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DEVELOPMENT OF A FUNCTIONAL SEA BUCKTHORN-BASED DRINK WITH A SUGAR SUBSTITUTE AND COLLAGEN

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Functional drinks exhibit antioxidant activity due to their content of vitamins, flavonoids, and polyphenols. The developed drink, based on sea buckthorn, apple, and grape juices, contains vitamin C (35 mg/100 mL), beta-carotene, and resveratrol, contributing to its antioxidant and immunostimulating properties. The formulation includes natural, freshly squeezed juices: sea buckthorn ("Altai"), apple ("Voskhod"), and grape ("Isabella"), along with collagen (8.5 g) and stevia (0.3 g). The optimal juice ratio (apple 60%, sea buckthorn 20%, grape 20%) ensures a balanced taste and enhanced functional value. The drink exhibits a golden-orange color, a sweet and sour taste, and a fruity aroma. Collagen enhances its biological value, while stevia lowers the calorie content without affecting the glycemic index. Research findings confirm that this combination results in a functional beverage with antioxidant properties, desirable organoleptic characteristics, and reduced calorie content, promoting overall health. Additionally, the drink provides essential nutrients that support metabolic processes and overall well-being. Regular consumption of this beverage may help strengthen the immune system and improve skin health due to its rich composition. Moreover, the combination of bioactive compounds contributes to better digestion, energy metabolism, and overall vitality.

Keywords: functional drink, sea buckthorn, stevia, collagen, technology, recipe, antioxidants.

ҚАНТ АЛМАСТЫРҒЫШ ПЕН КОЛЛАГЕН ҚОСЫЛҒАН, ШЫРҒАНАҚ НЕГІЗІНДЕГІ ФУНКЦИОНАЛДЫ СУСЫННЫҢ РЕЦЕПТУРАСЫН ӘЗІРЛЕУ

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Функционалды сусындар дәрумендердің, флавоноидтардың және полифенолдардың арқасында антиоксиданттық белсенділікке ие. Шырғанақ, алма және жүзім шырындарына негізделген сусын құрамында С дәрумені (35 мг/100 мл), бета-каротин және резвератрол бар, ол антиоксидантты және иммуностимуляторлық қасиеттерді қамтамасыз етеді. Сусын дайындау үшін, шырғанақ ("Алтай"), алма ("Восход"), жүзім ("Изабелла") табиғи, жаңа сығылған шырындары, сонымен қатар коллаген (8,5 г) және стевия (0,3 г) қолданылды. Шырындардың оңтайлы қатынасы (алма — 60%, шырғанақ — 20%, жүзім — 20%) теңдестірілген дәм мен функционалды құндылықты қамтамасыз етеді. Сусынның алтын-қызғылт сары түсі, тәтті және қышқыл дәмі және жеміс хош иісі бар. Коллаген оның биологиялық құндылығын арттырады, ал стевия гликемиялық индексті жоғарылатпай калорияны төмендетеді. Зерттеулер бұл компоненттердің үйлесімі денсаулықты нығайтуға көмектесетін антиоксиданттық қасиеттері, жағымды органолептикалық сипаттамалары және төмен калориялы функционалды өнім жасауға мүмкіндік беретінін растады. Сонымен қатар, сусынның құрамында метаболикалық процестер мен жалпы әл-ауқатты қолдайтын маңызды қоректік заттар бар. Бұл сусынды үнемі тұтыну иммундық жүйені нығайтуға және оның бай құрамының арқасында терінің денсаулығын жақсартуға көмектеседі. Және де, биологиялық белсенді қосылыстардың үйлесімі ас қорытуды, энергия алмасуын және жалпы өмір тонусын жақсартуға көмектеседі.

Негізгі сөздер: функционалды сусын, шырғанақ, стевия, коллаген, технология, рецептура, антиоксиданттар.

РАЗРАБОТКА РЕЦЕПТУРЫ ФУНКЦИОНАЛЬНОГО НАПИТКА НА ОСНОВЕ ОБЛЕПИХИ С ДОБАВЛЕНИЕМ САХАРОЗАМЕНИТЕЛЯ И КОЛЛАГЕНА

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Функциональные напитки обладают антиоксидантной активностью благодаря витаминам, флавоноидам и полифенолам. Напиток на основе облепихового, яблочного и виноградного соков содержит витамин С (35 мг/100 мл), бета-каротин и ресвератрол, что обеспечивает антиоксидантные и иммуностимулирующие свойства. Использованы натуральные, свежевыжатые соки: облепиховый («Алтайская»), яблочный («Восход»), виноградный («Изабелла»), а также коллаген (8,5 г) и стевия (0,3 г). Оптимальное соотношение соков (яблочный — 60%, облепиховый — 20%, виноградный — 20%) обеспечивает сбалансированный вкус и функциональную ценность. Напиток имеет золотисто-оранжевый цвет, кисло-сладкий вкус и фруктовый аромат. Коллаген повышает его биологическую ценность, а стевия снижает калорийность без повышения гликемического индекса. Исследования подтвердили, что сочетание этих компонентов позволяет создать функциональный продукт с антиоксидантными свойствами, приятными органолептическими характеристиками и низкой калорийностью, способствующий укреплению здоровья. Кроме того, напиток содержит необходимые питательные вещества, которые поддерживают обменные процессы и общее самочувствие. Регулярное употребление этого напитка может помочь укрепить иммунную систему и улучшить здоровье кожи благодаря его богатому составу. Также, сочетание биологически активных соединений способствует улучшению пищеварения, энергетического обмена и общего жизненного тонуса.

Ключевые слова: функциональный напиток, облепиха, стевия, коллаген, технология, рецептура, антиоксиданты

Introduction.

Functional drinks constitute a significant segment of the healthy food market due to their unique properties aimed at promoting health and preventing diseases. A promising direction in this field is the development of beverages based on sea buckthorn, which is rich in vitamin C, vitamin E, carotenoids, polyphenols, and fatty acids. The incorporation of sugar substitutes reduces the calorie content of the product, while the addition of collagen supports skin, joint, and bone health.

In recent years, next-generation functional food products have gained increasing popularity in the domestic consumer market. Unlike conventional food products, functional beverages offer not only nutritional value but also beneficial physiological effects on the human body. With the rising consumer interest in a healthy lifestyle, the production of functional juices, nectars, and juice-based drinks has become increasingly relevant.

The functional beverage market in Kazakhstan has shown steady growth, driven by the increasing demand for products fortified with vitamins, minerals, antioxidants, and other bioactive compounds [1].

Current Market Status: According to the National Bureau of Statistics, 732.8 million liters of soft and mineral drinks were produced in Kazakhstan in Q1 2023, representing a 10.2% increase compared to the same period in 2022 [2].

In 2023, revenue in Kazakhstan's general soft drinks market reached USD 1,830.0 million, with the functional (energy and sports) drinks segment accounting for USD 91.0 million.

Functional Drinks: Functional drinks differ from conventional beverages by incorporating health-promoting properties beyond basic hydration. These products align with 21st-century consumer demands for health, well-being, taste, and convenience. Inspired by the wellness trend, manufacturers continue to develop next-generation beverages that not only quench thirst but also provide physiological benefits [3].

Sea buckthorn plays a *significant role* in the functional beverage market, offering health benefits that extend beyond physical well-being. Its bioactive compounds contribute to skin and hair health, presenting opportunities for the development of beauty-enhancing functional beverages [4].

Functional drinks containing sea buckthorn represent an innovative trend in the healthy food industry. These beverages not only provide essential nutrients but also offer multiple functional benefits, contributing to overall consumer well-being.

Based on the conducted research and considering its chemical composition, bioactive properties, and physiological effects, sea buckthorn was selected as the primary ingredient for developing a functional drink. To ensure homogeneity and high bioavailability, the formulation includes sea buckthorn juice enriched with hydrolyzed collagen and the natural sweetener stevia [5,6].

The selected components enhance the drink's nutritional value: its high vitamin and antioxidant content supports immune function, while its balanced composition promotes overall health. Additionally, the production process, incorporating pasteurization and aseptic packaging, ensures an extended shelf life while preserving the beneficial properties of the ingredients.

This study aims to develop a formulation and production technology for a sea buckthorn-based functional drink with stevia and hydrolyzed collagen. The goal is to expand the range of healthy food products by enhancing their biological and nutritional value, improving organoleptic characteristics, and ensuring long-term stability and consumer appeal [7].

Materials and research methods.

Based on the research objectives and tasks, the following raw materials and ingredients were used: natural, freshly squeezed sea buckthorn juice, apple and grape juices, the sugar substitute stevia, and hydrolyzed collagen.

The study involved analyzing literature sources that provided approximate ingredient proportions for the preparation of functional beverages based on plant-derived raw materials. Based on this analysis, preliminary dosages of components were determined for developing a 500 mL drink.

To achieve a balanced taste and maximize the drink's health benefits, five different formulations with varying ratios of key ingredients — sea buckthorn, grape, and apple juices, along with stevia and hydrolyzed collagen — were tested. The aim of this testing was to identify the optimal proportions that ensure high organoleptic and functional properties of the beverage [8,10].

Option 1: 200 mL sea buckthorn juice, 100 mL grape juice, 200 mL apple juice.

- **Disadvantages:** This variant was too sour. The dominance of sea buckthorn juice resulted in a sharp taste, overshadowing the sweetness of the grape and apple juices.
- **Conclusion:** The low content of sweet juices did not allow for a balanced acidity.

Option 2: 150 ml sea buckthorn juice, 150 ml grape juice, 200 ml apple juice

- **Disadvantages:** In this ratio, the acidity of the sea buckthorn juice was still noticeable but more balanced. However, the increased amount of grape juice created a strong grape aroma that overpowered the overall taste of the drink.
- **Conclusion:** The excess grape juice disrupted the flavor harmony.

Option 3: 100 ml sea buckthorn juice, 200 ml grape juice, 200 ml apple juice

- **Disadvantages:** The flavor of grape juice became dominant, overshadowing the unique characteristics of sea buckthorn, which should serve as the foundation of the functional profile.
- **Conclusion:** The excessive amount of grape juice reduced the functional value of the drink and disrupted its balance.

Option 4: 100 mL sea buckthorn juice, 50 mL grape juice, 350 mL apple juice

- **Disadvantages:** Apple juice became the dominant flavor, creating an overly sweet profile. The slight tartness of sea buckthorn and the richness of grape were almost lost. As a result, the drink became too simple and lacked vibrancy.
- **Conclusion:** The high proportion of apple juice diluted the originality of the recipe.

Option 5: 100 mL sea buckthorn juice, 100 mL grape juice, 300 mL apple juice

Reason for Selection: This ratio achieved an ideal flavor balance. The tartness of sea buckthorn harmonized well with the sweetness of grape and apple juices. Apple juice provided a mild base without overpowering the flavors of sea buckthorn and grape. This formulation resulted in a well-balanced taste and appealing organoleptic characteristics [9].

During the experiment, an organoleptic analysis was conducted to determine the optimal ratio of the main ingredients. Five participants took part in the study, tasting five different formulations of the sea buckthorn-based functional drink. Each sample was evaluated based on the following organoleptic characteristics: appearance, color, consistency, aroma, and taste. The assessment was carried out using a five-point scale, where 1 represented the lowest quality level and 5 the highest. Based on the obtained data, the formulation with the highest average scores across all parameters was selected. The profilogram of this organoleptic analysis is illustrated in Figure 1.

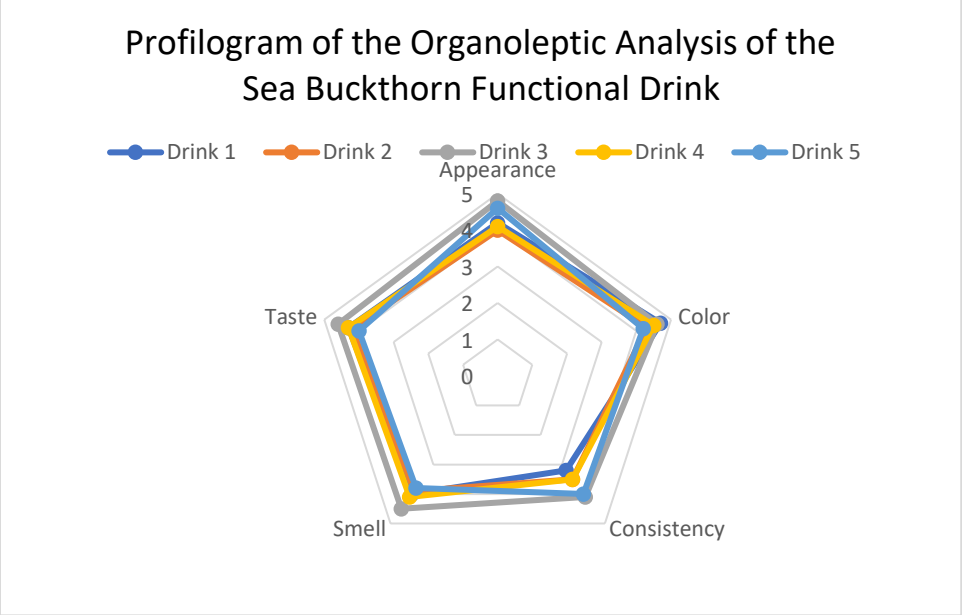

Figure 1. Profilogram of the Organoleptic Analysis.

As a result of the study, the optimal ingredient proportions were determined. The drink is based on 100 ml of sea buckthorn juice, 100 ml of grape juice, and 300 ml of apple juice. This ratio provides a harmonious taste, combining the sweet and sour notes characteristic of sea buckthorn, grapes, and apples.

To achieve the functional properties of the drink, the formulation includes the sugar substitute stevia and hydrolyzed collagen. Experimental results established that the optimal amount of stevia for a 500 ml drink is 0.3 g, ensuring the necessary sweetness without an aftertaste and without increasing caloric content. Hydrolyzed collagen is added in an amount of 8.5 g, which meets the daily recommended intake and gives the drink pronounced functional properties, including a strengthening effect.

Thus, based on literature analysis and experimental testing, a functional drink formulation was developed, ensuring a balanced taste and high nutritional value. The obtained results can be used for further standardization of the technology and the introduction of the drink into mass production [11,13].

As part of the study, the energy value of the developed functional drink, based on sea buckthorn, grape, and apple juices with the addition of the sugar substitute stevia and hydrolyzed collagen, was assessed. The results are shown in Table 1.

Table 1. Energy value of the developed functional drink

Product name	Weight	Proteins, g	Fats, g	Carbohydrates, g	Kcal
Sea Buckthorn Juice	100 ml	0,6	3,4	4,3	50,2
Grape Juice	100 ml	0,3	0	14,0	57,2
Apple Juice	300 ml	1,2	1,2	29,4	133,2
Stevia (powder)	0,3 g	0	0	0	0
Collagen	8,5 g	0	0	0	0
TOTAL	**508,8**	**2,1**	**4,6**	**47,7**	**240,6**
Per 100 ml	**100**	**0,4**	**0,9**	**9,37**	**47,29**
Kilojoule		**6,68**	**33,9**	**147,1**	**197,9**

The calculated values showed that the energy content of the drink is 47.29 kcal per 100 ml, which corresponds to 197.9 kJ for the total volume of 500 ml. This value makes the drink low-calorie, which is an important criterion for functional nutrition products [12].

Experimental studies on determining the quality indicators of the sea buckthorn-based drink

with a sugar substitute were conducted in the laboratory of the "Technology of Grain Products and Processing Industries" department at Almaty Technological University.

The physicochemical parameters of functional drinks, in accordance with GOST (state standard), include the following parameters: determination of organoleptic characteristics, determination of dry matter content, density measurement, acidity assessment**,** etc. The results of studies of physico-chemical parameters are shown in Table 2.

Table 2. Study Results of the Physicochemical Properties of the Developed Functional Drink

Indicator name	Research Results	Standard according to GOST
Mass fraction of solids	0,4%	±0,2%
density	1,048 g/cm³	1-1,5 g/cm³
acidity	±0,2 ml	±0,3 ml
Shelf life (days)	4	5

The conducted studies have shown that the developed drink meets all established standards. The organoleptic properties of the drink, including its harmonious taste, pleasant aroma, and uniform consistency, comply with the standard requirements. The physicochemical parameters, such as acidity and dry matter content, are also within the norms established by GOST 28188-2018 "Non-alcoholic beverages. General technical conditions."

Results and discussion

In the course of the research, a formulation of a functional drink based on sea buckthorn with the addition of stevia and collagen was developed. The optimal ratio of the components (apple juice – 60%, sea buckthorn – 20%, grape – 20%) provided a balanced taste and high nutritional value.

The analysis showed that the drink has antioxidant and immunomodulatory properties due to vitamins and polyphenols. The introduction of stevia reduced the caloric content, and collagen increased its biological value.

The physico-chemical parameters meet the standards, the energy value is 47.29 kcal per 100 ml. Comparison with similar studies confirmed the effectiveness of the selected composition. The drink has good organoleptic characteristics and is promising for mass production.

Conclusion

As part of this study, a formulation for a functional sea buckthorn-based beverage with the addition of stevia and hydrolyzed collagen was developed. Sea buckthorn, rich in vitamins, antioxidants, and trace elements, serves as an excellent source of beneficial nutrients that support overall health. Stevia, as a natural sugar substitute, enhances the taste of the drink while reducing its caloric content, making the product more appealing to consumers monitoring their diet. Hydrolyzed collagen, an essential component for maintaining the health of the skin, joints, and other connective tissues, adds additional functional value to the beverage [14, 15].

During the experiment, organoleptic and physicochemical studies were conducted, demonstrating the beverage's excellent taste and texture characteristics. The drink remained stable throughout its shelf life, preserving its beneficial properties and attractive appearance. Chemical analysis confirmed that all components met the declared quality standards.

The proposed functional beverage can be recommended as part of a daily diet for individuals seeking to improve their health, support the immune system, and enhance skin and joint condition. The product combines the beneficial properties of natural ingredients, making it a promising candidate for mass consumption in the functional beverage market.

Future research will focus on optimizing the formulation, improving taste characteristics, expanding the product range, and conducting clinical trials for a deeper assessment of its health benefits.

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ОЦЕНКА ФИЗИКО-ХИМИЧЕСКИХ ХАРАКТЕРИСТИК РАСТИТЕЛЬНОГО СЫРЬЯ ДЛЯ КОМБИКОРМОВ

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В данной статье приведены исследования и полученные результаты физико-химических показателей 3 сортов зерна тритикале «Указ», «Бару», «Зернокормовое», и верблюжьей колючки из разных областей Казахстана: Алматинская область (с. Баканас), Туркестанская область (с. Шаульдер), Туркестанская область (г. Арыс). Проведены физико-химические анализы, определена кормовая ценность выбранного растительного сырья. Процесс проращивания тритикале применялся с целью улучшения его питательной ценности и усвояемости. До проращивания состав тритикале характеризовался относительно низким содержанием витаминов, минералов, что ограничивало его питательную ценность.