

UDC 637.146
IRSTI 65.63.33

STUDY OF FUNCTIONAL PROPERTIES OF PECTIN-CONTAINING KOUMISS

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The article describes a method for obtaining traditional koumiss and provides a scheme for preparing pectin-containing koumiss. It was found that due to the addition of liquid Apple pectin in the studied form of koumiss, there is a significant excess of vitamin C and protein content in comparison with traditional koumiss. Preclinical experiments were conducted on laboratory white rats with cadmium intoxication in order to identify the detoxification properties and safety of the obtained pectin-containing koumiss. It is shown that pectin containing koumiss had a positive effect on blood parameters and contributed to improving the general condition of the studied animals, which allows using this type of koumiss as a functional therapeutic and prophylactic drug for poisoned with heavy metals living organisms.

Keywords: pectin, traditional koumiss, pectin-containing koumiss, biochemical composition, heavy metals, functional product.

ҚҰРАМЫНДА ПЕКТИН БАР ҚЫМЫЗДЫҢ ФУНКЦИОНАЛДЫҚ ҚАСИЕТТЕРІН ЗЕРТТЕУ

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Мақалада дәстүрлі қымыз алу тәсілі сипатталған және құрамында пектин бар қымыз дайындау сұлбасы келтірілген. Зерттелетін қымыз түрінде сұйық алма пектинін қосу есебінен С витамині мен ақуыз құрамының дәстүрлі қымызмен салыстырғанда айтарлықтай артуы байқалады. Құрамында пектин бар қымыздың детоксикациялық қасиеттері мен қолдану қауіпсіздігін анықтау мақсатында кадмиймен уланған зертханалық ақ егеуқұйрықтарға клиникаға дейінгі эксперименттер жүргізілді. Құрамында пектин бар қымыздың қан көрсеткіштеріне оң әсерін тигізгенін және зерттелетін жануарлардың жалпы жағдайының жақсаруына ықпал ететінін, және де бұл қымыздың осы түрін ауыр металдармен

тірі организмдердің уланған кезде функционалдық емдеу-профилактикалық препарат ретінде пайдалануға мүмкіндік беретіні көрсетілді.

Негізгі сөздер: пектин, дәстүрлі қымыз, құрамында пектин бар қымыз, биохимиялық құрамы, ауыр металдар, функционалдық өнім.

ИЗУЧЕНИЕ ФУНКЦИОНАЛЬНЫХ СВОЙСТВ ПЕКТИНСОДЕРЖАЩЕГО КУМЫСА

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В статье описан способ получения традиционного кумыса и приведена схема приготовления пектин содержащего кумыса. Установлено, что за счет добавления жидкого яблочного пектина в изучаемом виде кумыса отмечается значительное превышение витамина С и содержания белка по сравнению с традиционным кумысом. С целью выявления детоксикационных свойств и безопасности применения полученного пектин содержащего кумыса были проведены доклинические эксперименты на лабораторных белых крысах с кадмиевой интоксикацией. Показано, что пектинсодержащий кумыс оказывал положительный эффект на показатели крови и способствовал улучшению общего состояния исследуемых животных, что позволяет использовать этот вид кумыса как функциональный лечебно-профилактический препарат при отравлении живых организмов тяжелыми металлами.

Ключевые слова: пектин, пектинсодержащий кумыс, биохимический состав, тяжелые металлы, функциональный продукт.

Introduction. The national food product of the Kazakh people, the most popular at all times, was a healing drink made by mare's milk. The use of mare's milk is due to its unique composition. This product is a huge amount of time used as a remedy. Quite often, it is used during the treatment of metabolic problems, as well as for colds. In addition, this drink contributes to the treatment of tuberculosis and the treatment of even various oncological diseases [1]. Therefore, the interest in this unique drink does not weaken, but on the contrary increases, and currently we are developing a Law in the Republic "on kumys and shubat". Lactic acid bacteria contained in fermented milk products are called probiotics, most often it is bifido and lactobacilli, which belong to the natural microflora of man, developed in the process of evolution. Prebiotics are used to enhance the growth of beneficial microflora. An effective prebiotic is pectin, which is a polysaccharide formed by residues of D-galacturonic acid, and contained in plant raw materials. In addition, clinical studies have shown the ability of pectin to remove heavy metals and toxins from the body. Therefore, expanding the range of pectin products, especially if pectin is added to dairy products is an urgent task. In connection with the foregoing, in this work we

were set a **goal:** to develop, on the basis of traditional koumiss, by adding liquid apple pectin to it, a method for producing a functional pectin-containing koumiss that is capable of removing heavy metals from the body.

Objects and methods of research. The main objects of research in this work were:

- raw Mare's milk in accordance with ST RK 1005-98;
- raw cow's milk in accordance with ST RK 1760-2008;
- active production Starter cultures consisting of strains of lactic acid Bacillus Lactobacillus bulgaricum, acidophilic Lactobacillus acidophilum bacteria and yeast Saccharomyces lactis in accordance with ST RK ISO 27205-2012;
- pectin in accordance with with GOST 291186-91;
- kumys natural and functional pectin-containing KUMYS in accordance with St RK 1004-98.

Studies of organoleptic, physical-chemical, biochemical parameters of the main raw materials and finished products were carried out using generally accepted and modified methods of study at the Department of «Food Biotechnology» of Almaty Technological University. Experiments on the study of detoxifying prope-

ries of functional pectin-containing koumiss were performed on white laboratory rats at the «Institute of Human and Animal Physiology» of the MES RK at the laboratory of physiology of the lymphatic system. Hematological parameters of rat blood were determined on an automatic hematological analyzer Sysmex KX-21. Biochemical parameters were determined using the biochemical analyzer BS200 Mindray. Animal experiments were conducted in accordance with the principles of humanity set out in the directives of the Helsinki Declaration of the World Medical Association. The results of the experiments were statistically processed using the Student's criterion.

Results and their discussion. To prepare high-quality koumiss, we used fresh Mare's milk. It is known that one of the main features of Mare's milk is the negative impact of boiling on its composition and properties, it can not be sterilized or pasteurized. In the process of sterilization of Mare's milk, natural qualities are lost and even some harmful properties are acquired for the human body.

The koumiss fermentation process in our studies lasted 10-12 hours. When koumiss was completely ready for use, first of all, we revealed its organoleptic characteristics, such as color, smell, taste and texture.

To determine the physicochemical properties of freshly prepared koumiss, studies were conducted to determine its active and titratable acidity, ash content, density and Moisture. The

amount of protein, carbohydrates and vitamin C in freshly prepared koumiss was also determined.

When developing the technology for producing pectin-containing koumiss, we based it on the technology of preparing traditional koumiss. An important stage in the technology of developing pectin-containing koumiss is the process of preparing pectin and adding it in the finished form to the fermented mixture. To prepare pectin used dry pectin obtained from Apple squeezes, local cultivar "Aport" [3].

It is known that all existing prebiotics, including pectins, are divided into two large groups – liquid and dry. Microorganisms in the composition of dry prebiotics are in a kind of "sleepy state" and after entering the body they need at least 8-10 hours for the bacteria to move from hibernation to the active form and begin to act. The bacteria in the liquid prebiotics are bacteria in the "active state of life", that is, they fully retain all their valuable properties and begin to act immediately after entering the body.

To this aim, we converted the dry Apple pectin we obtained into a liquid by adding sugar to it in a ratio of 1:3. The mixture of dry pectin and sugar was thoroughly mixed until smooth and then stirred in cow's milk, heated to 40-45°C. For 1 minute, the mixture of pectin in milk must be boiled constantly stirring, then this mixture is cooled to 30-35°C and simultaneously with the starter cultures is added to the fermented mixture.

The scheme of technology for obtaining a functional food product, koumiss, containing pectin, is shown in figure 1.

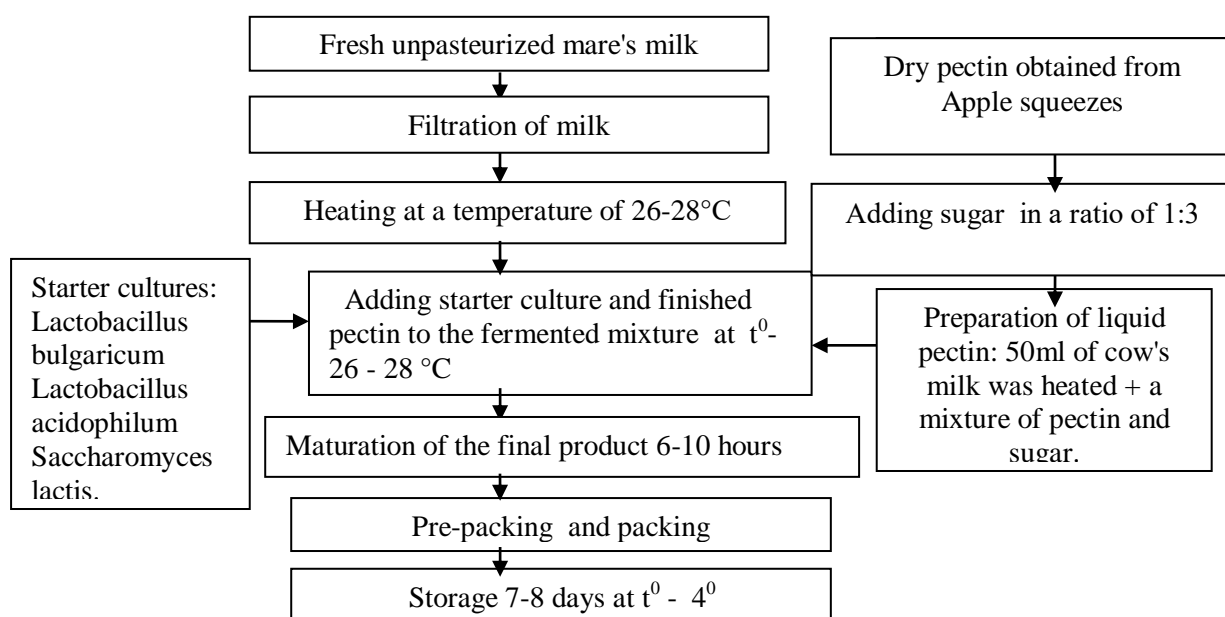


Figure 1 - Technological Scheme of obtaining a functional food product - pectin-containing koumiss

After the simultaneous addition of the starter culture and the prepared liquid pectin product to the fermented mixture, we mix the whole mixture for 2-3 minutes and leave it to ferment at a temperature of 28-32 ° C. We found that the fermentation time of pectin-containing koumiss, compared with the maturation time of traditional koumiss, decreases by 2-3 hours, which indicates the possibility of pectin affecting the process of accelerating the maturation of koumiss. In the work of Batkibekova M. B., it was shown that pectin exerts a stabilizing effect on the sour milk clot and accelerates its formation, which is completely consistent with our data [4].

The study of the organoleptic, physico-chemical and biochemical properties of pectin-containing koumiss in a comparative aspect with

traditional koumiss and the identification of differences between them in the studied parameters is of great theoretical and practical interest. When studying the organoleptic properties of pectin-containing koumiss in comparison with traditional koumiss, changes in color, taste, and consistency were noted. So, the color of the traditional koumiss has changed from milky white to a cream-milk shade, the pungent taste of the traditional koumiss becomes soft and slightly sweet due to pectin mixed with sugar, the taste of yeast is muffled; the consistency of the pectin-containing koumiss becomes more dense and less foaming in the pectin-containing koumiss. The results of the study of the organoleptic parameters are shown in Table 1.

Table 1 – Organoleptic characteristics of two types of koumiss

№	Parameter	Characteristics of kumys samples	
		koumiss	pectin-containing koumiss
1	Appearance	Fluid	Fluid
2	Taste and smell	Pure sour-milk, slightly pungent taste, specific for koumiss, bases of extraneous smacks and smells. Has a yeast aftertaste.	Pure sour-milk, pleasant, mild taste, slightly sweet, without extraneous smacks and smells.
3	Consistence	Liquid, homogeneous, carbonated, foaming, without clumped lumps of fat and flakes.	More or less dense, uniform, carbonated, less foaming, without flakes and clumps of fat
4	Color	Milky white, uniform throughout the mass.	Creamy milk, uniform throughout the mass

The changes in organoleptic parameters that occur in koumiss when pectin is added to it can be

explained by changes in physical and chemical parameters, which are shown in Table 2.

Table 2 - Physical-chemical characteristics of the two types of koumiss

№	Parameter	koumiss	pectin-containing koumiss
		Characteristic	
1	Active acidity pH	3,9	3,3
2	Titrateable acidity °T	96	92
3	Ash content %	4,4	5,6
4	Density g / cm ³	1,030	1,050
5	Moisture	88	85

Thus, in pectin-containing koumiss, acidity is reduced, both active and titrated acidity. This helps to reduce the sharp taste, which becomes soft and even slightly sweet. At the same time, in pectin-containing koumiss, such values as density, ash content increased, and moisture decreased in comparison with traditional koumiss. It is known that pectin has gelling and moisture-binding

properties due to which there is a change in the consistence of traditional koumiss in a thicker pectin-containing koumiss.

For a more detailed and complete analysis of the results obtained, it was necessary to analyze the biochemical composition of two types of kumys samples, the results of which are shown in figure 2.

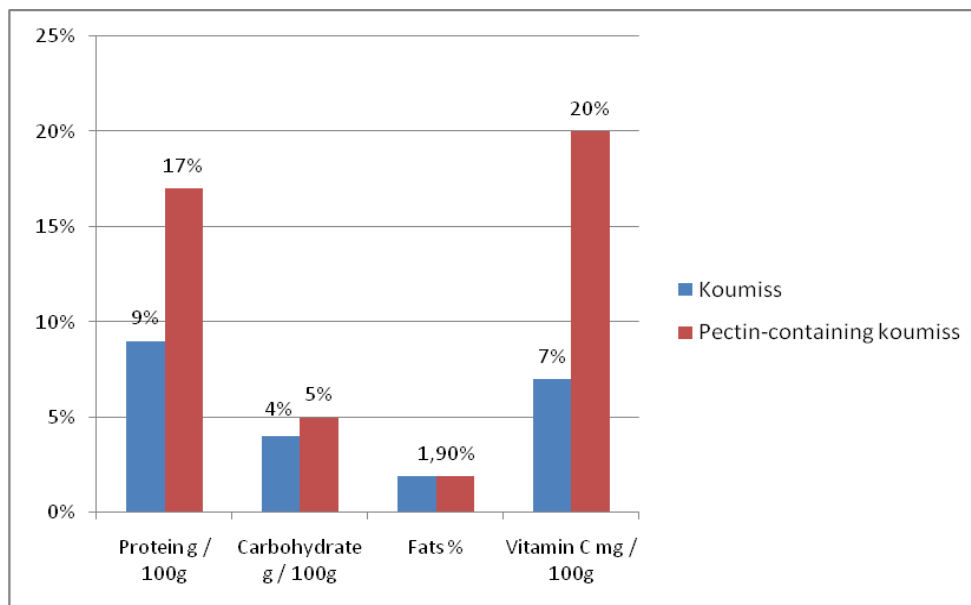


Figure 2 – The content of organic substances and vitamin C in pectin-containing koumiss and traditional koumiss.

The results of the analysis on the biochemical composition of pectin-containing koumiss indicate that in pectin-containing koumiss all biochemical parameters such as protein, carbohydrates and vitamin C increase, especially and significantly increase the content of protein and vitamin C, more than twice, compared with traditional koumiss. The probability of such a result, we associate with the fact that pectin combines with vitamin C and forms a strong complex: pectin ascorbic acid, which in turn helps to stabilize and prevent the rapid breakdown of vitamin C in the pectin-containing koumiss. These data coincide with our previous work, where there was a significant excess of vitamin C in our developed pectin-containing fruit drinks [5].

It is known that the fat content in koumiss ranges from 1.1 to 2.5% depending on the breed of horses, the period of lactation, the composition of the feed and especially on the completeness of the milk output. To maintain a normal amount of fat, it is necessary to maintain the acidity level of the product evenly. This means that acidity affects the ability of fat to maintain a stable index. Due to the fact that koumiss is a product of rapid increase in acidity, the process of permanent preservation of the fat content in it is difficult. If pectin is added to its composition, the quality of the product will remain longer than the original form of the product.

Thus, the conducted research on the study of organoleptic, physico-chemical and biochemical parameters of 2 types of koumiss: traditional and

pectin-containing product showed its compliance with the requirements of technical regulations TR TS 033/2013 "Requirements for milk and dairy products" and the possibility of using the latter type of koumiss as a functional preventive product, in connection with which we conducted experiments on white laboratory rats [6-7].

It is known that pectins are able to remove biogenic toxins, anabolics, xenobiotics, metabolic products from the body, as well as biologically harmful substances that can accumulate in the body: cholesterol, bile acids, urea, bilirubin [8]. In our experiments in rats with experimental cadmium intoxication, health correction was carried out for 30 days with pectin-containing koumiss in the amount of 50 g / kg (experimental group) and in the second group of rats, traditional koumiss were fed in the same amount of 50 g / kg (control group) daily.

It was found that after a month of feeding this functional food product containing pectin, experienced rats significantly increased their appetite, rats gained weight by 10-15%, improved their behavioral status, became more active in communicating with experimenters. Throughout the experiment, the rats consistently consumed 1/3 of the daily norm of liquid due to koumiss.

Determination of hematological and biochemical parameters of the blood of rats poisoned with cadmium chloride before and after the end of feeding with a functional product showed a significant improvement in the studied blood parameters, approximation of these values

to the norm, contributing to the reduction of intoxication and improvement of their General

condition, which can be seen in tables 3-4.

Table 3 - Results of hematological indicators of rat blood when feeding with pectin-containing koumiss.

Parameter	Rats of intact group (normal)	Rats with cadmium intoxication		
		CdCl ₂	Experimental group CdCl ₂ + pectin-containing koumiss 50g / kg	Control group CdCl ₂ + pectin-containing koumiss 50g / kg
White blood cells (thousand/mm ³)	6,10 ±0,33	4,11±0,40	5,66±0,20	4,98±0,20
Red blood cells (million / mm ³)	7,40 ±0,31	5,65±0,20	6,96±0,24	5,80±0,22
Hemoglobin (gr/ DL)	14,37±0,90	11,10±0,30	12,80±0,24	11,29±0,66

From the data of table 3 and table 4, it can be seen that the introduction of 50 g/1 kg of body weight of pectin-containing koumiss into the daily diet significantly increased all studied hematological and biochemical blood parameters

of rats in the experimental group, compared with rats from the control group, although in the control group of animals there was also a positive trend on the part of the studied blood parameters.

Table 4 - Results of biochemical parameters of rat blood when feeding with pectin-containing koumiss

Parameter	Rats of intact group (normal)	Rats with cadmium intoxication		
		CdCl	Experimental group CdCl ₂ + pectin-containing koumiss 50g / kg	Control group CdCl ₂ + pectin-containing koumiss 50g / kg
Total protein g%	9,80 ±0,80	4,83±0,88	8,36±0,45	6,49±0,50
Glucose mmol / l	5,48±0,31	2,65 ±0,20	4,96±0,24	3,08±0,22
Urea mmol / l	4,18±0,04	3,10±0,03	3,50±0,06	3,29±0,06

The main effect of the therapeutic action of pectin is associated with the formation of strong insoluble chelate complexes with polyvalent metals and the removal of the latter from the body. In the food industry of the world health organization, pectin is recognized as an absolutely safe product.

Thus, the experiments on rats with cadmium intoxication convincingly showed the ability of pectin-containing koumiss to reduce intoxication and remove heavy metals from the body, contributing to the normalization of hematological and biochemical blood parameters, and to improve the general condition of experimental rats.

Conclusion. Thus, in the present work, a technology was developed and a scheme for producing a functional pectin-containing koumiss was described. We studied its organoleptic, physical-chemical and biochemical parameters, which were functionally more favorable than those of traditional koumiss, which contributed to the improvement of its dietary properties and proved

the possibility of using this type of koumiss as a functional therapeutic and prophylactic product.

1. For the first time, a technology has been developed to obtain functional pectin-containing koumiss. Its organoleptic, physicochemical and biochemical properties were studied, which in terms of performance were functionally more favorable compared to pectin-free koumiss. It was found that the process of pectin-containing koumiss fermented from 6 to 10 hours and compared with traditional koumiss, its fermentation time decreased by 2-3 hours.

2. It has been established that in pectin-containing koumiss, all biochemical parameters such as protein, carbohydrates and vitamin C increase, especially the protein and vitamin C content more than double, compared to traditional koumiss. Pectin-containing koumiss on a model of rats with cadmium intoxication in the amount of 50 g / kg body weight has a positive effect on the hematological and biochemical parameters of blood in rats, which helps to improve the general

condition and normalize the physiological functions of experimental animals.

3. The study allows us to recommend pectin-containing koumiss as a functional therapeutic and prophylactic product for residents living under conditions of chronic environmental stress in order to remove heavy metals from the body.

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