical quality characteristics of the milk samples taken from source 2

	Density, g/cm³	Fat, %	Dry substance, %	Acidity, °T	Lactose, mg%
Density, g/cm³	1				
Fat, %	0.2431	1			
Dry substance, %	0.5035	0.7357	1		
Acidity, °T	-0.0267	0.2077	0.1773	1	
Lactose, mg%	0.1972	-0.1147	-0.2207	-0.2141	1

Pearson correlation index between the dry substance and the density of milk samples indicates a highly significant connection, r =0.503*. Also, the fat and the dry substance correlate strongly significant positive, the correlation index r =0.735** indicates this connection. In Table 4 are presented the correlations between the physicochemical characteristics of milk from source 2 with the period of lactation and the age.

Table 4.
Pearson correlation matrix between the dependent variables and the lactation period, the age of cattle at the milk sample from source 2

	Density, g/cm³	Fat, %	Dry substance, %	Acidity, °T	Lactose, mg%	Lactating period	A e
Density, g/cm³	1						
Fat, %	0.2431	1					
Dry substance,, %	0.5035	0.7357	1				
Acidity, °T	-0.0267	0.2077	0.1773	1			
Lactose, mg%	0.1972	-0.1147	-0.2207	-0.2141	1		
Lactating period	-0.2315	-0.2270	-0.0231	0.2443	0.1141	1	
Age	-0.2315	-0.2270	-0.0231	0.2443	0.1141	1	1

The lactation period and the age don't show any correlation with the studied variables: density, fat, lactose and dry substance. The variation of the components from the milk samples taken from source 2 could be under the influence of other factors, genetic factors or factors which are related to the animal's individuality.

5. Conclusions

The study revealed significant variations in the quality characteristics of raw milk during winter in both milk samples. There were not significant variations of qualitative characteristics of raw milk during the spring-summer time, which is explained by the inclusion of green fodder in the cattle feed.

The measurements findings reinforce the conclusion of specialty studies, according to which the qualitative factors of milk varies significantly during the period of lactation. The milk collected from source 2, recorded the largest variations of density. The density values are higher than 1.034 following the ones with a value of 1.033 g/cm³.

We notice a very significant positive correlation index between dry substance and fat content, $r = 0.899^{***}$. Lactose is significantly positively correlated with the fat content, $r = 0.628^{**}$ and with the dry substance content, $r = 0.564^{*}$ as well [11-12].

Pearson correlation index indicate a weak significant negative correlation between the period of lactation and the milk acidity in the milk samples taken from source 1. The influence weakly significant positive is also seen in the lactose content, $r = 0.453^{*}$[13-14]. In conclusion, it is estimated that the age and the lactation period don't influence a lot the variation of physical and chemical constituents.

6. References

[1] CLARE D.A., SWAISGOOD H.E., Bioactive milk peptides: A prospectus, *Journal of Dairy Science*,83 (6), 1187–1195, (2000).

[2] PHELAN M., AHERNE A., FIT GERALD R., J., O'BRIEN N.M.: Casein-derived bioactive peptides: Biological effects, industrial uses, safety aspects and regulatory status, *International Dairy Journal*, 16, 643-654, (2009).

[3] RANGANATHAN R., NICKLAS T. and BERENSON G.S.: The nutritional impact of dairy product consumption on dietary intakes of adults . *Journal of the American Dietetic Association* 105(9), 1391-400, (2005).

[4] PETIT H. V: Digestion, Milk Production, Milk Composition, and Blood Composition of Dairy Cows FedFormaldehyde Treated Flaxseed or Sunflower Seed, (2003).

[5] KIM Y.K., SCHINGOETHE D.J., CASPER D.P., LUDENS F.C.: Lactational response of dairy cows to increased dietary crude protein with added fat, *Jurnal Dairy Science*, 1991 Nov; 74(11):3891-9 (1991).

[6]TIDONA F., CRISCIONE A., GUASTELLA A M., Bioactive peptides in dairy products, *Italian Journal of Animal Science*, 8, 315-340, (2009).

[7] ENB A., ABOU DONIA M.A., ABD-RABOU N.S., ABOU-ARAB A.A.K. and EL-SENAITY M.H.: Chemical Composition of Raw Milk and Heavy Metals Behavior During Processing of Milk Products, *Global Veterinaria 3 (3):* 268-275, (2009).

[8] SHAKOUR, A.A., N.M. EL-TAIEB AND S.K. HASSAN: Seasonal variation of some heavy metals in total suspended particulate mater in Great Cairo atmosphere. *The 2nd International Conference of Environmental Science and Technology*, Egypt, 4-6 September, (2006).

[9] ANTUNAC N., MIOČ B., IVANKOVIĆ A., HAVRANEK L J.: Influence of stage of laction on the chemical composition and physical propreties of sheep milk, *Czech Journal Animal Science*, 47 (2): 80-84, (2002).

[10] MARTIN J. AULDIST , BRIAN J. WALSH and NORMAN A. THOMSON: Seasonal and lactational influences on bovine milk composition in New Zealand, *Journal of Dairy Research*, 65 (3), 401-411, (2004).

[11] CEBALLOS L. S., MORALES E. R., GLORIA DE LA TORRE ADARVE, CASTRO J. D., MARTINEZ L.P., REMEDIOS M.: Composition of goat and cow milk produced under similar conditions and analyzed by identical methodology. *Journal of Food Composition and Analysis* 322–329, (2009).

[12] ELVAN OZRENK, SEBNEM SELCUK: The effect of seasonal variation on the composition of cow milk in Van Province. *Pakistan Journal of Nutrition* 7(1), 161-164, (2008).

[13] BANSAL B., HABIB B., REBMANN H. and D. CHEN X.: Effect of seasonal variation in milk composition on dairy fouling, Proceedings of International Conference on Heat Exchanger Fouling and Cleaning VIII, June 14-19, Schladming, Austria, (2009).

[14] BANKS J.M., TAMIME A.Y, : Seasonal trends in the efficiency of recovery of milk fat and casein in cheese manufacture, *Journal Society Dairy Technology* 40:64–66, (1987).