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РАЗРАБОТКА И ИССЛЕДОВАНИЕ ФУНКЦИОНАЛЬНОГО НАПИТКА С ДОБАВЛЕНИЕМ ЭКСТРАКТА МЯТЫ ПЕРЕЧНОЙ

DEVELOPMENT AND RESEARCH OF A FUNCTIONAL DRINK WITH THE ADDITION OF PEPPERMINT EXTRACT

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Аннотация. *Современный рынок продовольственных товаров регулярно пополняется новыми функциональными продуктами питания. При реализации продовольственных товаров важно учитывать, чем больше ассортимент предлагаемых вкусов, тем лучше для их реализации.*

Наиболее удобным объектом для экспериментов в области сырьевого состава являются напитки. В первую очередь, это позволяет вводить обоснованный выбор ингредиентов, положительным образом влияющий не только на сенсорные показатели напитка, но и влияющий эффективным образом на укрепление защитных функций организма человека. Во-вторых, внедрение функционального ингредиента в сырьевой состав напитка не требует принципиальных изменений технологического процесса. К таким напиткам можно отнести воду минеральную столовую.

Вода минеральная столовая характеризуется особым химическим составом и физико-химическими свойствами, обладает замечательным лечебным и терапевтическим действием. Одна из характерных черт химического состава минеральной воды - наличие минералов, содержащих углекислый газ, в силу того, что в земной коре тяжелые металлы мигрируют с углеводородами в виде гидрокарбонатов, поскольку грунтовые воды насыщены CO_2 [6].

Потребление воды минеральной столовой по назначению требует строго соблюдения режима, а также изучения ее химического состава и органолептического качества. Введение в воду минеральную столовую растительного сырья позволяет улучшить органолептические показатели и ингредиентный состав напитка, а также обеспечить организм человека необходимыми витаминами.

Целью исследования явилась разработка технологии, и рецептуры напитка на основе воды минеральной столовой с использованием экстракта мяты перечной. В процессе исследования разработана технология и рецептура, определены сенсорные показатели качества.

Разработанная рецептура функционального напитка позволяет получить продукт, обогащенный полезными макронутриентами, который можно будет рекомендовать к повсеместному использованию. При этом сохраняются высокие органолептические показатели разрабатываемого напитка.

Мятный привкус напитка способствует лучшему усвоению минеральной воды. Напиток оказывает благотворное воздействие на организм человека, благодаря сбалансированной минерализации питьевой воды.

Ключевые слова: вода минеральная столовая, растительные компоненты, экстракт мяты перечной, рецептура, технология, показатели качества, безалкогольные напитки, функциональные продукты питания

Abstract

The modern food market is regularly replenished with new functional food products. When selling food products, it is important to consider that the larger the range of tastes on offer, the better for their implementation.

The most convenient object for experiments in the field of raw material composition is drinks. First of all, this allows you to introduce a reasonable choice of ingredients, which positively affects not only the sensory indicators of the drink, but also effectively affects the strengthening of the protective functions of the human body. Secondly, the introduction of a functional ingredient into the raw material composition of the beverage does not require fundamental changes in the technological process. These drinks include mineral table water.

Mineral table water is characterized by a special chemical composition and physicochemical properties, has a remarkable healing and therapeutic effect. One of the characteristic features of the chemical composition of mineral water is the presence of minerals containing carbon dioxide, due to the fact that heavy metals in the earth's crust migrate with hydrocarbons in the form of hydrocarbons, since groundwater is saturated with CO2 [6].

Consumption of mineral canteen water for its intended purpose requires strict adherence to the regime, as well as the study of its chemical composition and organoleptic quality. The introduction of vegetable raw materials into the mineral table water allows to improve the organoleptic characteristics and the ingredient composition of the drink, as well as to provide the human body with the necessary vitamins.

The aim of the study was to develop the technology and formulation of a drink based on mineral table water using peppermint extract. In the course of the research, a technology and a formulation were developed, and sensory quality indicators were determined. The developed formulation of a functional drink allows obtaining a product enriched with useful macronutrients, which can be recommended for widespread use. At the same time, high organoleptic characteristics of the developed drink are preserved.

The mint flavor of the drink promotes better absorption of mineral water. The drink has a beneficial effect on the human body, due to the balanced mineralization of drinking water.

Key words: mineral table water, herbal ingredients, peppermint extract, recipe, technology, quality indicators, soft drinks, functional products

Introduction

Currently, human health issues are more acute than ever [8]. Mineral water has a therapeutic effect on the human body, as it contains biologically active mineral and organic components [9]. As the market analysis in Russia showed, the production of mineral canteen water amounted to more than 25 billion liters in 2020, increased by 6% compared to last year. Mineralization up to 1 g / dm $_3$ inclusive is typical for mineral dining water.

The production of mineral canteen water leads in comparison with other non-alcoholic drinks by 38.7%. This product has been popular with the population for many years [5, 6]. The requirements for the water of the mineral canteen are described in the standards adopted in Russia [1]. To better meet the growing demands of consumers, as well as to increase competitiveness in the market by expanding the range of drinks, it is advisable to use herbal ingredients that can improve their organoleptic, physicochemical parameters [7].

On the territory of Russia, mint is an available vegetable raw material, numbering over 13 species. Raw materials contain useful vitamins and microelements, essential oils, as well as phytoncides, tannins.

The use of mint for medicinal purposes helps to eliminate a number of diseases, prevent their occurrence or recurrence. Due to the pronounced antiseptic action, it is actively used in various branches of medicine, cooking, cosmetology, aromatherapy, and the food industry. The introduction of this raw material allows enriching the composition of the mineral dining room water with valua-

ble active substances. The use of mint will not only give a refreshing taste and aroma to the product, but also enrich it with biologically active substances.

The importance of the research lies in the development of a new product with the addition of a natural plant ingredient, which would not only satisfy the human physiological need for nutrients, but would also have functional properties.

Thus, the aim of the study is to develop a new functional drink based on mineral table water with the addition of peppermint extract.

In accordance with the formulated goal of the study, the following tasks were solved in the work:

1. to develop a technology and recipe for a new functional drink based on mineral canteen water with the addition of peppermint extract;

2. evaluate the quality indicators of the new drink.

The scientific novelty of the research is as follows:

1. in creating a new product and technology on based on mineral dining room water with the addition of mint extract;

2. in the development of technology and recipes that will allow you to get a new functional product of high quality.

Object and methods of research

In this work, the objects of study are: mineral drinking natural table hydrocarbonate magnesium-calcium water from well No. 10/98 - meets the requirements of GOST R 54316-2011, drinking water - meets the requirements of GOST R 52109-2003; peppermint - meets the requirements of GOST 23768-94; fructose - meets the requirements of TU 9111-196-79036538-2011 and GOST 23768-94; sodium benzoate - meets the requirements of GOST 32777-2014; citric acid - meets the requirements of GOST 908-2004. Food raw materials and food products have appropriate certificates.

When studying the quality indicators of the final product, standard methods provided for by GOST, as well as optical methods of chemical analysis, were used [2, 3, 4].

Figure 1 shows a block diagram of the experimental research.

At the first stage of the experimental study, samples of the aqueous extract of peppermint were prepared. Extraction modes were selected, and the degree of transition of dry substances into extracts was determined. The organoleptic parameters were evaluated in the finished samples.

At the second stage, the technological process of the production of the drink was worked out, including the following stages: preparation of the blend; filtration; cooling; saturation; bottling; sealing; labeling. Each stage of production is strictly regulated.

Preparation of blending syrup in a cold way: all components - fructose syrup, acid solution, vegetable raw material extract, preservative working solution - are poured into a blending vat and mixed.

The finished fructose syrup is pumped into a blending tank, then the calculated amount of acid is added. Mint leaves are ground, ground into powder, then the vegetable raw material is combined with water in a continuous countercurrent horizontal extractor.

The residence time of the mixture in the extractor is 5 hours. After the expiration of time, the extract is pumped into a storage tank, then sent for filtration and disinfection with ultraviolet rays.

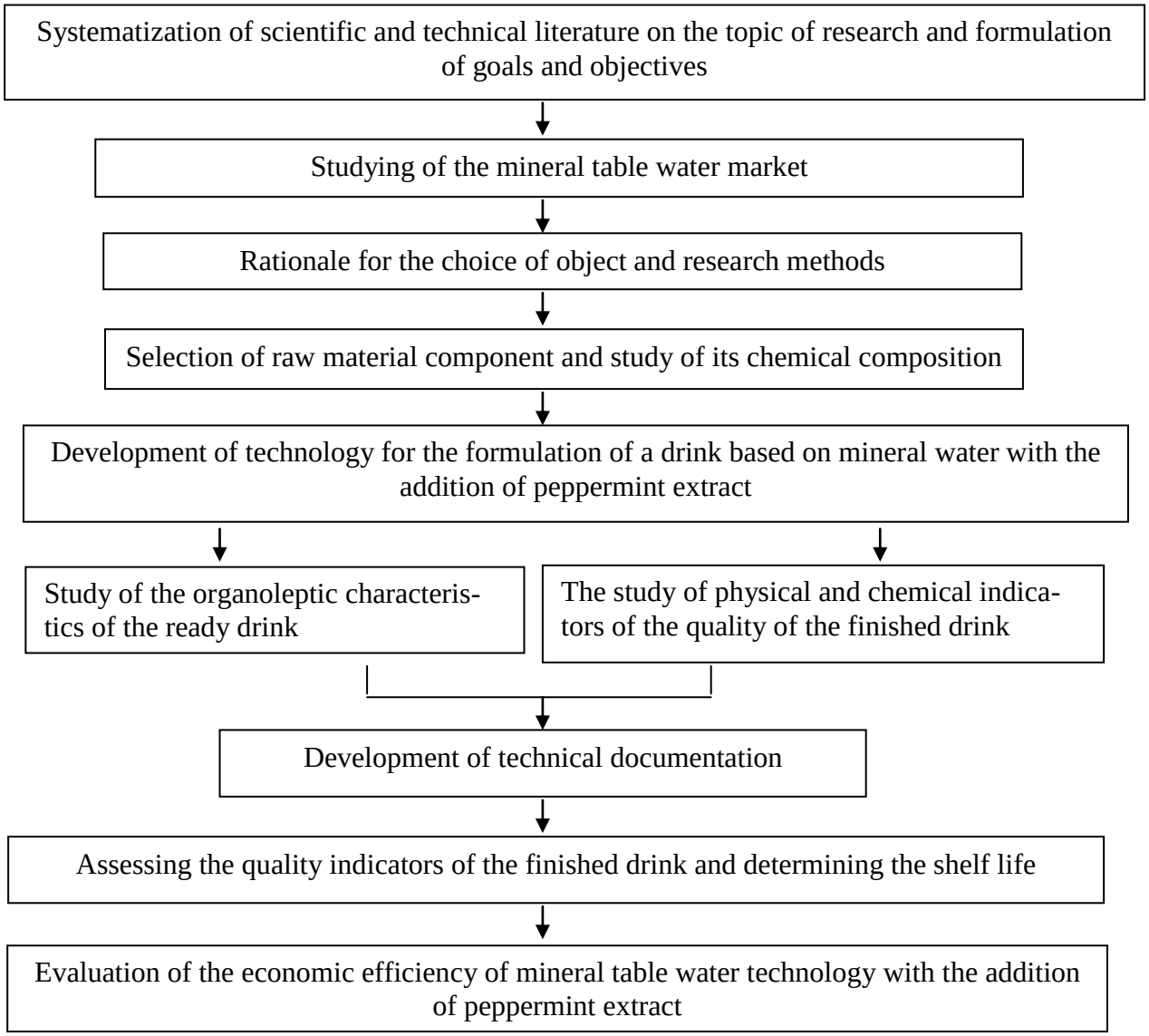

Рисунок 1. Структурная схема исследования/ Fig.1 - Block diagram of the study

The extract is pumped through a mernik into a blending tank. Sodium benzoate is weighed on a balance and poured into a collector, where water is also added, then the mixture enters the blending tank. The ingredients of the drink in the blending apparatus are thoroughly mixed.

Next, the mixture is filtered to complete transparency and the syrup is cooled to 8-10 ° C, then the process of removing dissolved air from the mixture and saturation with carbon dioxide in the saturator, pouring into containers.

All bottles are labeled in a labeling machine, then packaged in boxes.

Results and its discussion

To determine the appropriate recipe for a drink based on mineral canteen water, consumer characteristics of drinks with different doses of fillers were studied. 3 compositions were developed and one optimal variant was chosen.

The profile evaluation method was used, which allows to obtain a complete description of the sensory perception of the product, the number of variants of samples with the added herbal supplement is shown in Figure 2.

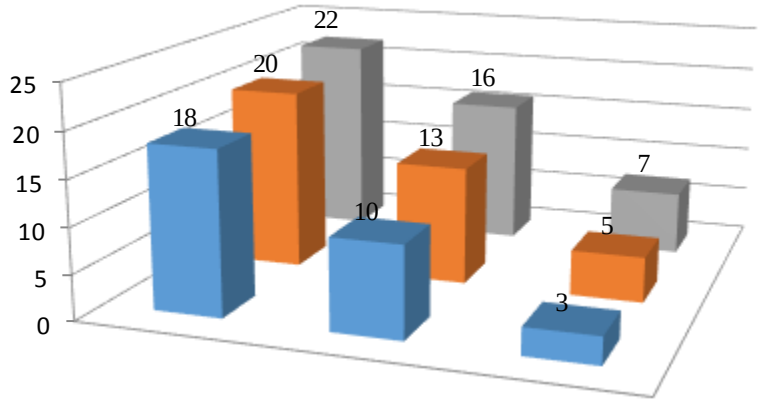

Рисунок 2. Количество внесенной растительной добавки в образцах, мл/ Fig. 2 - The amount of herbal supplement applied in the samples, ml

The method for determining the organoleptic and physico-chemical indicators of drinks was carried out in accordance with the requirements of GOST 28188-2014 . The organoleptic assessment of the quality of drinks was carried out on a 25-point scale according to the following quality indicators: transparency, color, appearance - from 1 to 7 points; taste and aroma - from 6 to 12 points; saturation with carbon dioxide - from 2 to 6 points. The results of tasting sample samples are presented in table 1.

Table 1 - Results of tasting sample samples

Index	Sample with a bookmark of peppermint extract, ml								
	3	5	7	ten	13	16	eighteen	twenty	22
Appearance	transparent liquid without sediment and foreign inclusions, slight opalescence is allowed, due to the characteristics of the raw materials used								
Color	colorless						light greenish shade without shine		light greenish tint with glitter
Taste and aroma	insufficient sweetness, a drink characteristic of mineral table water, without pronounced or insufficient mint flavor						insufficient sweetness and acidity of the drink, with insufficient pronounced aftertaste		sweet and sour, with a pleasant refreshing residual aftertaste, light mint aroma
Saturation with carbon dioxide	Profuse and prolonged bubbling of carbon dioxide, a slight tingling sensation on the tongue								
Final score	10-19					twenty	21	22	25

From the data in Table 1 it can be seen that, according to the tasters, the drink with the addition of a natural plant extract 22 ml is the best due to a pleasant refreshing residual aftertaste and a light mint aroma. Next, we assessed the physico-chemical parameters of the samples with the highest values , for which we determined the content of solids and vitamin C, acidity; routine, phenolic substances, flavonoids; saturation with carbon dioxide; the content of bicarbonates, calcium and magnesium; fullness of filling; seal tightness; durability.

The results of the obtained values are shown in Figures 3-14 .

The mass fraction of dry substances was determined according to GOST 6687.2-90. The arithmetic mean of the results of two parallel determinations was taken as the test result. The data obtained are shown in Figure 3.

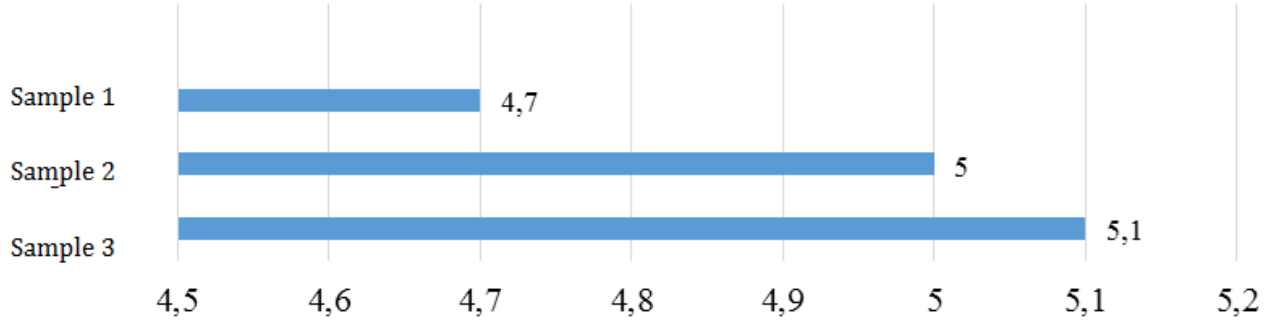

Рисунок 3. Массовая доля сухих веществ в напитках, %/ Figure 3. Mass fraction of solids in drinks,%

As can be seen from Figure 3, all samples have values within the normal range and comply with the requirements of GOST 6687.2-90. Next, the acidity of drinks was determined according to GOST 6687.4-86.

The results of the obtained values are presented in Figure 4 .

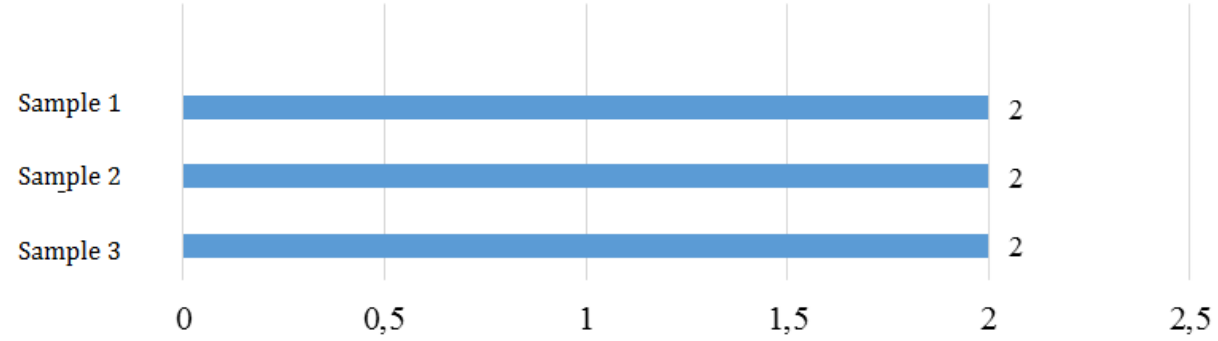

Рисунок 4. Кислотность напитков, см^{3}/ Figure 4. Acidity of drinks, cm ^{3}

As can be seen from Figure 4, all samples have acidity within the normal range. The data obtained correspond to the requirements of GOST 6687.4-86.

The results of the study on the content of ascorbic acid in drinks are shown in Figure 5.

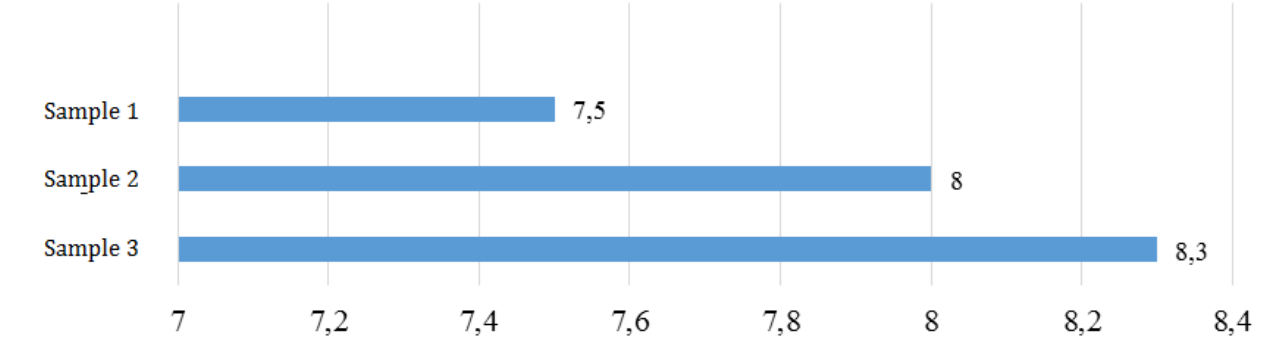

Рисунок 5 – Содержание аскорбиновой кислоты в напитках, мг/дм^{3}/ Figure 5. The content of ascorbic acid in drinks, mg / dm ^{3}

As can be seen from Figure 5, sample 3 has the highest content of ascorbic acid.

Next, the content of rutin was determined according to the optical method of analysis. The data obtained are presented in Figure 6.

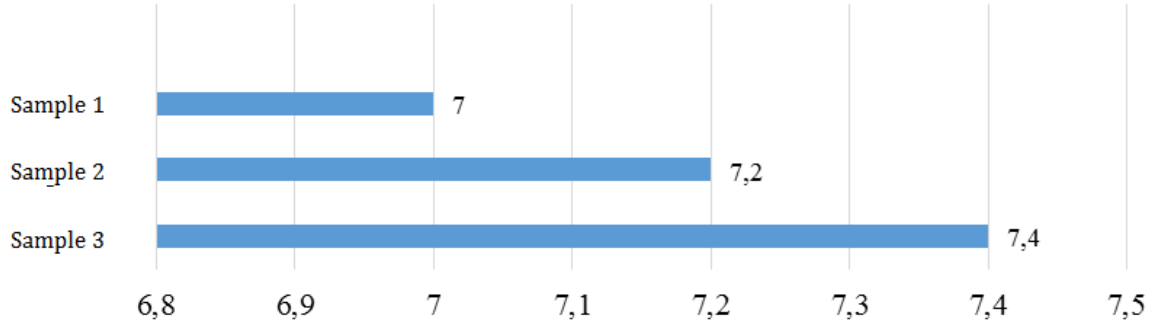

Рисунок 6. Содержание рутина в напитках, мг/дм^3/ Figure 6 - The content of rutin in drinks, mg / dm^3

As can be seen from Figure 6, sample 3 contains the highest amount of the bioflavonoid rutin, which allows increasing the antioxidant activity of vitamin C in the drink.

The content of phenolic substances in drinks was determined according to the optical method of analysis. The data obtained are presented in Figure 7.

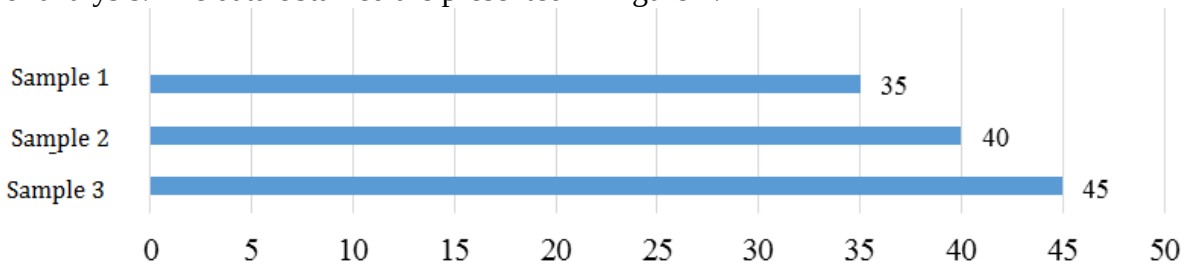

Рисунок 7. Содержание фенольных веществ в напитках, мг/дм^3/ Figure 7.The content of phenolic substances in drinks, mg / dm^3

As can be seen from Figure 7, sample 3 has an increased biological antioxidant activity of the drink.

The content of flavonoids in drinks was determined according to the optical method of analysis. The color intensity indicates a higher content of biologically active substances and, accordingly, an increase in antioxidant activity. The results are shown in Figure 8.

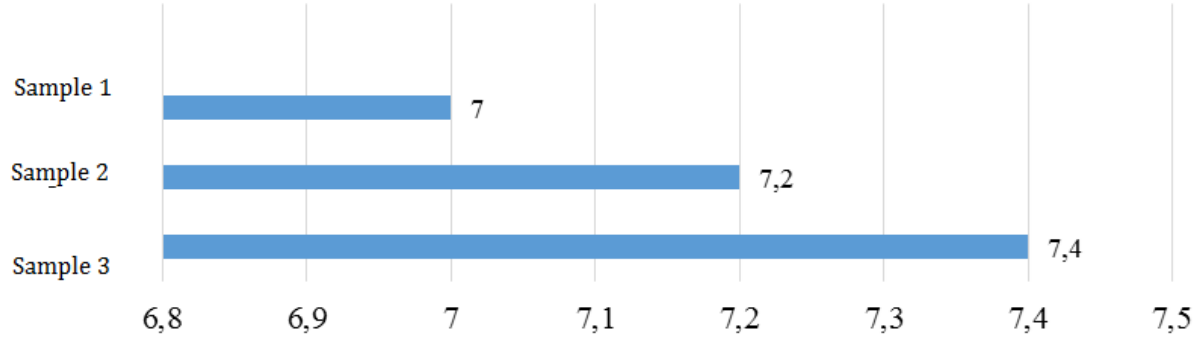

Рисунок 8. Содержание флавоноидов в напитках, мг/дм^3/ Fig. 8. The content of flavonoids in drinks, mg / dm^3

As can be seen from Figure 8, sample 3 has the highest content of flavonoids.

The mass fraction of carbon dioxide in drinks was determined according to GOST 23268.2-91. The analysis was carried out by a manometric method based on measuring the equilibrium pressure in the gas space of a bottle sealed with a crown cork at a certain temperature of 20 °C.

The beverage bottle was fixed in a pressure detection device. The crown cork was pierced with a hollow needle, connecting the gas space of the bottle with the manometer chamber.

The device connected to the bottle was shaken with a mechanical shaker or manually until a constant pressure was established on the manometer. Manometer readings were noted.

When the required tightness in the system is reached, the pressure gauge needle should remain motionless for 2 minutes.

The device was removed from the bottle and washed with water.

The mass fraction of carbon dioxide (%) in the drink was determined according to the reference appendix by gauge pressure and temperature.

The results of the study are presented in Figure 9.

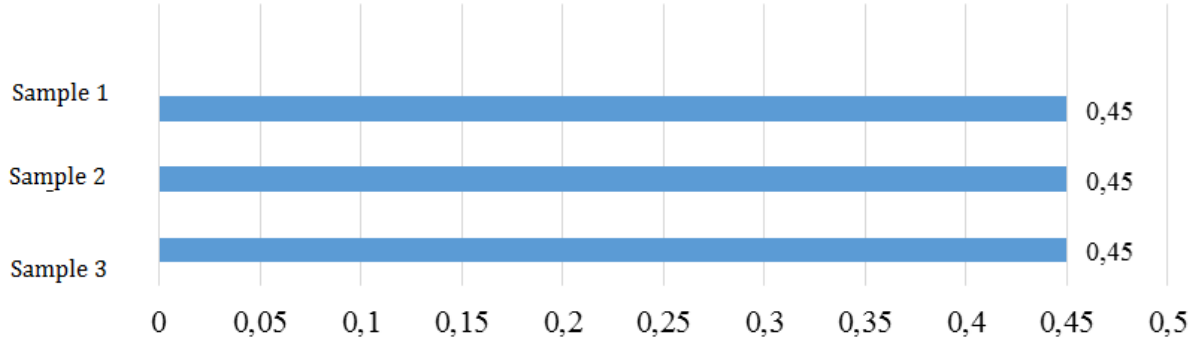

Рисунок 9. Массовая доля двуокиси углерода в напитках, %/ Fig.9. Mass fraction of carbon dioxide in drinks,%

As can be seen from Figure 9, the mass fraction of carbon dioxide in all 3 samples is 0.45%, which corresponds to the standards according to GOST 23268.2-91.

The mass fraction of bicarbonate ions in drinks was determined according to GOST 23268.3. The arithmetic mean of two parallel determinations was taken as the final result, the allowable discrepancies between which should not exceed 3.0%.

The results of the study are shown in Figure 10.

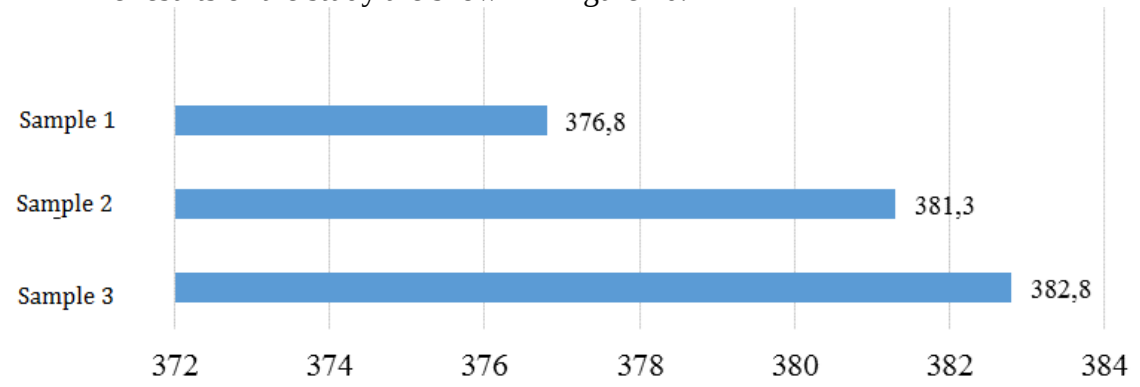

Рисунок 10. Массовая доля гидрокарбонат-ионов в напитках, мг/дм^3/ **Fig.10. Mass fraction of bicarbonate ions in drinks, mg / dm ^{3}**

As can be seen from Figure 10, sample 3 has the highest content of hydrocarbonate ions. The obtained values correspond to GOST 23268.3-78.

The mass fraction of calcium in drinks was determined according to GOST 23268.5-78.

In a conical flask with a capacity of 250 cm ^{3} , from 10 to 100 cm $^{3\ of}$ the drink was measured, diluted with distilled water to 100 cm ^{3} , neutralized with a solution of hydrochloric acid at a concentration of 0.1 mol / dm according to the methyl red indicator until the solution turned pink,

1 cm $^{3\ of}$ hydrochloric acid was added , boiled for 5 minutes at reflux to remove carbon dioxide (the refrigerator can be replaced with an inverted funnel). The solution was cooled to a temperature of 20°C. By adding 2 cm ^{3} of a solution of sodium hydroxide with a concentration of 2 mol/dm, the pH was set from 12 to 13. As an indicator, 1 cm ^{3} of a solution of calconcarboxylic acid was introduced, and the sample was slowly titrated with a solution of complexone III with a concentration of 0.05 mol/dm until the color of the solution changed from cherry into blue.

The mass concentration of calcium ions (X), mg/dm ^{3}, was calculated by the formula:

$$X = \frac{V_1 M \cdot 40{,}08 \cdot 1000}{V_2}, \quad (1),$$

where V_1 is the volume of the complexone III solution used for titration, cm ^{3};

M is the molar concentration;

40.08 - molar mass of calcium ion, g/mol;

V_2 - the volume of the drink taken for analysis, cm ^{3}

The results of the study are presented in Figure 11.

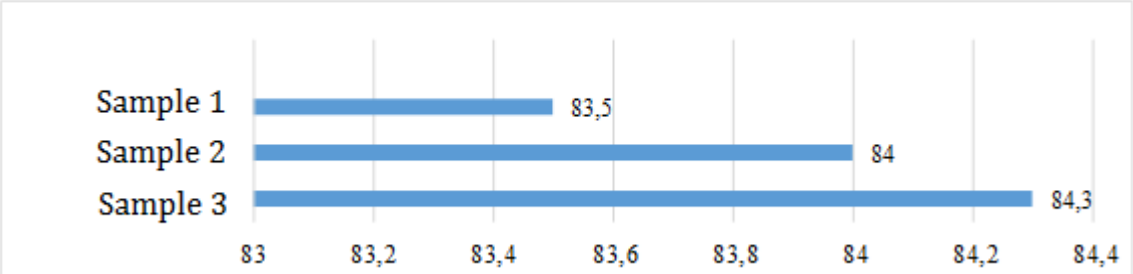

Рисунок 11. Массовая доля кальция в напитках, мг/дм^3/ Fig. 11. Mass fraction of calcium in drinks, mg / dm ^{3}

As can be seen from Figure 11, sample 3 contains more calcium. The data obtained correspond to the standards of GOST 23268.5-78.

The mass fraction of magnesium in drinks was determined according to GOST 23268.5-78.

The mass concentration of magnesium ions (X), mg/dm ^{3}, was calculated from the difference in the volumes of complexon III used to titrate the sum of calcium and magnesium ions and separately calcium ions in equal volumes according to the formula:

$$X_1 = \frac{(V_1 - V_2) M \cdot 24{,}32 \cdot 1000}{V_3}, \quad (2),$$

where V_1 is the volume of the complexone III solution used for titration of the sum of calcium and magnesium ions, cm ^{3};

V_2 - the volume of the complexone III solution, which went to the titration of calcium ions, cm ^{3};

M is the molar concentration;

24.32 - molar mass of magnesium ion, g/mol;

V_3 - the volume of water taken for analysis, cm ^{3}

The results are clearly shown in Figure 12.

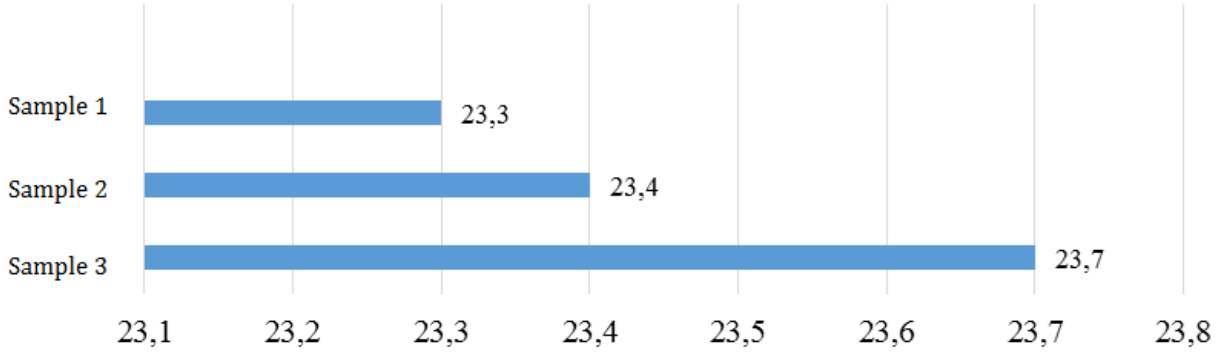

Рисунок 12. Массовая доля магния в напитках, мг/дм^3/ Fig. 12 - Mass fraction of magnesium in drinks, mg / dm ^{3}

As can be seen from Figure 12, the largest amount of magnesium is contained in the third sample. The data obtained correspond to the standards of GOST 23268.5-86.

The filling completeness volume was determined according to GOST 6687.5-86.

The average volume of production was:

V \u003d 1476.6 s m ^{3}

The deviation of the volume of products in bottles from the nominal amounted to:

X $_1$ \u003d - 1.5%

Permissible deviations of filling completeness are not more than ± 3%.

The results of the study are presented in Figure 13.

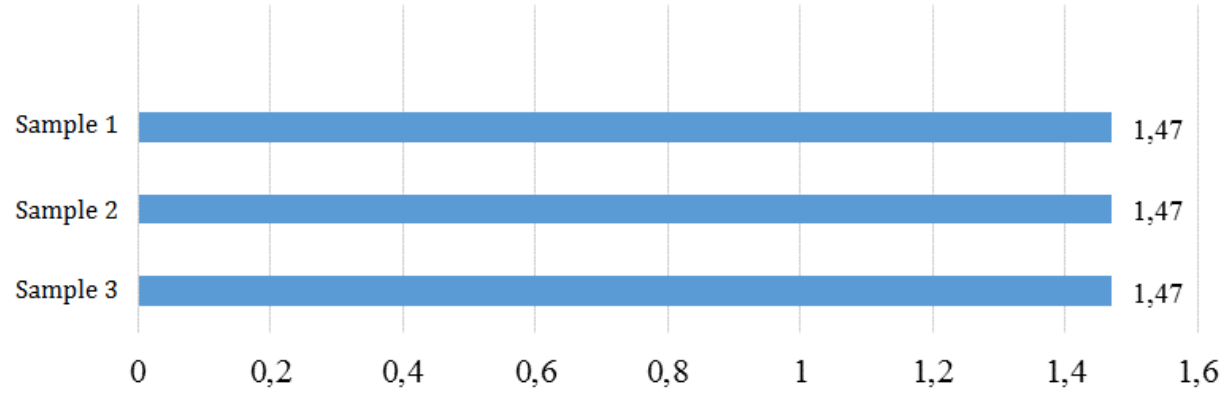

Рисунок 13. Объем полноты налива в бутылках с напитками, см^3/ Fig.13. The volume of full filling in bottles with drinks, cm ^{3}

The filling volume in the bottles of all 3 samples was 1.47 cm3, which corresponds to the standards according to GOST 6687.5-86.

Next, the shelf life of the product was determined according to GOST 6687.6-88. To do this, the samples were placed in a cabinet at a temperature of (20 ± 2)°C and the presence of changes in the product was recorded.

If significant changes were found in the parameters of the studied drinks, if sediment, turbidity and other suspensions were detected, the expiration date of the drink was considered expired. Fixed the period at which the changes occurred. Persistence was measured in days from the time of bottling to the formation of haze or sediment. The data obtained are shown in Figure 14.

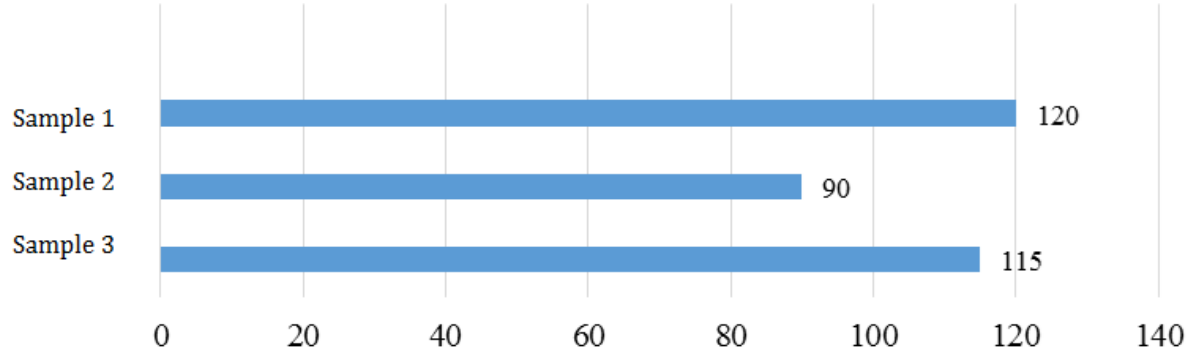

Рисунок 14. Стойкость напитков, сут./ Fig. 14. Persistence of drinks, days.

An analysis to determine the stability in the studied samples showed that the stability of the drink is 115 days, which corresponds to the current standards of GOST 6687.6-88. The tightness of the capping of bottles with drinks was determined according to GOST R 52109-2003.

In a container with a capacity of 10 l with water, previously boiled for 15 min and cooled to a temperature from 40 °C to 50 °C, sealed containers with packaged water were completely immersed. The closure is considered airtight if no gas bubbles are observed within 10 minutes after immersion.

The tightness of the capping of bottles with drinks was determined according to GOST R 52109-2003, which meets the requirements of the standard.

Table 2 presents the physicochemical parameters of the three studied samples.

Table 2 - Summary table of physical and chemical indicators of drinks

Name of indicator	Sample with a bookmark of peppermint extract, ml			control
	eighteen	twenty	22	
	3 sample	1 sample	2 sample	
General mineralization, g/l	0.33	0.33	0.33	0.05-0.35
Mass fraction of solids, %	4.7	5.0	5.1	4.4-8.6
Acidity, cm ^{3}	2.0	2.0	2.0	no more than 2
Mass fraction of carbon dioxide, %	0.45	0.45	0.45	not less than 0.4
Bicarbonates (HCO3-), Mg/Dm3	373.6	381.3	382.8	5 0-400
Magnesium (Mg2+), mg/dm3	23.3	23.4	23.7	5-20
Calcium (Ca2+), mg/dm3	83.5	84.0	84.3	50-70
Sodium (Na+) + Potassium (K+), mg/dm3	17.7	19.0	18.6	1-16
Fluorine (F+), Mg/Dm3	0.5	0.5	0.5	no more than 5.0
Amount of Vitamin C, Mg	7.5	8.0	8.3	at least 5
Phenolic Substances, Mg	35	40	45	At least 30
Content of Flavonoids, Mg	7.0	7.2	7.4	at least 5
Vitamin (A), Mg/Dm3	0.161	0.165	0.169	
Copper (Cu), mg / dm ^{3}	0.3	0.3	0.3	no more than 1.0
Pantothenic acid, mg / dm ^{3}	0.18	0.18	0.18	
Folic acid	0.030	0.030	0.030	
Vitamin B $_{1,}$ mg / dm ^{3}	0.20	0.22	0.24	
Vitamin B $_{2,}$ mg / dm ^{3}	0.22	0.24	0.26	
Vitamin B $_{6,}$ mg / dm ^{3}	0.30	0.33	0.36	
Vitamin B $_{12,}$ mg / dm ^{3}	0.00042	0.00044	0.00046	
Chlorides (CI $^-$), mg / dm ^{3}	25	25	25	3-25
Sulphates (SO $_4$ $^{2-}$), mg / dm ^{3}	25	25	25	5-30

Filling volume, cm^3	1.47	1.47	1.47	
Persistence, days	115	115	115	
Sealing tightness	Complies with GOST R 52109-2003			

Conclusions and offers

Based on the results of the conducted research, it was found that:

1. Sample 3, containing 22 ml of peppermint extract, has the highest similarity score (85%) compared to the control sample, as well as better sensory scores. Based on the results of the study, the optimal amount of application of peppermint extract is 22 ml per 1.5 liters of drink;

2. organoleptic and physico-chemical properties of the indicators of the new functional drink meet the requirements of GOST R 56543-2015 [1]. In the finished drink, the content of minerals, vitamins C, P, as well as other biological components from the daily requirement amounted to calcium (CA) - up to 20%, magnesium (mg) - up to 14%, vitamin C - up to 17%, which allows it to be called a functional product.

3. Technical documentation was developed for a new product - a non- alcoholic drink with mint of the Force of Nature series (TI 9984-003-28188-15) and submitted for implementation to an enterprise for the production and bottling of mineral water, beer and soft drinks. This drink will satisfy the growing demand of the population for environmentally friendly products [8].

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