Physicochemical Characteristics and Microelement Content of Sheep's Milk from Different Regions of Kazakhstan

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Absrtact **-** The study results of physicochemical characteristics and mineral composition of sheeps milks of "South-Kazakh Merino" breed of the South Kazakhstan and Almaty regions are presented. Comparative analysis shows that sheep's milk of South Kazakhstan region mostly has organic compounds with high lipids content, and milk of Almaty region has a rich mineral composition. The paper deals with the study of lipids, titratable acidity, activity index hydrogen, water content, water activity, density, protein content, moisture and energy of the ash content. Microelements content is represented by the presence of oxygen, sodium, magnesium, phosphorus, potassium and calcium.

Keywords **–** feed, sheep's breed, nutrition, microelements, physicochemical properties, sheep's milk, water activity

I. Introduction

IN recent years, with the support of the Government of the Republic of Kazakhstan of agriculture, particularly small- and middle-peasant farming trend in the annual increase in the number of livestock: cows, mares, camels, sheeps, goats and others. At the same time there is increased a consumer demand for new kinds of dairy products that locally produced. However, mainly the production of dairy products in Kazakhstan based on cows and partly mares and camels milks. Since ancient times, in Kazakhstan sheeps meat and feel widely used, and milk has not any applications. Currently, many local Kazakh livestock farms are numerous sheep, whose milk can organize the production of dairy products. In this regard, the actual problem is a study of different kinds of milk and the development of new types of dairy products.

Sheep's milk compared with the cow's more than 1,8 times rich in proteins and lipids, and dry solids 1,4 times more. Due to the high content of protein and salt, it is characterized by high acidity. The fat of sheep's milk contains more caproic acid and fat globules larger than in cow's milk [1]. Sheep's milk has a lot of beneficial properties and characteristics. Thus, sheep's milk proteins are digested in the human body till 99,1%. Sheep's milk is concentrated, the energy value of 109,7 kcal (428,34 kJ), it is much higher than cow's and goat's milks calories [2].

As it is well known sheep's milk and dairy products are widely used by the inhabitants of the Middle East, Greece and Italy. In these countries, it uses for butter, curd, yoghurt, kefir and other types of dairy products. Owing to its high nutritional qualities, high content in fat and protein, as well as the peculiar smell of sheep's milk is almost ideal raw material for the manufacture of cheese [3]. However, control of milk composition has importance in dairy, because ewe's milk is mostly used for cheese making [4].

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In different countries the sheep's milk cheese made by various techniques and therefore is called differently. The best known are: "Roquefort" - the world famous French goat cheese; olive cheese - all of them are made only from sheep's milk. The most famous among them are the "Brousse Du Moat" and "Picodon"; sheep's cheese - a type of brine cheese; feta - the traditional pickled cheese in Greece [5].

It should be noted that milk lipids - one of the best dietary fat composition and taste. Fat milk has a low melting point and therefore is easily and quickly absorbed by the body. Milk lipids are source of vitamins C and D, fatty acids, many of which are not in plant and animal fats of other origin. Polyunsaturated fatty acids are particularly valuable because they can not be synthesized in humans [6]. Milk composition of mammalian species varies widely with reference to genetic, physiological, nutritional factors and environmental conditions. The use of milk proteins to give food desirable organoleptic or textural properties is strongly influenced by their functional properties [7].

TABLE I
MILK COMPOSITION OF MAMMALIAN SPECIES

Milk	Solids content	Lipids	Proteins	Lactose	Ash	Acidity, ^{0}T
Cow	12,7	3,8	3,5	4,7	0,7	16
Goat	13,7	4,4	3,3	4,9	0,8	15
Sheep	17,9	6,7	5,8	4,6	0,8	25
Mare	10,1	1,0	2,1	6,7	0,3	6
Donkey	10,4	1,6	2,2	6,0	0,5	9
Buffalo	17,8	7,5	4,5	5,0	0,8	20
Camel	13,7	4,5	3,5	5,0	0,7	15
Zebu	16,7	7,7	4,3	3,6	0,8	-
Reindeer	36,7	22,5	10,3	2,5	0,4	-

The chemical composition of sheep's milk is not constant and depends on many factors, including the breed and age of the animal, lactation, terms of feeding, housing and other [8].

So, a high level of nutrition will decrease fat and slightly increase milk proteins and casein percentages in most cases in dairy sheep. Increase in dietary protein concentration in well-fed ewes has no effect on milk fat or milk protein contents. Feeding with concentrate, which is a valuable mean of increasing energy intake, may depress by its own action the milk fat and protein contents as a result of acidosis if it is in excess [9].

Currently, the livestock farms of the South Kazakhstan and Almaty regions have sufficient "South-Kazakh Merino" sheep breed, which give milk per lactation in average 110-143 kg. In this regard, the purpose of this study was to examine the physicochemical properties and mineral

composition of sheep's milk of "South-Kazakh Merino" breed of the South Kazakhstan and Almaty regions.

II. Materials And Methods

The study objects were sheep milks of "South-Kazakh Merino" breed of the South Kazakhstan (sample 1) and Almaty regions (sample 2).

Physicochemical properties of sheep milks were studied by using the following standard equipment:

- For the determining a medium acidity, the pH tester «SCHOTT Instrument» Lab 850 was used;
- For the determination of protein content and density Lactan-4 was used;
- Water activity was determined by the device assembled on base of a microcontroller platform Arduino Uno and four temperature sensors DS18B20 Dallas Semiconductor company;
- Moisture binding energy was calculated by equation [3]

$$E = - R \cdot T \cdot \ln a_w$$

where R - gas constant (R = 461,889 kJ / (kg K));
T - temperature, ° K;
a_w - water activity

The microelement content in the ash of sheep's milk was determined by Raster Electron Microscope (REM).

III. Results And Discussion

The study results of physicochemical characteristics of sheep milk are shown in Table II.

Table II
Physicochemical Characteristics Of Sheep's Milk

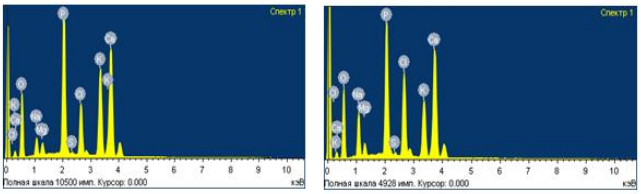
№	Physicochemical indicators	Sheep's milk		
		Data [8]	Sample 1	Sample 2
1	Medium acidity, pH	6,21	6,84	6,62
2	Titratable acidity,°T	25	25	24
3	Water activity, A_w	-	0,967	0,952
4	Moisture binding energy E, kJ/kg	-	4,395	4,423
5	Density ρ, kg/m^3	1036,2	1038,20	1039,47
6	Water,%	82,1	83,45	82,12
7	Proteins, %	5,6	4,12	4,44
8	Lipids, %	6,7	8,12	4,10
9	Ash content,%	0,80	0,86	0,87

Analysis of the data shows that the test samples of sheep's milk differ in physicochemical properties not only among themselves, but as well as from literature data. For example, in the sample 1 a fat content more than in the sample 2 of 98,1% and at 21,19% increases in comparison with the literature data.

Comparative analysis of the titratable acidity and medium acidity shows that the sample 1 titratable acidity (°T) is greater of 4,17% and the pH value (pH) at 3,32% is less than in the sample 2. Titratable acidity of the milk sample 1 and the literature data [8] are identical, and the pH value differs by 15,15%.

The samples differ in quantitative and ash contents. For example, if in the sample 1 the ash content of 7,5%, and the ash content of the sample 2 of 8,8% greater than the literature data [8].

Study of the microelement content in the ash of the sample 1 (a) and sample 2 (b) areas are presented in Fig.1.



a) б)

Fig. 1 The microelement content of sheep's milk of the South Kazakhstan (a) and Almaty (b) regions.

Table III
Microelement Content Of Sheep's Milk

Sheep's milk	The Ash Microelement Content, %							
	O	Na	Mg	P	S	Cl	K	Ca
Sample 1	38,99	7,89	1,67	13,85	0,31	10,28	8,47	18,51
Sample 2	39,15	3,53	1,50	15,53	0,31	6,84	13,47	19,66

The analysis of the microelement content shows that in the sample 2, the content of calcium 6,21%, oxygen 0,41%, phosphorus 12,13%, potash 59,03% greater and content of such elements as magnesium 11,33% and chlorine 50,29% less than the sample 1.

Comparative analysis of the microelement content of sheep's milk of South Kazakhstan and Almaty regions with the domestic animal milks shows the leading position among the phosphorus and calcium content that is recommended as proportion for the better assimilation of these elements. Analyzing the mineral composition can be concluded that sheep's milk may be used in the nutrition of children and elderly people, and as well as the main additive in the dietary nourishment.

IV. Conclusion

Comparative analysis shows that sheep's milk the South Kazakhstan region is rich in fat of 82,88%, sodium 44% and chlorine 66%. Probably a high content of lipids and salt NaCl is related with the feed salinity and the high level of nutrition. For other characteristics and physicochemical properties sheep milks of the South Kazakhstan and Almaty regions within permissible limits correspond to the literature data. Microelements analysis is presented the optimal ratio of essential elements in human nutrition: magnesium, phosphorus, potassium and calcium. It can be concluded that the physicochemical properties and mineral content of the sheep's milk depend feed, breed, age and individual characteristics of sheep. The experimental data allowed the assessing of the suitability of the sheep's milk in the production of a wide range of dairy products.

References

[1] G.V. Tverdohleb, and R.I.Ramanauskas, "Chemistry and physics of milk and milk products" (Book style), DeLi print, Moscow-Russia, 2002, p.360 (rus)

[2] A.I. Erokhin, and S.A.Erokhin "Sheep breeding" (Book style), Moscow-Russia, 2009, p.213 (rus)

[3] N.A.Tikhomirova, "Technology of food products therapeutic preventive nutrition" (Book style), MGUPB, Moscow-Russia, 2001, p.242 (rus)

[4] F.Bocquier, and G. Caja. Effects of nutrition on ewe's milk quality. in Proc. of the 5th Great Lakes Dairy Sheep Symposium, Brattleboro, Vermont, University of Wisconsin-Madison, 1999, p:1-15

[5] Z.H.Dilanyan, "Cheesemaking" (text), Light and food industries, Moscow-Russia, 1984, p.280 (rus)

[6] T.Tultabayeva, U.Chomanov, B.Tultabayev, and A.Shoman. Study of Fatty Acids Content of Lipids in Mare's and Camel's Milk, International Journal of Chemical, Environmental & Biological

Sciences (IJCEBS) Volume 3, Issue 1 (2015) ISSN 2320–4087 (Online), p:90-93

[7] M.K.Sabahelkhier, M.M.Faten, and F.I.Omer, Comparative Determination of Biochemical Constituents between Animals (Goat, Sheep, Cow and Camel) Milk with Human Milk, *Res.J.Recent Sci.*, 1(5), 2012, p:69-71

[8] K.K.Gorbatova, and P.I.Gunkova. "Chemistry and physics of milk and milk products" (Book style), GIORD, St. Petersburg, 2012, p.336 (rus)

[9] F.Bocquier, and G.Caja. Effects of nutrition on the composition of sheep's milk. In: Ledin I. (ed.), Moran d-Fehr P. (ed.). Sheep and goat nutrition: Intake, digestion, quality of products and rangelands. Zaragoza: CIHEAM, 2000, p:59-74 (Cah iers Option s Méditerran éen n es; n.52)