

## STUDY OF PHYSICAL AND CHEMICAL PROPERTIES OF SOFT DRINKS OBTAINED WITH ADDITION OF GOOSEBERRY EXTRACT

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The manufacturing of juice-containing soft drinks is experiencing significant expansion in both international and domestic markets, including Kazakhstan. This tendency can be attributed to the aspiration of the working-age population in developed countries to adopt a health-conscious lifestyle. The manufacturing of beverages using natural fruit and berry ingredients is highly intriguing in this context. Enriching soft drinks with a diverse array of physiologically active chemicals derived from plant materials is highly significant. This study aims to investigate the physicochemical characteristics of soft drinks and assess the potential application of gooseberry extract.

In order to create a non-alcoholic beverage, the valuable wild gooseberries were utilised. These gooseberries are rich in biologically active elements, including vitamins, vitamin-like compounds, flavonoids, minerals, and other chemicals.

The acquired results are derived from a substantial volume of empirical study and are founded upon an examination of literary data pertaining to the chemical makeup of gooseberries. The study investigated the chemical makeup of gooseberries using contemporary techniques of chemical analysis. A recipe for a non-alcoholic beverage made using gooseberry extract, free from any artificial ingredients, has been devised. The organoleptic and physico-chemical features of it have been determined.

**Keywords:** soft drinks, gooseberry, plant extracts, fruit and berry raw materials, functional purpose, ultrasonic extraction method

## ИССЛЕДОВАНИЕ ФИЗИКО-ХИМИЧЕСКИХ СВОЙСТВ БЕЗАЛКОГОЛЬНЫХ НАПИТКОВ, ПОЛУЧЕННЫХ С ДОБАВЛЕНИЕМ ЭКСТРАКТА КРЫЖОВНИКА

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В последнее время наблюдается значительный рост производства безалкогольных напитков, содержащих сок, как на внутреннем, так и на международном рынках, включая Казахстан. Эту тенденцию можно связать с желанием трудоспособного населения в промышленно развитых странах вести здоровый образ жизни. В этом контексте производство напитков на основе натуральных фруктово-ягодных компонентов вызывает большой интерес. Актуальным является и добавление в безалкогольные напитки широкого спектра биологически активных веществ, полученных из растительного сырья. Цель данного исследования - изучение физико-химических свойств безалкогольных напитков и оценка возможности применения экстракта крыжовника.

Использование дикого крыжовника позволило получить безалкогольный напиток, содержащий значительное количество биологически активных компонентов, таких как витамины, витаминоподобные соединения, флавоноиды, минералы и другие вещества.

Полученные результаты основаны на анализе литературы, посвященной химическому составу крыжовника, а также на значительном объеме проведенных экспериментальных исследований. В ходе исследования использовались современные методы химического анализа для изучения химического состава крыжовника. С использованием экстракта крыжовника была разработана рецептура напитка, не содержащего искусственных компонентов и спирта. Также помимо физико-химических свойств, были выявлены и органолептические характеристики напитка.

**Ключевые слова:** безалкогольные напитки, крыжовник, растительные экстракты, фруктово-ягодное сырье, функционального назначения, ультразвуковой способ экстрагирования

## ҚАРЛЫҒАН СЫҒЫНДЫСЫ ҚОСЫЛҒАН АЛКОГОЛЬСІЗ СУСЫНДАРДЫҢ ФИЗИКАЛЫҚ-ХИМИЯЛЫҚ ҚАСИЕТТЕРІН ЗЕРТТЕУ

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Құрамында шырыны бар алкогольсіз сусындар өндірісінің ассортименти шетелде де, Қазақстанда да қарқынды өсуде. Бұл үрдіс дамыған елдердегі тұрғындардың белсенді бөлігінің салауатты өмір салтына ұмтылысына байланысты. Осыған орай, табиғи жеміс-жидек шикізаты негізіндегі сусындар өндірісі үлкен қызығушылық тудыруда. Алкогольсіз сусындарды өсімдік тектес биологиялық белсенді заттардың кең спектрімен байыту өте маңызды. Бұл жұмыстың мақсаты алкогольсіз сусындардың физика-химиялық қасиеттерін зерттеу, сонымен қатар қарлыған сығындысын пайдалану мүмкіндігін зерттеу.

Алкогольсіз сусын алу үшін дәрумендер мен витаминге ұқсас қосылыстар, флавоноидтар, минералдар және басқа заттар сияқты биологиялық белсенді заттардың құнды көзі болып табылатын жабайы қарлыған пайдаланылды.

Алынған нәтижелер тәжірибелік зерттеулердің айтарлықтай көлеміне және қарлығанның химиялық құрамы туралы әдеби деректерді талдауға негізделген. Жұмыста қазіргі заманғы химиялық талдау әдістерін қолдану арқылы қарлығанның химиялық құрамы зерттелді. Құрамында синтетикалық компоненттері жоқ қарлыған сығындысы бар алкогольсіз сусынның рецепті әзірленді. Оның органолептикалық және физика-химиялық көрсеткіштері анықталды.

**Түйін сөздер:** алкогольсіз сусындар, қарлыған, өсімдік сығындылары, жеміс-жидек шикізаты, функционалдық мақсаты, ультрадыбыстық экстрагирлеу тәсілі

**Introduction.** The soft drink business is experiencing significant growth and is one of the fastest-growing sub-industries in the global food sector. Both the production and consumption of soft drinks are exhibiting a consistent upward trend, both currently and in the foreseeable future. Furthermore, alongside the proactive adoption of novel packaging formats, a media-based advertising campaign is being executed, effectively capturing the interest of a growing customer base [1]. The priority direction of that area is considered to be the diversification of soft drinks, including low-

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calorie specialized drinks with various functional orientations. Development of non-alcoholic industry was to be carried out in two main directions: increasing the production of drinks on fruit and berry and malt raw materials; increasing the production of tonic and fortified drinks, as well as "protection" drinks having a special purpose [2].

At present, the challenges of the logical and efficient use of commonly available plant materials as a valuable source of functional components and the creation of healthy soft beverages are highly essential.

It is widely known that food has a significant impact on human health. Antioxidants can help reduce environmental oxidative stress caused by free radicals, which can damage the body's cellular system. Free radicals can be generated intracellularly due to the impact of detrimental factors such as radiation, UV radiation, and chemical processes involving polycyclic aromatic hydrocarbons. Free radicals are accountable for the partial or complete degradation of lipids and proteins in the human body. The degradation mentioned causes cellular and genetic mutations, as well as interactions with polyunsaturated fatty acids, DNA, and proteins. These interactions ultimately contribute to the development of various illnesses.

Conversely, antioxidants hinder the oxidation of lipids by interacting with free radicals. Plant-based commodities, such as fruits and berries, serve as the main sources of antioxidants. The reason for this is that only plant-based products have the ability to generate bioflavonoids and other polyphenolic compounds. The exploitation of indigenous plant resources, which provide the greatest health benefits to those living in the same region, is a particularly promising strategy [3,4].

In recent years, scientists have focused their research on developing innovative formulations and technologies for soft drinks that not only quench thirst and provide refreshment, but also have physiological or preventative effects. Considerable emphasis is placed on enhancing the longevity of beverages throughout the storing process. There are novel varieties of soft drinks that distinguish themselves from conventional ones in terms of both

ingredients and production methods, as well as in terms of taste and their effects on the human body [5].

An efficient approach to addressing nutritional deficiencies caused by vitamin deficiencies is the advancement of novel formulations and technology for juice-based products with functional properties. Therefore, it is necessary to develop novel plant-based products utilising indigenous raw ingredients.

The utilisation of plant-derived raw materials for the development of novel food items offers several benefits owing to the elevated bioactivity and bioavailability of the active food constituents present in them. Fruits and berries have a limited duration before they spoil, which necessitates the development of processing techniques to ensure a continuous supply of these items to the population throughout the year. The plants contain biologically active compounds that determine the specific attributes of the resulting product and provide essential technological characteristics. This eliminates the need for the addition of flavours, colours, and preservatives. One method for maintaining the advantageous qualities of fruits and berries, such as their antioxidant capabilities, all year round is by creating fruit and berry extracts and incorporating them into food [6].

The efficiency of the process of extracting biologically active chemicals from plants is influenced by key technological elements such as temperature, extraction time, degree of raw material grinding, type of extractant, hydromodule, and others. Every variety of plant raw material possesses certain parameters, modes, and conditions that have been determined through experimental research [7]. To introduce natural flavors, including essential oils, into drink recipes, surfactants (surfactants) are needed to distribute them evenly throughout the volume of the drink. Highly effective surfactants include triterpene plant saponins, which have a wide range of pharmacological effects (hypercholesterolemic, anticarcinogenic, hepatoprotective effects; antioxidant, immunological effects, and so on) [8,9].

Here are a few instances of biologically active supplements that have been proposed: the ginseng

biomass infusion, known as "BAD-GS," consists of potassium, sodium ions, and 12 trace elements. The preparation called "MIGI-K-LP" is derived from mussel meat and possesses radioprotective and anti-inflammatory effects. The preparation called "Zosterin" is obtained from seaweed and contains a substantial quantity of polygalacturonic acid. In addition, the therapy process include infusions of medicinal plants such as Chinese lemongrass, levzei safflower, and eleuterococcus. This foundation has been employed in the development of several beverages that possess both preventive and therapeutic properties: [1,10].

Drinks on flavors occupy a significant segment of the market, as they are the most popular due to the presence of a large variety of flavoring components, high organoleptic indicators and relatively low cost. For flavouring beverages, artificial and identical natural flavors are mainly used, and water of various degrees of carbonation is used as a base [11,12].

It is crucial to incorporate plant extracts in the formulation of flavoured beverages to enhance the presence of their functional elements and biologically active substances (BAS) with antioxidant properties. This is due to the fact that contemporary clients possess tastes that diverge from those held by prior generations. Plant raw materials contain a substantial amount of phenolic compounds, alkaloids, glycosides, polysaccharides, organic acids, essential oils, vitamins, minerals, and other components. These molecules exert a favourable influence on the physiological functioning of several systems inside the human body, encompassing the digestive, urinary, cardiovascular, immunological, and other systems [13].

Specialised beverages tailored for athletes are currently being formulated, which include energy drinks infused with juices, extracts, caffeine, ginseng preparations, and other natural adaptogens. A diverse assortment of powdered drink combinations incorporating medicinal and preventative characteristics derived from vegetable

raw materials has been created [14,15].

For completion of losses of liquid during trainings and competitions use specialized sports drinks generally on the basis of a carbohydrate chloridno - sodium composition. But at the same time it is necessary that sports drinks not only recovered losses of liquid, but also had functional focus that is reached by enrichment of a compounding with biologically active agents. A specific place is held by the substances possessing adaptogenny action, in particular, extracts of plants, for example, of an echinacea, a ginseng, ginger and a St. John's wort [16,17].

Enriching soft drinks with polycomponent systems of plant extractives in the form of concentrates and bases is a new approach to promoting health, improving productivity, and supporting the body's natural healing processes.

**Materials and methods.** *Methods (methodology) of the experiment*

Apple juice and gooseberry extracts were the primary components utilised in the manufacturing of soft drinks.

Due to the distinctive composition of gooseberry (Red Large variety), which contains significant amounts of vitamins A and C, as well as vitamins E, PP, B groups, and various minerals like potassium, calcium, iron, zinc, and others, gooseberry was selected as the main ingredient.

The chemical makeup of gooseberries is influenced by various elements such as the variety, age, soil conditions, and other environmental factors. Consequently, the data regarding the chemical composition of gooseberries from different sources are more prone to variation compared to the data for other garden crops [1].

The health advantages of berries are attributed to a combination of beneficial compounds and vital vitamins. The product's pulp is distinguished by the presence of pectins, minerals, and metals. Table 1 shows the amount of beneficial components and vitamins found in 100 grammes of gooseberries.

**Table 1 - Useful components and vitamins in composition of gooseberries**

Vitamins	Quantity, mg	% from 100 g norm	Minerals	Quantity, mg	% from 100 g norm
A	0.033	3.6	potassium	260	10.4
B1	0.01	0.7	calcium	22	2.2
B2	0.02	1.1	magnesium	9.0	2.3
B4	42.1	5.11	sodium	23	1.8
B5	0.286	5.0	sulfur	18	1.8
B6	0.03	1.5	phosphorus	28	4.0
B9	5.0 mkg	1.3	chlorine	1.0	3.5
C	30.0	33.3	iron	0.8	4.4
E	0.5	3.3	iodine	1.0	0.7
K	7.8 mkg	0.7	manganese	0.45	22.5
PP	0.4	2.0	copper	130	13
Niacin B3	0.3	3.1	molybdenum	12	17.1
Antioxidants	0.389±0.005	0.413±0.006	fluorine	12	0.3
			chromous	1.0	2.0
			zink	0.09	0.8

Note: compiled based on source [1]

Gooseberries are popular in diets due to their low calorie level, high liquid content, presence of fibre, and pectin content.

Based on our analysis of the literature and existing recipes for producing beverages, we have determined that incorporating gooseberries into the formulation will enhance its composition, while also imparting a more delicate hue and flavour to the drink.

#### *Experimental part*

Extracts are highly concentrated juices that are free of pectin and can be produced using sulfitated materials. Consequently, the extraction of aromatic compounds does not occur throughout the manufacturing process. The extracts are utilised in the production of carbonated beverages.

Ultrasound is a highly promising technique for enhancing the extraction of plant resources. Utilising the ultrasonic extraction method can effectively decrease the time required for the procedure and result in a more thorough extraction of compounds [18 in Russian].

The extraction of nutrients from a mixture depends not only on the composition of the raw materials, but also on the specific type of extractant used. In order to ascertain the most effective extractant and the optimal percentage of

raw materials, we generated numerous samples of gooseberry extracts using the technique outlined below. To attain a particle size of 1-2 millimetres, we measured and pulverised the unprocessed components. Subsequently, we mixed the raw materials with distilled water and an aqueous solution of ethyl alcohol, which had concentrations of 10%, 15%, and 20%. This was done using the standard method and the ethyl alcohol solution had a volume of 40% at room temperature. The mixture was left for a duration of one hundred twenty minutes [1].

The low-frequency ultrasonic device was utilised to perform ultrasonic processing brand PLS-FSJ-300 made in China. The container containing a sample of raw materials is positioned into an isothermal bath that has been pre-heated to a temperature range of 38-40 degrees Celsius. The reverse refrigerator initiates operation upon turning on the water pipe valve. An electrically powered Hoover pump is activated. Once the residual pressure in the system has been measured and the length of ultrasound treatment for the raw materials has been set to 15 minutes, the low-frequency ultrasonic device is activated. After completing the ultrasound processing of the raw materials, the vacuum pump is turned off and the vacuum flow valve is opened to remove the container containing the extract.

Subsequently, the extract is strained using a sieve, and the residual substance is then subjected to compression. The obtained extract is forwarded for more investigation.

**Results and discussion.** The study employed physicochemical research methodologies, adhering to the technical regulations and standards specified

for this particular product [19]. The sensory parameters of the juice-containing beverage were determined using established procedures [20].

Gooseberry extract was utilized at every stage of the soft drink manufacturing process. The recipes for soft drinks containing gooseberry extract are provided in table 2 [1].

**Table 2 - Formulations of soft carbonated drinks with goosberry juice per 100 dal of finished product**

Raw material	formulation 1		formulation 2		formulation 3	
	Content of raw material in juice					
	measuring unit	quantity	measuring unit	quantity	measuring unit	quantity
sugar	kg	75.16	kg	65.90	kg	29.26
apple juice	l	95.5	l	95.5	l	95.5
raspberry juice	l	23.46	l	26.3	l	24.7
gooseberry extract	l	0.35	l	1.43	l	1.408
citric acid	kg	2.46	kg	2.32	kg	2.12
essential oil	l	0.002	l	-	l	0.004
color	kg	0.35	kg	-	kg	-

Note: compiled based on source [1]

Organoleptic indicators are assessed through visual observation and taste evaluation to evaluate quality factors such as appearance, colour, taste, scent, and transparency of the drink.

The table 3 displays the sensory properties of the

soft drink containing gooseberry extract.

The table 4 displays the physical and chemical characteristics of the soft drink containing gooseberry extract.

**Table 3 - Organoleptic characteristics of soft drink with gooseberry extract**

Indicator	Formulation 1	Formulation 2	Formulation 3
Appearance	Nontransparent liquid, without seeds and impurities	Nontransparent liquid, without seeds and impurities	Nontransparent liquid, without seeds and impurities
Color	ruby	ruby	Saturated ruby
Taste, aroma	Taste is peculiar to gooseberry, pleasant aroma	Taste is peculiar to gooseberry, pleasant aroma	Taste is peculiar to gooseberry, pleasant aroma

Note: compiled based on source [1]

**Table 4 - Physical and chemical parameters of soft drink with gooseberry extract**

Indicator	formulation 1	formulation 2	formulation 3
Mass share of dry substances, %	7.3	8.1	8.7

**Table 4 - Physical and chemical parameters of soft drink with gooseberry extract**

Indicator	formulation 1	formulation 2	formulation 3
Acidity, ml of 1 M solution NaOH for 100 ml of drink	2.5	2.9	3.7
Mass share of vitamin C, %	3.2	3.3	4.3
Vitamin P, mg%	3.5	3.7	4.2
Pectin substances, %	2.7-3.0	1.6-2.2	2.1-2.7
pH	4.4	4.6	4.4±0.2

Note: compiled based on source [1]

Tables 3 and 4 demonstrate that the sensory, physical and chemical characteristics of the soft drink align with the established criteria for soft drinks. The preparation of the drink enables the following: diversifying the range of options, enhancing the presence of biologically active compounds, improving the sensory characteristics of the product, and imparting functional properties to the drink [1].

The study findings reveal that the produced soft drink includes significant amounts of biologically

active components, including 3.2-4.3 mg% of ascorbic acid and 3.5-4.2 mg% of vitamin P.

**Conclusions.** Based on the experimental results, it can be concluded that gooseberry extract can be used as a supplement for soft drinks. The utilisation of gooseberry extract in the manufacturing of soft drinks serves as proof of its ability to enhance the sensory characteristics of the beverage and enable the creation of a functional beverage that offers both therapeutic and preventative benefits.

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