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**DEVELOPMENT OF FUNCTIONAL TEA DRINKS**

**ON FRUIT AND VEGETABLE BASIS**

***Annotation.*** *The article presents data on the development of new types of tea beverages based on fruit and vegetable raw materials with targeted preventive properties. Scientific and experimental justification of the selection of raw materials with increased content of bioactive substances, including vitamins, macro- and microelements, phenolic compounds, bioflavonoids, and organic acids, is provided. Three types of tea beverages have been developed: "Antioxidant," "Immunostimulating," and "Cardiovascular." The aim of this research was the scientific substantiation and development of new types of tea beverages with targeted preventive properties. Fruit and vegetable raw materials with increased content of essential nutrients served as the research materials. Commonly accepted analytical, physico-chemical, and technological research methods were used in the study. The choice of raw materials was justified based on their physiological impact on the antioxidant defense system, immunity, and cardiovascular system. Formulas for specialized fruit-based tea beverages with the addition of medicinal plants are provided. Physico-chemical and organoleptic indicators of tea beverages were evaluated, and data on the chemical composition, including major bioactive substances, are presented. The developed functional tea beverages for mass consumption and preventive purposes are formulated according to the created recipes, taking into account antioxidant and immunostimulating activities, as well as the favorable effects of individual tea components on the cardiovascular system.*

***Keywords:*** *tea beverages, fruit raw materials, medicinal plants, antioxidant properties, immunostimulating properties, cardiovascular system.*

**Introduction**

In recent years, chronic alimentary-related diseases and immunodeficiency states have become one of the most important medical and social problems of world health care, due to their high prevalence and serious threats to public health [1]. One of the solutions to this problem is the rationalization of nutrition of the population by introducing specialized and functional food products for healthy nutrition into the diet.

The results of numerous applied scientific and technical studies indicate that various specialized food products based on fruit, berry and medicinal plant raw materials can have a directed tonic, immune-stimulating and generally preventive effect.

In this connection, it is urgent to develop scientifically substantiated and innovative in recipe and technological execution of tea drinks on fruit and berry and herbal basis of polyfunctional purpose for replenishing the deficit of a number of essential nutrients and improving the structure of nutrition of the population.

Taking into account the above-mentioned, the aim of the present study was the design of formulation compositions based on fruits, berries, medicinal raw materials of local growth for the development of tea drinks of preventive action.

**Materials and methods of research**

The objects of the present study were black and green tea leaves, freeze-dried fruits and berries, as well as medicinal plants with increased content of biologically active substances.

Physico-chemical and technological methods of research were used in the work. Acceptance of tea was carried out in accordance with the Interstate Standard (GOST) 1936-85 "Acceptance rules and methods of analysis". Black and green tea leaves were accepted in batches. According to the mentioned normative document, the batch is considered to be the number of packing units with tea of one or several brands. Sampling was carried out in a closed room in accordance with GOST ISO 1839-2018 "Tea. Sampling".

Mass fraction of moisture, protein, lipids, ash, vitamins and minerals were determined using chemical and physicochemical methods of analysis according to generally accepted methods of testing. Determination of mineral substances was carried out using the method of atomic adsorption spectrometry. Analysis of water- and fat-soluble vitamins in the composition of tea drinks was carried out using high-performance liquid chromatography.

Determination of beta-carotene content was carried out in accordance with GOST 8756.22-80 "Fruit and vegetable processing products. Method for determination of carotene". Determination of the total content of antioxidants in products of plant origin was carried out on the device "TsvetYauza-01-AA" with amperometric detection. Amperometric detection consists in measuring the electric current in the cell, arising from the oxidation (reduction) of the analyzed substance on the surface of the working electrode when a certain potential is applied to it [2].

The estimation of the level of dry matter and moisture in dried fruits and vegetables was carried out in accordance with GOST 28561-90 "Fruit and vegetable processing products. Methods for determination of dry matter or moisture".

Vitamin C level in fruit and vegetable raw materials, as well as in finished tea drinks was estimated in accordance with GOST 24556-89 "Fruit and vegetable processing products. Methods of determination of vitamin C". Determination of vitamin E content in tea drinks was carried out in accordance with GOST EN 12822-2014 "Food products. Determination of vitamin E (alpha-, beta-, gamma- and delta-tocopherols) by high-performance liquid chromatography".

The mineral composition of tea drinks was analyzed in accordance with GOST 26928-86 "Food products. Method for determination of iron" and GOST 26934-86 "Raw materials and food products. Method for determination of zinc".

The level of bioflavonoids and organic acids in the composition of tea drinks was evaluated in accordance with R 4.1.1672-03 "Guidance on methods of quality control and safety of biologically active food additives".

**Literature review**

Tea beverages, as mass consumption products, have long held an important place in the life of many countries around the world and have a rich history. Plant raw materials used in tea beverages include fresh or dried roots, stems, leaves, fruits, flowers, seeds, bark or whole plants of one or more plant species. The increase in tea beverage consumption over the last decade has paralleled the increase in organic production worldwide. Consumer demand for organic products is driven by their obvious environmental and human health benefits.

One of the promising directions of expanding the range of specialized tea drinks is modification of the component composition of traditional teas by introducing into the formulation of fruit and vegetable raw materials with an increased content of biologically active substances, in particular, vitamins, natural antioxidants, macro- and microelements, bioflavonoids, phenolic compounds and organic acids. At the same time in the production of functional tea drinks it is necessary to use only natural raw materials of plant origin without the addition of ingredients obtained by chemical synthesis [3].

**Results and their discussion**

For the design of new composite tea drinks with expressed preventive properties the selection of raw material sources with increased content of biologically active substances providing directed antioxidant and immunostimulant properties, as well as favorably affecting the cardiovascular system was carried out.

In order to scientifically and experimentally substantiate the choice of plant components in the development of a tea drink with targeted antioxidant properties, the content of vitamin C and β-carotene, as well as the total content of antioxidants in the used fruit and vegetable raw materials was analyzed. The results of the analysis are summarized in Table 1.

Table 1 - Content of vitamin C and β-carotene, as well as the total content of antioxidants in the fruit and vegetable raw materials included in the tea drink

|  |  |  |  |
| --- | --- | --- | --- |
| Name of Ingredients | Vitamin C content, mg/100g | β-carotene content, mg/100 g | Total content of antioxidants, mg/g |
| Cranberries | 17,2±1,2 | 0,03±0,01 | 44,8±3,2 |
| Goji berries | 49,5±3,8 | 91,3±7,6 | 31,0±2,6 |
| Black tea leaves | 8,2±1,0 | Not detected | 25,4±1,9 |
| Dried black currant fruit | 196,5±14,3 | 0,1±0,03 | 21,6±1,2 |
| Peppermint leaves | 32,5±1,9 | 18,7±1,6 | 15,2±1,1 |
| Oregano herb | Not detected | 0,1±0,01 | 6,6±0,7 |
| Sea buckthorn fruits | 215,7±18,4 | 33,7±2,9 | 3,2±0,5 |
| Melissa leaves | 100,1±9,9 | 47,2±3,6 | 0,7±0,01 |
| Dried lemon peel | 90,5±8,4 | 24,4±1,6 | 0,8±0,03 |

The high level of total antioxidants in cranberries, Goji berries, black tea leaves and freeze-dried black currant fruits is due to the high content of catechins, anthocyanins, carotenoids, vitamins C, E, tannin and bioflavonoids that regulate the protective functions of the body against free radical damage and prevent the development of oxidative stress in the body [4-6].

Sea buckthorn fruits included in the formulation of the tea drink have a high content of flavonols, xanthophylls, carotenes, tocopherols, as well as vitamins A, C, E and β-carotene [7]. Melissa medicinalis leaves contain substances of antioxidant nature, including flavonoids (quercetin and rutin), polyphenols (rosmarinic acid and caffeic acid), and carotenoids. These phytochemical components are powerful antioxidants that help protect body cells from the harmful effects of free radicals and reduce oxidative stress [8].

Also designed a recipe for the preparation of a tea drink, based on green tea, fruit and vegetable raw materials, increasing the protective functions of the body to the impact of external environmental factors, as well as contributing to the nutritional support of the immune system of the body and the prevention of alimentary-related diseases.

Immunostimulating properties of green tea leaves are associated with the content of polyphenols, catechins and epigallocatechins, vitamins, amino acids and carbohydrates. Also green tea leaves are rich in alkaloids, saponins, tannins, tannins, terpenoids, flavonoids, phenols and sterols [9]. Lemon peel (Citrus limon) is characterized by its high content of vitamin C, phenolic compounds and bioflavonoids [10]. Goji berries have a favorable effect on the immune system, promote the activation of T-lymphocytes, NK-cells and immunoglobulins Lg G and LgA. Ginseng root and Eleutherococcus herb contain tetracyclic triterpenoid saponins (ginsenosides), polyacetylenes, polyphenolic compounds and various polysaccharides [11,12].

One of the widely used medicinal plants in the food industry is licorice root due to its pronounced immunostimulant and antioxidant properties. Licorice root is used for the prevention of a number of non-infectious diseases and antiviral conditions [13]. Resveratrol contained in grape seeds is a polyphenol with pronounced antioxidant and immunostimulant properties [14].

For use in the prevention of cardiovascular diseases developed a composite tea drink containing black tea leaves with the addition of a complex of freeze-dried berries and medicinal plants that have a favorable effect on the cardiovascular system.

Black currant hawthorn and rosehip fruits characterized by high content of vitamin A, C and E, phenolic compounds, anthocyanins, catechins, as well as macro- and microelements increase antioxidant capacity of the body, contribute to the reduction of cholesterol in the blood, improve the work of the heart muscle and reduce blood pressure and the risk of arrhythmias [15,16]. Blueberries are also a good source of phenolic compounds, especially anthocyanins, which help to reduce blood pressure and high-density lipoprotein (HDL) cholesterol levels, which are potential predictors of cardiovascular disease [17].

Also, motherwort herb is of particular interest in the prevention of cardiovascular diseases, due to its favorable effect on the functioning of a number of individual body systems [18]. The wide use of immortelle flowers in the prevention of cardiovascular diseases is due to the high content of polyphenolic compounds such as arzanol, homodimeric α-pyrone, phenolic acids and flavonoids [19].

Based on the uniqueness of the chemical composition and high biological value of the above-mentioned fruit and vegetable raw materials, the formulations of tea mixtures "Antioxidant", "Immunostimulating" and "Cardiovascular" were designed. Component compositions of tea drinks are given in Table 2.

Table 2 - Recipes of tea drinks

|  |  |  |  |
| --- | --- | --- | --- |
| Ingredient Name | Antioxidant, g  | Immunostimulating, g  |  Cardiovascular, g |
| Black tea leaves | 25,0 |  | 10,0 |
| Green tea leaves |  | 15,0 |  |
| Carcade |  | 38,0 |  |
| Hawthorn fruit |  |  | 20,0 |
| Lemon zest |  | 17,0 |  |
| Black currant fruit |  |  | 15,0 |
| Rose hips |  |  | 15,0 |
| Goji berries | 10,0 | 13,0 |  |
| Blueberries |  |  | 10,0 |
| Sea buckthorn fruit  | 10,0 |  |  |
| Melissa leaves | 10,0 |  |  |
| Cranberry berries | 10,0 |  |  |
| Common oregano | 10,0 |  |  |
| Ginger root | 5,0 |  |  |
| Clove flowers | 5,0 |  |  |
| Bearberry leaves | 5,0 |  |  |
| Echinacea | 5,0 |  |  |
| Mint leaves  | 5,0 |  | 5,0 |
| Ginseng root |  | 5,0 | 5,0 |
| Eleutherococcus herb |  | 5,0 |  |
| Rhodiola rosea root |  | 3,0 |  |
| Licorice root |  | 3,0 | 3,0 |
| Motherwort herb |  |  | 5,0 |
| Chicory root |  |  | 5,0 |
| Immortelle flowers |  |  | 5,0 |
| Resveratrol |  | 1,0 | 2,0 |

During the research, indicators of the nutritional value of dry tea drink blends were identified, as well as the content of minor and bioactive substances, including vitamins, minerals, bioflavonoids, tannins, etc.

Table 3 - presents the physicochemical characteristics of the developed tea beverages, calculated per 100 g of dry tea mixture.

|  |  |  |  |
| --- | --- | --- | --- |
| Indicators | "Antioxidant." | «Immunostimulating» | «Cardiovascular» |
| Protein, g | 0,76±0,05 | 2,91±0,05 | 1,49±0,09 |
| Fats, g | 0,92±0,06 | 1,56±0,06 | 1,02±0,06 |
| Carbohydrates, g | 82,05±4,1 | 76,18±3,8 | 79,34±3,98 |
| Moisture, % | 9,16±0,46 | 8,49±0,42 | 8,79±0,44 |
| Ash, % | 7,11±0,36 | 10,86±0,54 | 9,36±0,47 |
| Energy value, kcal/KJ | 339/1418 | 330/1380 | 332/1389 |

The results of studies regarding the physico-chemical characteristics of the developed tea blends indicate their high nutritional and energy value, which is attributed to the low protein and fat content, coupled with a high level of carbohydrates.

The results for the content of vitamins and macroelements in tea blends based on fruit and herbal ingredients are presented in Table 4.

Table 4 – Vitamin and mineral composition of tea beverages, per 100 g of dry tea blend.

|  |  |  |  |
| --- | --- | --- | --- |
| Nutrients | "Antioxidant." | «Immunostimulating» | «Cardiovascular» |
| Vitamin E, mg | 0,57 ±0,06 | 0,62 ±0,04 | 0,53 ±0,05 |
| Vitamin C, mg | 67,58 ±4,65 | 57,43±4,23 | 49,96 ±3,65 |
| β-carotene, mg | 0,78 ±0,06 | 0,42±0,02 | 0,49 ±0,51 |
| Iron (Fe), mg | 0,84 ±0,07 | 0,75±0,03 | 0,94 ±0,06 |
| Zinc (Zn), mg | 0,15±0,02 | 0,13±0,01 | 0,14±0,01 |

The evaluation of the vitamin and mineral composition of tea beverages revealed that the developed tea blends had a balanced composition of the investigated micronutrients, particularly vitamin C, E, β-carotene, iron, and zinc. Polyvitamin deficiency, as well as the deficiency of macro- and microelements, reduce the overall resistance of the body to viral and bacterial agents and increase the risk of developing various metabolic disorders, oncological, and cardiovascular diseases. Taking into account the above introduction into the diet of specialized products, in particular, functional fruit and herbal tea beverages with an increased content of natural bioactive substances, is an effective method of preventing these diseases.

In addition to vitamins and minerals, a special role in strengthening immunity, as well as in the prevention of cardiovascular diseases, belongs to bioflavonoids. Bioflavonoids, in combination with organic acids, give food products color and possess a wide range of beneficial properties. During the study, the levels of bioflavonoids and organic acids were determined in the developed tea compositions, including the content of quercetin, dehydroquercetin, catechins, gallic acid, and tannins.

Table 5 - The results of the analysis.

|  |  |  |  |
| --- | --- | --- | --- |
| Nutrients | "Antioxidant." | «Immunostimulating» | «Cardiovascular» |
| Quercetin, mg | 1,16±0,56 | 23,00±1,32 | 1,12±0,59 |
| Dehydroquercetin, mg | Not detected | Not detected | 2,07±0,68 |
| Catechin, mg | 13,68±0,97 | 22,41±1,45 | 35,91±2,89 |
| Gallic acid, mg | 64,47±5,23 | 40,08±3,56 | 45,53±4,22 |
| Tannin, mg | 2,32±0,32 | 7,00±0,89 | 1,60±0,35 |

The results of conducted clinical studies indicate that incorporating foods with elevated levels of quercetin and its derivatives into the diet contributes to reducing the risk of developing cardiovascular diseases and ischemic brain injuries, which are currently the most common pathologies in developed countries [20]. The research findings suggest that the developed tea beverages can serve as an additional source of quercetin in the body, with the highest level of this bioflavonoid observed in the "Immune-Boosting" tea beverage samples. Dehydroquercetin was present in only one tea blend sample - "Cardiovascular." Additionally, virtually all tea beverage samples showed a high content of catechins, gallic acid, and tannin, exerting targeted physiological effects, primarily antioxidant, and enhancing the body's protective functions and preventive action against various non-infectious diseases, as well as countering the negative impact of foreign compounds and adverse environmental factors.

**Conclusion, Findings**

Thus, the developed functional tea beverages for mass consumption and preventive purposes are formulated in accordance with created recipes, considering their antioxidant and immune-stimulating activity, as well as their beneficial impact on the cardiovascular system. The recipes and technology for functional tea beverages involve the use of black and green tea leaves with the addition of both traditional and non-traditional fruit, berry, and plant materials. The results of conducted research indicated that the tea blends exhibited high sensory characteristics and a well-balanced content of minor substances.

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**ЖЕМІС-ЖИДЕКТЕР НЕГІЗІНДЕ ФУНКЦИОНАЛДЫҚ**

 **ШАЙ СУСЫНДАРЫН ӘЗІРЛЕУ**

***Аннотация.*** *Мақалада шай сусындарының жаңа түрлерін әзірлеу туралы ғылыми-тәжірибелік негіздемесі мен профилактикалық қасиеттері бойынша деректер көрсетілген. Зерттеудің мақсаты жеміс-жидек шикізатының жоғары деңгейінде биологиялық белсенді заттарды, дәрумендерді, макро- және микроэлементтерді, фенолдық қосылыстарды, биофлавоноидтарды қолдана отырып, шай сусындарының 3 түрін – «Антиоксиданттық», «Иммуностимуляциялау», «Жүрек-қан тамырларына арналған» – жасау. Зерттеу материалдарында жеміс-жидек шикізатының маңызды қоректік заттары қолданылды. Аналитикалық, физика-химиялық және технологиялық зерттеу әдістері арқылы шай сусындарының профилактикалық қасиеттерінің жүзеге асуы, физиологиялық әсерін ескере отырып, дәрілік өсімдіктер қосылған рецептураларды жасау жүргізілді. Жеміс-жидек шикізатының биологиялық құрамы, химиялық құрамы, органолептикалық көрсеткіштері туралы мәліметтер берілген. Жасалған функционалды шай сусындары антиоксидантты иммуностимуляциялау белсенділігін, жүрек-тамыр жүйесінің жұмысына пайдалы әсерін көрсетеді.*

***Түйін сөздер:*** *шай сусындары, жеміс-жидек шикізаты, дәрілік өсімдіктер, антиоксиданттық қасиеттер, иммуностимуляциялық қасиеттер, жүрек-тамыр жүйесі.*

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**Разработка чаев и чайных напитков с использованием местных**

**растительных материалов с целью обеспечения здорового питания.**

***Аннотация.*** *В данной статье представлены результаты исследования, посвященного разработке новых видов чайных напитков, основанных на использовании плодов и ягод, а также растительного сырья с направленными профилактическими свойствами. В ходе научно-экспериментального исследования было обосновано выбор сырьевых материалов, содержащих повышенное количество биологически активных веществ, таких как витамины, макро- и микроэлементы, фенольные соединения, биофлавоноиды и органические кислоты. Разработаны три вида чайных напитков с фокусированными превентивными свойствами: "Антиоксидантный", "Иммуностимулирующий" и "Сердечно-сосудистый". Основной целью исследования было научное обоснование и разработка этих напитков с учетом их направленного воздействия на здоровье. Материалами для исследования послужили плодово-ягодное и растительное сырье с повышенным содержанием необходимых питательных веществ. В ходе работы использовались стандартные методы анализа, включая аналитические, физико-химические и технологические подходы. Выбор сырья осуществлялся с учетом его воздействия на антиоксидантную защиту, иммунитет и функционирование сердечно-сосудистой системы. Рецептуры специализированных чайных напитков на основе плодов и ягод с добавлением лекарственных растений были разработаны и представлены.*

*Произведена оценка физико-химических и органолептических характеристик чайных напитков, а также предоставлены данные о химическом составе, включая основные биологически активные вещества. Разработанные функциональные чайные напитки, предназначенные для массового потребления и профилактического применения, соответствуют созданным рецептурам и обладают антиоксидантной, иммуностимулирующей активностью, а также благоприятно воздействуют на работу сердечно-сосудистой системы.*

***Ключевые слова:*** *чайные напитки, плодово-ягодное сырье, лекарственные растения, антиоксидантные свойства, иммуностимулирующие свойства, сердечно-сосудистая система.*

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