

NATURAL COMPOUNDS IN PRODUCTS OF PLANT AND ANIMAL ORIGIN

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*Natural compounds of animal and plant origin play a key role in maintaining human health and preventing diseases. Camel milk and sea buckthorn *Hippophae rhamnoides* are traditional food products and medicinal remedies with a unique composition and therapeutic properties. The aim of this work was a comprehensive study of the natural compounds in camel milk from Bactrian and Dromedary camels in the village of Nura (Ili District), as well as a comparative analysis of the biochemical composition of large-fruited and dessert varieties of sea buckthorn from the highland region of the village of Narynkol (Raiymbek District), Almaty Region. The scientific novelty lies in obtaining new data on the natural compounds of camel milk (proteins, fats, lactose, protein fractions, amino acids) and sea buckthorn (vitamins, antioxidants, flavonoids, carotenoids, organic acids, sugars, serotonin, omega fatty acids), considering species and varietal characteristics. An analysis of the chemical composition, protein fractions, and amino acids of the milk was conducted. In sea buckthorn, vitamins, antioxidants, flavonoids, carotenoids, organic acids, sugars, and serotonin were determined. The main natural compounds identified in camel milk were: proteins (3,4-5,2%), fats (5,8-7,3%), lactose (4,6-5,0%). Electrophoresis revealed casein fractions (α , β , γ) and whey proteins (immunoglobulins, serum albumin, α -lactalbumin, lactoferrin, lysozyme). Amino acid analysis showed a high content of essential amino acids (38,56-39,41 g/100 g protein). In sea buckthorn, a high content was found for vitamins C (up to 297 mg/100g), E (6,9-8,3 mg/100g), A (as carotenoids up to 55,3 mg/100g); flavonoids (265-346 mg/100g); phenolic compounds (600-795 mg/100g); carotenoids (20,0-55,3 mg/100g); organic acids (1,5-3,2%); sugars (9,6-15,0%); serotonin (0,8-1,2 mg/100g). Differences were revealed between large-fruited (high content of carotenoids, sugars) and dessert (high content of vitamin C, balanced sugar-acid index) varieties. For the first time, a detailed analysis of the natural compounds of camel milk and sea buckthorn was conducted, identifying species and varietal characteristics of their accumulation. The results can be used in the development of functional food products and biologically active supplements.*

Keywords: natural compounds, camel milk, proteins, casein, lactoferrin, lysozyme, amino acids, sea buckthorn, vitamins, flavonoids, carotenoids, serotonin, omega fatty acids.

ӨСІМДІКТЕР ЖӘНЕ ЖАНУАР ТЕКТІ ӨНІМДЕРДЕГІ ТАБИҒИ ҚОСЫЛЫСТАР

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*Жануар және өсімдік тектес табиғи қосылыстар адам денсаулығын сақтауда және аурулардың алдын алуда маңызды рөл атқарады. Түйе сүті мен шырғанақ *Hippophae rhamnoides* дәстүрлі тағам өнімдері және емдік қасиеттері бар бірегей құрамға ие дәрілік заттар болып табылады. Ғылыми зерттеудің мақсаты, негізгі бағыттары мен идеялары. Бұл жұмыстың мақсаты Нұра ауылы (Іле ауданы) бактериандары мен дромедарларының түйе сүтіндегі табиғи қосылыстарды кешенді зерттеу, сондай-ақ Алматы облысының Нарынқол ауылында (Райымбек ауданы) өсетін ірі жемісті және десертті шырғанақ сорттарының биохимиялық құрамына салыстырмалы талдау жасау болды. Жұмыстың ғылыми және практикалық*

маңыздылығының қысқаша сипаттамасы. Ғылыми жаңалық түйе сүтінің (ақуыздар, майлар, лактоза, ақуыз фракциялары, аминқышқылдары) және шырғанақтың (витаминдер, антиоксиданттар, флавоноидтар, каротиноидтар, органикалық қышқылдар, қанттар, серотонин) табиғи қосылыстары туралы түрлік және сорттық ерекшеліктерін ескере отырып, жаңа мәліметтер алу болып табылады. Сүттің химиялық құрамына, ақуыз фракцияларына, аминқышқылдарына талдау жүргізілді. Шырғанақта витаминдер, антиоксиданттар, флавоноидтар, каротиноидтар, органикалық қышқылдар, қанттар, серотонин анықталды. Зерттеу жұмысының негізгі нәтижелері мен талдауы, қорытындылары. Түйе сүтінде негізгі табиғи қосылыстар анықталды: ақуыздар (3,4-5,2%), майлар (5,8-7,3%), лактоза (4,6-5,0%). Электрофорез әдісімен казеин фракциялары (α_s , β , χ , γ) және сарысу ақуыздары (иммуноглобулиндер, сарысу альбумині, α -лактальбумин, лактоферрин, лизоцим) анықталды. Аминқышқылдық талдау алмастырылмайтын аминқышқылдарының жоғары мөлшерін көрсетті (38,56-39,41 г/100 г ақуыз). Шырғанақта С дәруменінің (297 мг/100 г дейін), Е дәруменінің (6,9-8,3 мг/100 г), А дәруменінің (каротиноидтар түрінде 55,3 мг/100 г дейін); флавоноидтардың (265-346 мг/100 г); фенолдық қосылыстардың (600-795 мг/100 г); каротиноидтардың (20,0-55,3 мг/100 г); органикалық қышқылдардың (1,5-3,2%); қанттардың (9,6-15,0%); серотониннің (0,8-1,2 мг/100 г) жоғары мөлшері анықталды. Ірі жемісті шырғанақта (каротиноидтардың, қанттардың жоғары мөлшері) және десертті түрінде (С дәруменінің жоғары мөлшері, теңдестірілген қант-қышқыл индексі) сорттары арасындағы айырмашылықтар анықталды. Жүргізілген зерттеудің құндылығы. Алғаш рет түйе сүті мен теңіз шырғанағының табиғи қосылыстарына олардың жинақталуының түрлік және сорттық ерекшеліктерін анықтай отырып, егжей-тегжейлі талдау жүргізілді. Жұмыс нәтижелерінің практикалық маңызы. Нәтижелерді функционалды тағам өнімдері мен биологиялық белсенді қоспаларды әзірлеу кезінде қолдануға болады.

Негізгі сөздер: табиғи қосылыстар, түйе сүті, ақуыздар, казеин, лактоферрин, лизоцим, аминқышқылдары, шырғанақ, дәрумендер, флавоноидтар, каротиноидтар, серотонин, омега-май қышқылдары.

ПРИРОДНЫЕ СОЕДИНЕНИЯ В ПРОДУКТАХ РАСТИТЕЛЬНОГО И ЖИВОТНОГО ПРОИСХОЖДЕНИЯ

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Природные соединения животного и растительного происхождения играют ключевую роль в поддержании здоровья человека и профилактике заболеваний. Верблюжье молоко и облепиха *Hipporhae rhamnoides* являются традиционными продуктами питания и лекарственными средствами, обладающими уникальным составом и терапевтическими свойствами. Целью данной работы явилось комплексное исследование природных соединений верблюжьего молока бактрианов и дромедаров из с. Нура (Илийский район), а также сравнительный анализ биохимического состава крупноплодных и десертных сортов облепихи из высокогорного района с. Нарынкол (Райымбекский район) Алматинской области. Научная новизна заключается в получении новых данных о природных соединениях верблюжьего молока (белки, жиры, лактоза, белковые фракции, аминокислоты) и облепихи (витамины, антиоксиданты, флавоноиды, каротиноиды, органические кислоты, сахара, серотонин, омега-жирные кислоты) с учетом видовых и сортовых особенностей. Проведен анализ химического состава, белковых фракций, аминокислот молока. В облепихе определяли витамины, антиоксиданты, флавоноиды, каротиноиды, органические кислоты, сахара, серотонин. В верблюжьем молоке идентифицированы основные природные соединения: белки (3,4-5,2%), жиры (5,8-7,3%), лактоза (4,6-5,0%). Методом электрофореза выявлены фракции казеина (α_s , β , χ , γ) и сывороточные белки (иммуноглобулины, сывороточный альбумин, α -лактальбумин, лактоферрин, лизоцим). Аминокислотный анализ показал высокое содержание незаменимых аминокислот (38,56-39,41 г/100 г белка). В облепихе установлено высокое содержание витаминов С (до 297 мг/100г), Е (6,9-8,3 мг/100г),

А (в виде каротиноидов до 55,3 мг/100г); флавоноидов (265-346 мг/100г); фенольных соединений (600-795 мг/100г); каротиноидов (20,0-55,3 мг/100г); органических кислот (1,5-3,2%); сахаров (9,6-15,0%); серотонина (0,8-1,2 мг/100г). Выявлены различия между крупноплодными (высокое содержание каротиноидов, сахаров) и десертными (высокое содержание витамина С, сбалансированный сахаро-кислотный индекс) сортами. Впервые проведен детальный анализ природных соединений верблюжьего молока и облепихи с выявлением видовых и сортовых особенностей их накопления. Результаты могут быть использованы при разработке функциональных продуктов питания и биологически активных добавок.

Ключевые слова: природные соединения, верблюжье молоко, белки, казеин, лактоферрин, лизоцим, аминокислоты, облепиха, витамины, флавоноиды, каротиноиды, серотонин, омега-жирные кислоты.

Introduction

Natural compounds of animal and plant origin are an inexhaustible source of biologically active substances necessary for maintaining human health and preventing various diseases. Among products of animal origin, camel milk holds a special place – a traditional food product of the peoples of Kazakhstan and Central Asia, possessing a unique composition and medicinal properties [1-5]. Among plant sources, sea buckthorn (*Hippophae rhamnoides*), widely distributed in Kazakhstan, including in the highland regions of the Almaty region (village of Narynkol, Raiymbek District), and long used in folk medicine, deserves special attention [6-17].

Camel milk contains a unique complex of natural compounds that distinguish it from the milk of other farm animals. Sea buckthorn is a powerful natural source of various biologically active substances, the composition of which varies depending on the variety. The aim of this work is a detailed analysis of the natural compounds of camel milk and sea buckthorn, with an emphasis on their qualitative and quantitative composition.

Materials and methods

The objects of the study were 30 samples of camel milk (*Bactrian and Dromedary*) from the village of Nura, Ili District, Almaty Region, as well as samples of *Hippophae rhamnoides* (sea buckthorn) collected in the village of Narynkol, Raiymbek District, Almaty Region.

Milk was collected during the active lactation period (June–August). Sea buckthorn fruits were collected at the stage of full biological maturity. All studies were performed in triplicate.

Camel milk sampling was carried out into sterile containers. Transportation was carried out at a temperature of +4 °C. Analysis was performed within 24 hours after collection. Before analysis, samples were homogenized. If necessary, centrifugation was performed to separate the fat phase.

Sea buckthorn fruits were cleaned of impurities, washed with distilled water, and dried at a temperature not exceeding 40 °C to constant weight. Samples were ground to a powdery state.

Determination of the chemical composition of camel milk. The mass fraction of protein was determined by the Kjeldalhi method in accordance with GOST 23327-98. Results were expressed as percentages.

The mass fraction of fat was determined by the acid-butyrometric method (Gerber method). Lactose was determined by the refractometric method. Fractional composition of proteins. Casein was isolated from milk by isoelectric precipitation at pH 4,6.

Fractional composition was determined by polyacrylamide gel electrophoresis. The α -, β -, χ -, and γ -fractions of casein were isolated. Whey proteins were studied after separation of the casein fraction. Identification was carried out by comparison with marker proteins. Amino acid composition. Proteins were subjected to acid hydrolysis (6N HCl, 110°C, 24 hours).

Quantitative determination of amino acids was carried out by ion exchange chromatography. Results were expressed in g/100 g protein. The content of macro- and microelements was determined by atomic absorption spectrophotometry after sample mineralization.

Methods for studying sea buckthorn. Vitamin C was determined by the titrimetric method.

Tocopherols and carotenoids were determined by the spectrophotometric method.

Flavonoids and phenolic compounds were determined by the Folin–Ciocalteu method and the complexation method with aluminum chloride.

Antioxidant activity was assessed spectrophotometrically. Organic acids and sugars were determined by high-performance liquid chromatography. The sugar-acid index was calculated as the ratio of the sum of sugars to the sum of organic acids.

The fatty acid composition of sea buckthorn oil was determined by gas chromatography.

Statistical analysis. Results are presented as mean value and standard deviation ($M \pm SD$). Statistical significance of differences was determined using Student's t-test. Differences were considered significant at $p < 0,05$.

Results and discussion

Natural compounds of camel milk. Basic nutrients (macronutrients). Camel milk contains a

complex of basic nutrients, the quantitative content of which varies depending on the animal species (Table 1).

Table 1. Content of basic nutrients in camel milk (%)

Indicator	Bactrian	Dromedary
Proteins	4,0-4,1 (up to 5,2 in bulk)	3,2-3,4 (up to 4,2 in bulk)
Fats	6,2-6,6 (up to 7,3 in bulk)	5,3-5,6 (up to 6,9 in bulk)
Lactose	4,6	4,6

Camel milk proteins are represented by complete proteins containing the full spectrum of essential amino acids. The protein content in Bactrian milk (4,0-4,1%) is higher than in Dromedary milk (3,2-3,4%), which corresponds to literature data on the higher nutritional value of Bactrian milk [1]. In bulk milk, the protein content reaches 5,2% in Bactrians and 4,2% in Dromedaries, which is associated with the presence of highly productive animals in the herd and the characteristics of the lactation period [2-4].

Camel milk fats are characterized by a high content (5,8-7,3%), significantly exceeding that of cow's milk (3,5-4,5%). Camel milk fat contains valuable fatty acids, including polyunsaturated ones, and is characterized by small fat globules, which facilitates its absorption. Bactrian milk contains more fat (6,2-6,6%) than Dromedary milk (5,3-5,6%), and in bulk milk these indicators reach 7,3% and 6,9%, respectively.

Lactose is the main carbohydrate in camel milk. Its content (4,6%) is close to that of cow's milk (4,7-4,9%). An important feature is the absence of β -lactoglobulin, the main allergenic protein in cow's milk, which makes camel milk a hypoallergenic product [18-23].

Protein fractions. Camel milk proteins are represented by two main groups: caseins (80-85% of total protein) and whey proteins (15-20%). The casein complex of camel milk is characterized by high heterogeneity. Using agar gel electrophoresis, casein was separated into 10 fractions with the following quantitative content: α s-casein – 39,7%, β -casein – 36,9%, χ -casein – 20,6%, γ -casein – 2,9% [18].

Polyacrylamide gel electrophoresis revealed significantly higher heterogeneity of the casein complex and interspecific differences. Bactrian milk casein was separated into 21 fractions, including:

β -casein – 9 fractions (Rf 0,05-0,39), total content 32,5%.

α s-casein – 7 fractions (Rf 0,45-0,70), total content 42,2%.

χ -casein – 3 fractions (Rf 0,72-0,82), total content 19,7%.

γ -casein – 2 fractions (Rf 0,97-0,98), total content 5,6%.

Dromedary milk casein was separated into 17 fractions (4 fractions less), indicating breed differences in protein composition [19, 20].

Whey proteins of camel milk are represented by 8-9 fractions. Using marker proteins, the following were identified:

Immunoglobulins (Rf 0,09-0,11) – provide immunological protection.

Serum albumin (Rf 0,15-0,18) – transport function.

α -lactalbumin (Rf 0,92-0,93) – participates in lactose synthesis.

Lactoferrin – an iron-binding glycoprotein with antimicrobial, antiviral, immunomodulatory, and antitumor activity. The content of lactoferrin in camel milk (0,02-2,1 g/L) is higher than in cow's milk (0,02-0,5 g/L), which gives it unique therapeutic properties [5,18].

Lysozyme – an enzyme that destroys bacterial cell walls, providing bactericidal properties of milk. The content of lysozyme in camel milk (0,00015-0,005 g/L) is significantly higher than in cow's milk (trace amounts) [20].

Lactoperoxidase – an enzyme with antibacterial properties, part of the body's natural defense system.

Whey proteins also show interspecific differences: 9 fractions were identified in Bactrian milk, and 8 fractions in Dromedary milk [18-20].

Amino acid composition. Amino acid analysis showed a high content of essential amino acids in camel milk proteins (Table 2).

Table 2. Amino acid composition of camel milk proteins (g/100 g protein)

Amino Acid	Casein	Whey Proteins
Lysine	6,67	6,89
Threonine	5,59	5,77
Valine	6,30	6,42
Methionine	2,92	2,87
Isoleucine	4,67	4,65
Leucine	8,41	8,66
Phenylalanine	3,09	3,04
Tryptophan	1,18	1,18
Essential amino acids (sum)	38,56	39,41
Histidine	2,67	2,70
Arginine	3,79	3,81
Partially essential (sum)	6,46	6,51
Aspartic acid	6,24	6,14
Serine	6,19	5,69
Glutamic acid	13,30	6,14
Proline	5,80	5,38
Glycine	3,80	3,30
Tyrosine	2,30	2,20
Non-essential (sum)	43,59	40,97

Camel milk contains a complex of macro- and microelements: calcium (120-150 mg/100g), phosphorus (80-110 mg/100g), potassium (150-180 mg/100g), sodium (50-70 mg/100g), magnesium (10-15 mg/100g), iron (0,2-0,5 mg/100g), zinc (0,4-0,6 mg/100g), copper, manganese, selenium. A special feature is the high content of iron and zinc in a readily available form [18].

The vitamin composition includes vitamins A (0,03-0,05 mg/100g), E (0,1-0,2 mg/100g), C (5-10 mg/100g), B1 (0,05 mg/100g), B2 (0,06-0,18

mg/100g), B12, PP. The vitamin C content in camel milk (up to 10 mg/100g) is significantly higher than in cow's milk (1-2 mg/100g) [20].

As a result of a comparative study of large-fruited and dessert varieties of sea buckthorn from the village of Narynkol, a high content and significant variability of natural compounds were found depending on the variety.

Sea buckthorn is a multivitamin plant containing a complex of water- and fat-soluble vitamins (Table 3).

Table 3. Vitamin content in fruits of different sea buckthorn varieties (mg/100g)

Vitamin	Large-fruited varieties <i>Velikan</i>	Dessert varieties <i>Lyubimaya</i>
Vitamin C (ascorbic acid)	82-156	up to 297
Vitamin E (tocopherols)	6,9-8,3	7,0-8,0
Carotenoids (provitamin A)	20,0-55,3	10,7-25,0
Vitamin K	0,8-1,2	0,8-1,0
B vitamins: B1 (thiamine)	0,03-0,05	0,03-0,05
B2 (riboflavin)	0,04-0,06	0,04-0,06
B6 (pyridoxine)	0,7-0,8	0,7-0,8
B9 (folates)	0,02-0,03	0,02-0,03

Vitamin C is the dominant vitamin in sea buckthorn. The ascorbic acid content varies from 82 to 297 mg/100g, which significantly exceeds that of lemon (40-50 mg/100g) and most other fruit and berry crops [12]. The highest vitamin C content (up to 297 mg/100g) was noted in dessert varieties [8]. The high vitamin C content determines the immunomodulatory, antioxidant, and general strengthening properties of sea buckthorn.

Vitamin E (tocopherols) is represented by a

complex of isomers with antioxidant activity. The vitamin E content in sea buckthorn fruits is 6,9-8,3 mg/100g, making sea buckthorn one of the richest plant sources of this vitamin [13].

Tocopherols protect cell membranes from oxidative damage and participate in the regulation of reproductive function.

Carotenoids (provitamin A) are a group of fat-soluble pigments that give sea buckthorn fruits their characteristic orange color. The carotenoid content

varies from 10,7 to 55,3 mg/100g, with large-fruited varieties characterized by maximum accumulation of carotenoids (55,3 mg/100g) [8]. The main carotenoids of sea buckthorn are β -carotene, γ -carotene, lycopene, zeaxanthin, and lutein. Carotenoids possess antioxidant properties, are precursors of vitamin A,

and support vision and immunity.

Phenolic compounds are one of the most important groups of biologically active substances in sea buckthorn, determining its antioxidant, anti-inflammatory, and capillary-strengthening properties (Table 4).

Table 4. Content of phenolic compounds in sea buckthorn fruits (mg/100g)

Compound group	Large-fruited varieties <i>Velikan</i>	Dessert varieties <i>Lyubimaya</i>
Flavonoids (sum)	265-320	300-346
- including quercetin	45-60	50-70
- including isorhamnetin	80-100	90-120
- including kaempferol	30-40	35-45
Phenolic acids	105-150	130-170
Total phenolic compounds	600-720	650-795

Flavonoids are represented by glycosides of quercetin, isorhamnetin, and kaempferol. The flavonoid content varies from 265 to 346 mg/100g, with dessert varieties characterized by higher values [12]. Sea buckthorn flavonoids exhibit vitamin P activity, strengthen capillary walls, and have antioxidant, anti-inflammatory, and choleretic effects.

Phenolic acids (caffeic, ferulic, salicylic, ellagic) are present in amounts of 105-170 mg/100g and possess antioxidant, anti-inflammatory, and antimicrobial properties [14].

The antioxidant activity of sea buckthorn fruits, correlating with the content of phenolic compounds and vitamin C, varies depending on the variety. Varieties with a high content of vitamin C and flavonoids exhibit the highest antioxidant activity. It was found that the antioxidant activity of alcohol fractions is 1,3-1,7 times higher than that of aqueous fractions [14].

The carbohydrate-acid complex determines the taste qualities of the fruits and their nutritional value (Table 5).

Table 5. Sugar and organic acid content in sea buckthorn fruits (%)

Indicator	Large-fruited varieties <i>Velikan</i>	Dessert varieties <i>Lyubimaya</i>
Total sugars	9,6-15,0	8,0-12,0
- fructose	4,5-7,0	4,0-6,0
- glucose	4,0-6,5	3,5-5,5
- sucrose	1,0-1,5	0,5-1,0
Organic acids 1	1,5-2,5	2,0-3,2
Sugar-acid index	3,8-6,0	2,5-4,0

Sugars are represented mainly by fructose and glucose, the content of which varies from 8,0 to 15,0% [13]. Large-fruited varieties are characterized by a higher sugar content (9,6-15,0%), which determines their sweet taste and suitability for processing.

Organic acids (malic, citric, oxalic, succinic, quinic) are present in amounts of 1,5-3,2%. Dessert varieties are distinguished by a higher content of organic acids (2,0-3,2%), which, combined with an optimal sugar content, provides a balanced sweet-sour taste and a high sugar-acid index – an important indicator of the taste qualities of the fruit [8].

Sea buckthorn oil is a unique product containing a complex of fatty acids and fat-soluble biologically active substances.

A unique feature of sea buckthorn is the presence in the fruits of serotonin (5-hydro-

xytryptamine), a neurotransmitter known as the "happiness hormone". The serotonin content is 0,8-1,2 mg/100g [7]. Serotonin regulates emotional state, appetite, sleep, and participates in the regulation of vascular tone and intestinal peristalsis. The presence of serotonin determines the mild antidepressant effect of sea buckthorn products.

Sea buckthorn contains a complex of macro- and microelements (mg/100g): potassium (150-200), calcium (20-30), magnesium (25-35), phosphorus (15-25), iron (1-2), zinc (0,5-1,0), copper (0,1-0,2), manganese (0,3-0,5), boron (0,1-0,2) [13].

The conducted studies revealed clear differences in the accumulation of natural compounds between large-fruited and dessert varieties of sea buckthorn (Table 6).

Table 6. Comparative characteristics of natural compounds in large-fruited and dessert sea buckthorn varieties

Natural compounds	Large-fruited varieties <i>Velikan</i>	Dessert varieties <i>Lyubimaya</i>
sugars	High content (9,6-15,0%)	Moderate content (8,0-12,0%)
Organic acids	Moderate content (1,5-2,5%)	Increased content (2,0-3,2%)
Sugar-acid index	High (3,8-6,0)	Balanced (2,5-4,0)
Vitamin C	Medium (82-156 mg/100g)	High (up to 297 mg/100g)
Carotenoids	High (20,0-55,3 mg/100g)	Medium (10,7-25,0 mg/100g)
Flavonoids	265-320 mg/100g	300-346 mg/100g
Phenolic compounds	600-720 mg/100g	650-795 mg/100g
Antioxidant activity	High	Very High
Fruit size	Large (1.1-1.4 g)	Medium
Yield	High (up to 5.2 kg/bush)	Medium
Purpose	Processing (juice, oil)	Fresh consumption, functional foods

Large-fruited varieties are characterized by a high content of carotenoids (up to 55,3 mg/100g), sugars (up to 15,0%), large fruits (weight up to 1,4 g), and high yield [8]. These varieties are most suitable for obtaining juice, oil, and various types of processing.

Dessert varieties are distinguished by a high content of vitamin C (up to 297 mg/100g), a balanced sugar-acid index, and an increased content of flavonoids and phenolic compounds, which ensures their high taste qualities and antioxidant activity [8,12,14]. These varieties are optimal for fresh consumption and the production of functional food products aimed at boosting immunity and antioxidant protection.

Conclusion

Camel milk contains a unique complex of natural compounds, including complete proteins with a high content of essential amino acids (38,56-39,41 g/100 g protein), easily digestible fats (5,8-7,3%), lactose (4,6-5,0%), a wide range of protein fractions – caseins (α , β , χ , γ -fractions) and whey proteins (immunoglobulins, serum albumin, α -lactalbumin, lactoferrin, lysozyme, lactoperoxidase) [1-5, 18-20]. Interspecific differences were revealed: Bactrian milk is characterized by a higher content of protein and fat, as well as a larger number of casein fractions (21 versus 17 in Dromedaries) and whey proteins (9 versus 8). The high biological value of camel milk proteins is confirmed by the amino acid score exceeding 100% for six of the eight essential amino acids [22].

Sea buckthorn (*Hippophae rhamnoides*) is a source of various natural compounds: vitamins (C up to 297 mg/100g, E 6,9-8,3 mg/100g, carotenoids up to 55,3 mg/100g, K, B group), flavonoids (265-346 mg/100g), phenolic compounds (600-795 mg/100g), organic acids (1,5-3,2%), sugars (8,0-15,0%), serotonin (0,8-1,2 mg/100g) [6-10,12-23]. Varietal differences were revealed: large-fruited varieties are characterized by a high content of

carotenoids and sugars, while dessert varieties are characterized by a high content of vitamin C and a balanced sugar-acid index [8,12-14].

The obtained data can be used in the development of functional food products and biologically active supplements based on camel milk and sea buckthorn, considering their species and varietal characteristics.

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