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**Nusrat Gurbanov,
Mardan Tagiyev,
Aygun Jafarova,
Elza Omarova,
Afet Gasimova,
Gultakin Gasimova,
Aymira Huseynova**

IMPROVEMENT TECHNOLOGY FOR PREPARING BALSAM-TYPE DRINKS BASED ON PLANT RAW MATERIALS

The object of the study is the preparation of balsam-type drinks. The problem of creating balsam-type drinks capable of satisfying the population's need for biologically active substances and increasing the overall tone of the body, while maintaining the availability and technological effectiveness of production, was solved. The work developed a technology for the preparation of general tonic non-alcoholic and alcoholic balsam-type drinks enriched with vitamins, essential oils and phenolic compounds, intended for mass consumption. For this purpose, the most popular aromatic and spicy plants of Azerbaijan were used. A recipe composition for 11 plant names was selected in order to obtain bitter sugar-containing non-alcoholic and alcoholic tinctures. During the study, watermelon juice and coriander (wild cilantro) were used as a preservative for this purpose. In 3 versions, a recipe composition of plants for the basis of extracts of a new range of alcohol-containing and non-alcoholic balsams was developed and proposed. Using heat treatment in a gentle mode, a blend of plants was obtained for the extraction of biologically active valuable components. Organoleptic and physicochemical indicators of the balsams were determined after their storage in normal and refrigerated conditions. The results of the studies showed that the content of dry substances in them fluctuates within 41.3–57.2%. Active acidity (pH), total amount of macro- and microelements (%) and specific gravity (g/cm^3), respectively, amounted to 5.53 ÷ 7.74, 1.136 ÷ 1.253 and 1.647 ÷ 1.2609. The nitrite content was also determined (16–18 mg/kg), since the recipe includes watermelon juice. Studies have shown that the samples stored at room and refrigerated conditions differed slightly in the main indicators and retained the corresponding color without change. However, the balsam prepared using watermelon juice, unlike the others, had a light orange color. The analyses were carried out using chromatograph mass spectrometry. The results showed that the essential oil base of the prepared drinks in all three variants of balsams is 5-hydroxymethylfurfural (13.73 ÷ 34.65%); n-hexadecanoic acid (11.12 ÷ 34.96%); heptadecanoic acid (12.67 ÷ 18.16%). Together with other chemical indicators, they characterize the bouquet and taste of the developed balsam "Ganja".

Keywords: *plant extract, balsam, recipe, organoleptic assessment, essential oil base, aromatic and spicy plants.*

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1. Introduction

The problems of providing the population with mass and special purpose products have become more urgent since the beginning of the 21st century than in previous periods of human development. Previously, when solving scientific issues of nutrition, the initial factors were caloric content, energy supply and nutritional value of diets. Now it is believed that the created healthy food products should be rich in dietary fiber, antioxidants, prebiotics and probiotics. The latter are considered to be active factors in maintaining a healthy spirit of the body and at the same time ensuring safety in its physical and mental development. This provides a solution to many physiological issues related to improving the immune system of the human body. All of the above and other important factors bring to the forefront the issues of creating flexible technologies for food products that should contain rich biologically and physiologically active food components. In this regard, in parallel with "solid" food products in structure, the creation of energy and therapeutic and prophylactic, including restorative and tonic non-alcoholic and alcoholic drinks for the general population of any country is gaining popularity. The importance of the latter lies primarily in the fact that when used as part of a diet, they provide a great effect for maintaining human health.

Therefore, it is advisable to use natural antioxidants to reduce the risk of contracting diseases, neutralize and remove toxic elements from the body. Since essential oil plant products have this property, there is particular interest in the preparation and study of functional products based on them [1].

It is known that functional products are products that are intended for the nutrition of the main group of the population and are useful for ensuring health. The technology of preparing functional products requires new views based on knowledge of dietetics [2].

In this aspect, balsam-type drinks are usually produced using environmentally friendly medicinal plant materials, which are rich in vitamin-containing and essential oil compounds, including phenolic substances, macro- and microelements.

Based on these premises, the study of medicinal plant food raw materials from cultivated and wild plants is particularly relevant.

Azerbaijan is a country located in the favorable climate zone of the South Caucasus. Numerous fruit and vegetable and spice plants grow in the country, both cultivated and wild [3]. This is facilitated by the

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presence of various sources of drinking and mineral water, which are very important not only for drinking, but also for creating drinks for mass and special purposes [4].

The expansion of the range of non-alcoholic balsams is primarily based on the desire to create a new recipe for a drink that acts as a flavor additive, which in practice has a pronounced pharmacological effect: tonic, anti-inflammatory, anti-stress, normalizing the functioning of the gastrointestinal tract [5].

Balsams are substances of plant origin, consisting of essential oils with resins, aromatic and other compounds dissolved in them. Balsams are a product of normal plant metabolism or are formed when the bark is damaged. The uniqueness of balsams, from the point of view of medical use, is that essential oils improve permeability and promote deeper penetration of phytoncides and biologically active substances (BAS) into the cells of the body [6].

In most cases, alcohol-containing balsams in various scientific sources, including commodity sources, are classified as liquor products [7]. During the Soviet period in the former USSR, the following types of balsams were mainly produced under the name: Riga Black (45% alcohol alcohol by volume), Kyrgyz-Arashan (45% alcohol by volume), Moscow (45% alcohol by volume), Belarusian (40% alcohol by volume), Kazakh (45% alcohol by volume), Karelian (40% alcohol by volume), Kobystan (Caucasian, 35–42% alcohol by volume) and others [8].

According to the commodity classification, the following data were classified as physicochemical indicators of balsams as liquor products, which are presented in Table 1 [7].

Table 1

Physicochemical properties of traditional balsams

Name of the drink	Alcohol by volume, % vol	Total extract content	Sugar in the drink	g/100 ml acids in terms of citric acid
Balsam	40–45	7–30	–	–

According to the existing standards, certain requirements were also presented for the bottles for storing balsams, where clay jugs or cognac flat bottles with a volume of 0.25; 0.5; 0.75; 0.38 and 0.33 l, respectively, were and are used for this purpose. The use of clay jugs for infusion allows avoiding heat treatment, which helps to preserve the medicinal properties of the original raw materials [7, 8]. At the same time, according to these documents, permissible deviations were also regulated when using bottles for liquor and vodka products and balsams depending on their volumes. It should be noted that the use of medicinal and spicy plants in the production of bitter drinks, including balsams, is primarily associated with the chemical composition and therapeutic and prophylactic properties of their extracts for food, medicinal and pharmaceutical and medical purposes. Currently, they are used for food in cooking. As a rule, medicinal and food-flavoring cultivated and wild plants are used for the production of balsams [7, 9–12]. Both aboveground and root parts are used as raw materials. At least 10 to 30 plant species are selected for balsams.

From the literature it became known that essential oils can be included in the composition of balsam preparations, in particular, the work was carried out using red ginger and citronella leaves with a concentration of 2.5%, 5%, 7.5% and 10%. The use of prepared balsams among volunteers showed that the drug does not cause irritation and the pH corresponds to the standard [13].

The work [14] presents the results of experiments on the development of a technology for the preparation of natural medicinal drinks based on extracts of milk thistle (*Silybum marianum L.*). The development of a technology for the production of therapeutic and prophylactic food products with the addition of plant extracts rich in biologically active substances is aimed at ensuring public health in the country and the world. Optimal conditions for extracting silymarin and silybin from crushed milk thistle seeds have been determined.

The research paper [15] highlights the enrichment of the population's usual diet with functional products and the addition of natural biologically active additives that help remove radionuclides, toxins, normalize the functioning of body systems and enhance immunity. The paper studies the process of extracting biologically active substances from medicinal plant materials (plantain and St. John's wort) in order to obtain extracts on the basis of which new functional drinks are developed. Studies have shown that drinks that have health and prophylactic properties can be used by people of different age groups to replenish the body with biologically active substances. The work [16] is devoted to substantiating the feasibility of developing recipes and innovative technologies for the production of preventive drinks with antioxidant, probiotic and hepatoprotective properties using a secondary dairy product – whey, as well as plant materials with a high content of biologically active substances. The use of plant extracts and flower extract in preventive drinks is recommended.

Ancient Indian physicians had extensive knowledge of the medicinal properties of plants and used them to treat diseases. Many of these plants have become ingrained in our socio-cultural practices and more than 700 species are used to prepare medicines. These herbal medicines are prepared from dried plant components such as bark, stems, leaves, flowers, fruits, seeds and roots and sometimes the entire plant is used. Over the years, bioactive phytoconstituents, which are mainly secondary metabolites, have been isolated and characterized and are considered as lead molecules with potential for drug development. Several medicines have been found to promote protection against bacteria, viruses as well as parasites and enhance immunity in many disorders, diseases in both animals and humans. Their therapeutic efficacy and potency vary. This work presents a look at traditional Indian medicinal aromatic plants that are used for their medicinal properties and maintenance of good health [17]. The issues related to the optimal composition of the selected components for the recipe of tinctures, the definition of the essential oil composition of the prepared drinks remained unresolved. All this allows to assert the advisability of conducting a study devoted to the selection of the range of raw materials and components for the preparation of the extract for the balsam. It is important to take into account the amount of raw materials based on the purpose and chemical composition of the drink, in this case, the balsam. In addition, when choosing raw materials, preference is given to the essential oil components of plants that determine the taste and aroma of balsams. The development of technology for alcoholic and non-alcoholic bitter drinks (tinctures) such as a new range of balsams, using various parts of spicy-aromatic fruit and vegetable crops and wild plants of Azerbaijan is distinguished by its relevance.

The aim of this research is to select a rational option for preparing a balsam using a natural preservative and reducing the duration of heat treatment. This option will ensure the shelf life and preservation of the nutritional components of the balsam. Based on the results of the study, select the most suitable option for preparing an extract for a balsam as a biologically active supplement.

2. Materials and Methods

2.1. Research materials

The object of research is the preparation of balsam-type drinks.

To prepare balsams, the above-ground parts of 10 well-known and most common in the diet of the population of Azerbaijan, cultivated and wild plant species in fresh form were used as research material:

- cilantro (lat. *Coriandrum sativum*);
- dill (lat. *Anethum graveolens*);
- mint (lat. *Mentha piperita L.*);
- sorrel (lat. *Rumex confertus Willd*);

– spinach (lat. *Spinacia oleraseae L.*);
– basil (lat. *Ocīmum basilicum L.*);
– coriander (lat. *Bifora*);
– thyme (lat. *Thymus serpyelum L.*);
– parsley (lat. *Pertroselinum sativum Hoffm.*);
– celery (lat. *Apium graveolens*);
– watermelon (lat. *Citrullus vilgaris Schard.*).

The balsam was prepared in 3 versions. In addition, granulated sugar, 96% ethyl alcohol and drinking water from the Goygol district of Ganja (Azerbaijan) were used. All components met the requirements of the relevant standards.

Coriander (lat. *Coriandrum sativum*) – roots containing essential oils (up to 2.1%), which contain more than 20 components, including α-linalool (up to 80%), geraniol (up to 5%), geranyl acetate (up to 5%), borneol (up to 4%), acetic esters, α-pinene, β-pinene, camphene, myrcene, dipentene, *p*-cymene, α, β-terpinene. Rutin (up to 145 mg%), ascorbic acid (up to 67–140 mg%) and carotene (up to 278 mg%) were found in the aboveground part, and the seeds contain up to 16% protein [13]. The roots contain: ash – 7.22%; macroelements (mg/g): K – 23.10; Ca – 12.50; Mg – 4.40; Fe – 0.30, microelements: Mn – 0.10; Cu – 0.54; Zn – 0.54; Cr – 0.05; Al – 0.02; Ba – 0.27; Se – 6.90; Ni – 0.22; Sr – 0.14; Pb – 0.05 and B – 57.20 μg/g [18].

Essential oil of coriander has a choleretic, antihemorrhoidal, analgesic and antiseptic effect. It stimulates granulation and increases the secretion of the glands of the digestive tract. The fruits are used as a spice that stimulates the activity of the stomach, to improve the taste and smell of medicines. It is part of a number of teas: laxative, choleretic, antihemorrhoidal [19].

Cilantro fruits are widely used as a spice in the food industry. They are used to flavor culinary and bakery products, meat (sausages) and canned fish, for marinating and salting. The above-ground part is used as a seasoning for meat dishes. The main essential oil crop. Essential oil is also used in the perfume industry. The plant is a good honey plant.

Dill (lat. *Anethum graveolens*) – roots containing essential oil (up to 5%) are used, which consists of α-carvone (up to 60%), dillapiol (up to (40%), phellandrene, α-limonene, β-pinene and myristicin; flavonoid vicenin; xanthone dillanoside; fatty oil. Dill greens contain up to 1.5% essential oil with a lower content (up to 16%) of carvone than in the root oil. The greens contain such representatives of flavonoids as isorhamnetin, quercetin, kaempferol [20]. Dill roots contain: ash – 7.61%; macroelements (mg/g): K – 17.90; Ca – 19.50; Mg – 3.40; Fe – 0.20, microelements: Mn – 0.14; Cu – 0.26; Zn – 0.31; Cr – 0.04; Al – 0.08; Ba – 0.06; Se – 30.0; Ni – 0.31; Sr – 0.28; Pb – 0.06; I – 0.09; Ag – 64.0 and B – 40.40 g/g [3].

The total preparation anetine from the root is recommended for mild forms of chronic coronary insufficiency, with spasms of the abdominal organs (with chronic spastic colitis, etc.). The infusion of the fruits is used as a carminative and expectorant.

Dill is a widely known spicy and aromatic food plant. It is grown for greens and seeds for pickling, canning, making marinades, and also as a pleasant seasoning for many dishes. The fruits and essential oil are used in perfume and soap industries [20].

Mint (lat. *Mentha piperita L.*), cultivated in Azerbaijan, contains in its leaves:

– from 0.5 to 2.5% of essential oil, the main component of which is menthol, in the amount of 40–60% (free in the form of a complex ester of menthol with acetic and valeric acids);
– menthone (9–25%);
– pinene, limonene, pulegone, phellandrone, dipentene, cineole and other terpenes and derivatives of terpenes. In addition, the leaves contain hesperidin, ursolic, oleanolic acids, carotene, flavonoids (isoroifolin, mentoside, piperitoside) [21].

Sorrel (lat. *Rumex confertus Willd*): The most valuable substances in the roots are anthraglycosides, i. e. derivatives of oxymethylanthraquinone and tannins. Among the derivatives of oxymethylanthraquinone, the most valuable are chrysophanol and emodin, which have bactericidal properties. Tannins are usually mixed in nature – derivatives of pyrogallol and pyrocatechol.

The leaves contain representatives of flavonoids rutin, hyperoside. The leaves are very rich in vitamin C (fresh leaves of horse sorrel contain 78 mg of vitamin C%) [3, 15].

The roots and leaves of horse sorrel in the form of powder, water infusion, decoction and liquid extract are used for gastrointestinal diseases, in particular for dyspepsia, enterocolitis, diarrhea, dysentery, etc.

Sorrel root is part of gastric tea. Large doses of root powder (0.5 g or more 1–2 times a day) are used as a laxative.

Fresh leaves, as high-vitamin edible greens, and fruits in the form of a water decoction are used to increase appetite, for anemia and vitamin deficiencies.

In folk medicine, sorrel leaves are used for diarrhea, scurvy and vitamin deficiencies. They are used to prepare a special pilaf "eveliqli ash", which is eaten with curdled milk as an astringent antidiarrheal agent, to increase appetite, and also for pulmonary diseases.

Spinach (lat. *Spinacia oleraseae L.*): Spinach leaves contain 9.3% water, up to 2.3% nitrogenous substances, 0.3% fat, 2.8% non-nitrogenous substances, 1.0% fiber and 1.5% minerals. Fresh spinach contains 3 mg% iron and 0.009 mg arsenic per 100 g. Spinach contains 37–64 mg% vitamin C, 3.7 mg% carotene, 0.08–0.30 mg% B1, 0.25–0.30 mg% B2, 0.72 mg% PP [3, 13]. Since spinach contains protein, vitamins and other useful substances, it is considered a valuable product for children's and dietary nutrition, as well as the main means of preventing scurvy and vitamin deficiency. Since spinach contains a lot of iron, and chlorophyll is close to blood hemoglobin, it is recommended for anemia and tuberculosis.

Saponins contained in spinach stimulate the activity of digestive glands and intestinal peristalsis.

Basil (lat. *Ocīmum basilicum L.*): Basil is a very aromatic and pleasant vegetable, it is mainly used as a spicy seasoning, as well as to add flavor and aroma to sauces, salads and dishes.

Basil leaves and flowers contain 0.03–1.6% essential oil, and green leaves – 0.04–0.52%. Most of the essential oil is extracted from the plant during its flowering. The main components of the essential oil are eugenol (7.8%), methyl chavicol, linalool, camphor and osimene. The seeds also contain 11.6–19% lard fat. In addition to essential oil, the leaves of the basil contain up to 16.3% nitrogenous substances, 4.73% fats, 12.6% fiber, vitamins and coloring agents. The coloring agents of basil – chlorophyll, flavones, carotene are very useful from a medical point of view. These substances have a good therapeutic effect in anemia, gastrointestinal diseases and vitamin deficiency [3, 14].

Coriander (lat. *Bifora*): There are two types of mountain coriander in the world: ovoid Bifora testiculata, and radiant – Bifora radians. The radiant type exists in the Caucasus, including Azerbaijan. Mountain coriander ovoid is a naked annual plant 10–20 cm high. The leaves around the stem are long-petiolate, expanding from the main part, double, pinnately divided, serrated at the edges. The flowers are white, in the form of a two-rayed umbrella, collected at the end of the stem. It has two fruits. It blooms in April–May and bears fruit in May–June. Mountain ovate coriander is widespread in the Guba, Samur-Divichi, Khazar coast, Absheron, Gobustan and Kura-Araz plains of the Republic of Azerbaijan, as well as in the flat and mountainous regions of Lankaran. The green part of the coriander contains 75–80 mg% of vitamin C, carotene, flavonoids, 0.1% essential oil, chlorophyll and other substances. Coriander is added to dishes as a spice and a green vegetable [3].

Thyme (lat. *Thymus serpyelum L.*): In the greenery of the Transcaucasian thyme in the Azerbaijani samples, 0.1–0.5% of essential oil was found, containing thymol; it also contains flavonoids, glycosides, tannins, ursolic acid, resin and fatty substances. Ash contains a copper compound (0.17–0.22%). The young above-ground parts of thyme contain vitamin C (54.5 mg% of dry matter).

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In the Azerbaijani samples of Kochi thyme, the yield of essential oil is 0.18–0.5% with a pronounced smell of thymol [3].

The essential oil of creeping thyme, common thyme and thymol have strong antiseptic and bactericidal properties, and are used for coughs. Thyme herb is widely used as a preservative for meat and other food products.

Parsley (lat. *Pertroselinum sativum Hoffm.*): Parsley roots containing essential oil (up to 7%) are used. The main components of its composition are apiol, myristicin, allyl tetramethoxybenzene, α-pinene, apiolic acid. Of the flavonoids, there are apiin, diosmin, luteolin and its 7-apioglucoside, chrysoeriol-7-apioglucoside, isorhamnetin, 3,7-diglucoside, naringenin, graveobioside; furocoumarin bergapten; fatty oil (22%). The aboveground part of parsley contains: ash – 10.95%; macroelements (mg/g): K – 51.50; Ca – 13.9; Mg – 4.9; Fe – 0.4; Microelements: Mn – 0.13; Cu – 1.95; Zn – 1.03; Co – 0.18; Cr – 0.15; Al – 0.18; Ba – 0.5; V – 0.03; Se – 3.25; Ni – 0.35; Sr – 0.28; Pb – 0.08; I – 0.48 and B – 96.00 μg/g [3, 13, 14].

Celery (lat. *Apium graveolens*): Root celery contains 1.3% nitrogenous substances. Small amounts of mannitol alcohol and apiic glucoside have been found. The root contains 75 mg% of vitamin C, and the leaves contain 7 mg% of carotene (provitamin A) together with vitamin C. Celery is distinguished not only by its pleasant smell, but also by the presence of vitamins, mineral salts and sugars. Celery leaves contain 0.1%, the root 0.09%, and the seeds 2.4–3.0% of essential oil. The main components of the essential oil are *d*-limonene (77–78%), *d*-selinene (12–13%), an alcohol-ether mixture (5%), sedanolide, sedanonic acid, palmitic acid and phenol. The seeds also contain up to 18% fat. The oil contains 26–41% petroseline, petroseladin, 26–30% olein, 10–13% linoleic acid. Celery leaves also contain the amino acids asparagine and tyrosine [14]. In addition to essential oil, celery root contains furocoumarins, flavonoids, ascorbic acid, vitamins B1, B2, K, E, PP, sticky substances, minerals, choline alcohol, the leaves contain 117–240 mg% vitamin C, 18–24 mg% carotene (provitamin A), 6.17% extractive substances. In addition, 320 mg% potassium, 80 mg% sodium, 9 mg% manganese, 68 mg% calcium, 0.53 mg% iron were found in the leaves [3, 14, 15].

Watermelon (lat. *Citrullus vilgaris Schard.*): Watermelon contains on average 88–92% water, 5.5–10.5% sugar, 0.8% nitrogenous substances, 0.2% acids, 0.4% mineral substances, 0.6% fats and nitrates, 4% fiber, 8 mg% vitamins C, B1, B2 and A. Watermelon seeds contain 30% fat [3]. The most common sugar is fructose, which increases its sweetness.

Watermelon is a good diuretic. It is recommended for tumors associated with the cardiovascular system and kidney diseases. A decoction of fresh watermelon rind is also used as a diuretic. In liver diseases, watermelon juice not only removes excess water from the body, but also supplies the liver tissue with easily digestible sugars. The cellulose contained in watermelon improves the activity of beneficial microorganisms, helps digest food and removes cholesterol from the body. Vitamin C and folic acid (vitamin B9) in watermelon have an anti-sclerotic effect. Watermelon is also used for gonorrhea, gallstones and urinary tract stones.

2.2. Research methods

The study determined the following:

– organoleptic properties of drinks – visually;
– active acidity using a Mettler Tolersdo pH meter (United Kingdom);
– dry matter and refractive index using an ABBE DR-A1 refractometer (Japan);
– bulk density using a Radwag AS 220/C analytical scale and 100 ml pycnometers (Belarus);
– nitrate content using a SOEKS nitrate tester (Russia);
– the amount of microelements by ashing in a muffle furnace and determination using a standard method;
– the essential oil composition of the prepared drinks was determined using a Perkin-Elmer Clarus 680 chromatograph mass spectrometer with a Clarus SQ 8T mass-selective detector (USA) [21]. The analysis conditions were a ZB WAX plus capillary column (60 m × 0.32 mm × 0.25 μm). The column temperature program was from 80 to 2500°C, the temperature rise rate was 40°C/min in the isothermal mode for 30 min.

The electronic absorption spectra of the solutions were recorded at room temperature using a Specord 50 Plus spectrophotometer, Analytik Jena, Germany, in the range of 190–1100 nm.

The criteria for interpreting the HPLC chromatograms of the mass spectra of the peaks and selecting the expected structure of the substances were the data on the retention time of the UV and mass spectra of the peaks. These criteria were compared with similar data from standard samples available to us and data from literary sources. Extracts (tinctures) and balsams were made in laboratory conditions at the Department of Food Engineering and Expertise of the Azerbaijan Technological University. The finished drinks were stored in filled bottles without alcohol and (or) with alcohol at 10–120°C in room conditions for 2 months and analyzed.

3. Results and Discussion

The proposed recipe and component composition of the balsams based on preliminary calculations for the study are presented in Table 2.

Table 2

Recipe composition of raw materials for the preparation of balsams in 3 versions

No.	Name of raw materials	Unit of measurement	Mass		
			Option I	Option II	Option III
1	Cilantro (green leaves)	g	60	60	60
2	Dill (green leaves)	g	75	75	75
3	Mint (leaves with shoots)	g	85	85	85
4	Sorrel (leaves)	g	80	80	80
5	Spinach (leaves)	g	135	135	135
6	Basil (leaves with shoots)	g	70	70	70
7	Coriander (green leaves)	g	50	50	50
8	Thyme (above-ground green part)	g	50	50	50
9	Parsley (greens)	g	85	85	85
10	Celery (leaves with stems)	g	90	90	90
11	Watermelon juice	ml	–	–	1500
12	Granulated sugar	g	1650	1650	1000
13	Drinking water	ml	2000	1500	1000
14	Ethyl alcohol 96%	ml	–	500	–
Yield:		ml	3100	3210	3300

As can be seen from the data in Table 2, in the third variant, natural watermelon juice from a blender is additionally added to the prepared semi-finished product for balsams, i. e. to the blend of plants.

The variants for obtaining extracts for preparing balsams are as follows:

Option I. The above-ground parts of all used green vegetable plants are cleaned of foreign impurities and rotten parts, washed well and crushed separately to particles of 0.1 mm in size. Then the crushed

components are mixed well and boiling drinking water is added to them. The mixture in this state is boiled for 5 minutes from the moment of boiling. After that, the mixture is cooled to a temperature of 20–22°C and stored for 3 days in a closed container in the dark with periodic stirring 2–3 times daily. The resulting mixture with the extract is filtered under a press. Granulated sugar is added to the filtered mixture of extracts according to the recipe, mixed and boiled for 5 minutes. At the end of the process, the extract obtained is poured hot into a dark-colored bottle and left for storage and analysis.

Option II. In this option, the pure crushed and mixed mass, after adding boiling water, is boiled for 5 minutes from the moment of boiling. After which the mixture is cooled to a temperature of 20–22°C. Then ethyl 96% alcohol is added to the mixture of crushed mass, mixed well and left for extraction in a dark, closed vessel for 15 days with periodic daily stirring 2–3 times. Next, the extracted mixture of crushed mass from plants is filtered under a press. Granulated sugar is added to the filtered mass of the extract and the mixture is boiled and the extract is poured hot into dark-colored bottles, left for storage and analysis.

Option III. In this option, the process of obtaining an extract from a mixture of crushed plants is carried out in the same way as in the first option. However, after adding boiling water, the mixture is not further boiled for 5 minutes. The extract is separated from the mixture by pressing and filtering, and pre-prepared watermelon juice from the pulp of a ripe watermelon is added to it at room temperature. At the end of the preparation, the watermelon juice is mixed with granulated sugar, then added to the plant extract and boiled for 5 minutes. The resulting drink (extract), after filtering, is poured into bottles while hot, left for storage and analysis.

As can be seen, in the third option, compared to the previous ones, the time of heat treatment of crushed plants (roots) is reduced to a minimum, alcohol is not used, watermelon juice is additionally added to the extract, which contains nitrites, which have preservative properties.

The general technological scheme for the preparation of extracts (tinctures) for the preparation of balsams is shown in Fig. 1.

According to the options proposed above and the technological scheme using the above-ground parts of the selected essential oil crops and wild plants growing in Azerbaijan, the "Ganja" balsam was prepared.

From the results of the study, it became clear that the drinks in the preparation of which heat treatment was used were transparent (options I and II) and had a light-yellow color, and in the option with heat treatment they had a light orange color (Table 3).

Fig. 2 shows samples of balsams prepared in laboratory conditions based on the obtained extracts.

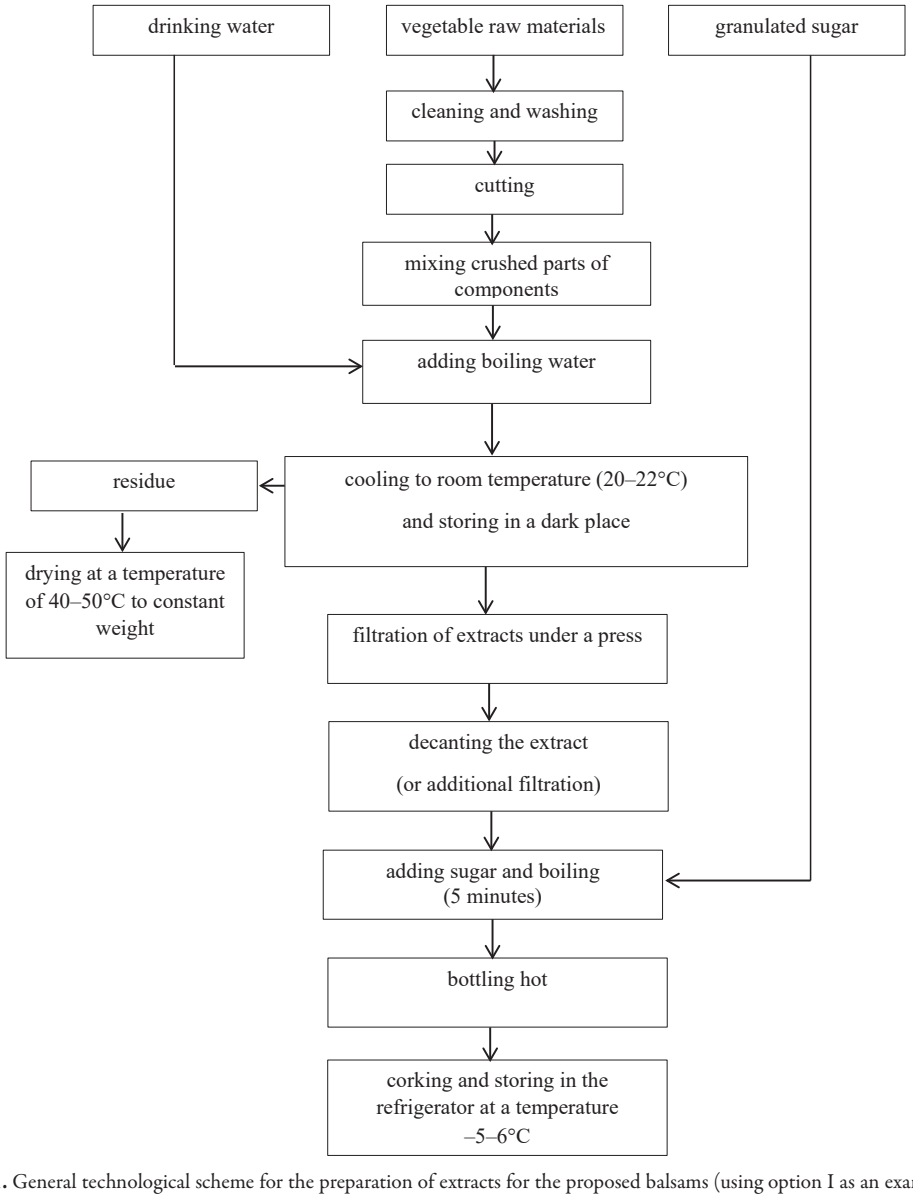

Fig. 1. General technological scheme for the preparation of extracts for the proposed balsams (using option I as an example)

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Table 3

Organoleptic and physicochemical indicators of the prepared balsams

No.	Determined parameters	Samples stored at room temperature		
		Option I	Option II	Option III
1	Color	Light yellow	Light yellow	Light orange
2	Active acidity of the medium, pH	6.79–5.83	7.74–7.01	6.66–5.53
3	Refractive index, Ndt	1.4020–1.4053	1.4346–1.4347	1.4204–1.4236
4	Dry substances, brix%	41.3–42.8	56.7–57.2	50.1–51.7
5	Total amount of macro- and microelements, %	1.174	1.136	1.253
6	Specific gravity, g/cm^3	1.647–1.662	1.2569–1.2609	1.2508–1.2551
7	Nitrite, mg/kg	0	0	16–18
Samples stored in refrigerated conditions				
1	Color	Light yellow	Light yellow	Light orange
2	Active acidity of the medium, pH	6.79–6.02	7.74–7.01	6.66–6.01
3	Refractive index, Ndt	1.4020–1.4069	1.4346–1.4354	1.4225–1.4244
4	Dry substances, brix%	41.3–43.4	56.7–57.1	51.1–51.8
5	Total amount of macro- and microelements, %	1.174	1.136	1.253
6	Specific gravity, g/cm^3	1.647–1.686	1.2569–1.259	1.2551–1.2572
7	Nitrite, mg/kg	0	0	16–18

a *b* *c*

Fig. 2. Samples of balsams prepared in laboratory conditions: *a* – sample 1; *b* – sample 2; *c* – sample 3

Based on the conducted studies, chromatographic and spectrometric determinations of the composition of extracts for the proposed balsams showed the following results (Table 4).

Table 4

The main identified composition of balsams by variants

No.	Name of organic substances	Unit of measurement	Sample 1	Sample 2	Sample 3
1	5-hydroxymethylfurfural	%	13.73	14.08	34.65
2	*n*-hexadecanoic acid	%	34.96	21.34	11.12
3	heptadecanoic acid	%	18.16	14.30	12.67

It was found that the balsam prepared according to the third variant of the recipe, where short-term heat treatment was used in the process of obtaining extracts, had the best composition in terms of the presence of biologically active compounds, and watermelon juice was used. In the general technological scheme for the preparation of balsams, ethyl alcohol is used, but in the developed technological scheme, watermelon juice was used as a preservative. The use of watermelon juice reduced sugar consumption and enriched the balsam with nutritional components included in the raw materials. It is important to note that the plant extract as a basis for the balsam was prepared from essential oil raw materials, which distinguishes the recipe ingredients from other balsams. The use of natural antioxidants is advisable in order to reduce the risk of infection, as well as neutralize and eliminate toxic compounds from the body. Considering that essential oil plant products have the specified properties, the development and study of functional food products based on them is of particular scientific interest. Organic substances identified in the composition of balsams, such as 5-hydroxymethylfurfural, *n*-hexadecanoic acid and heptadecanoic acid have a positive effect on human health. 5-hydroxymethylfurfural is formed during the heat treatment of sugar-containing products through the Maillard reaction, as well as during caramelization. When included in moderation in the diet, they exhibit antioxidant properties. *n*-hexadecanoic acid is a saturated fatty acid present in vegetable oils, which has antioxidant and antibacterial activity. Heptadecanoic acid is associated with potential benefits for cardiovascular and metabolic health, including a reduced risk of hypertension and diabetes. Therefore, balsams prepared from plant materials can be used in medicine for the prevention and treatment of diseases. In the food industry for flavoring and enriching products, adding extracts to drinks, desserts and confectionery. Tinctures can be used to make bitters, balsams and liqueurs. Plant extracts can also be used to prepare functional products, and this is actively used in food technology and nutrition. As studies have shown, plant extracts contain a wide range of biologically active substances – flavonoids, polyphenols, essential oils, organic acids, vitamins, minerals, alkaloids. These components have antioxidant, anti-inflammatory, immunomodulatory and other physiologically significant properties, which allows to classify products with their addition as functional. When researching and introducing

plant extracts into the composition of functional products, there are a number of restrictions and conditions that are important to consider so that the results can be safely and effectively applied in practice. It is important to take into account the chemical composition and safety of raw materials, it is necessary to exclude the presence of toxic compounds, heavy metals, pesticides, mycotoxins. Consider the dosage of some plant components, which, when certain concentrations are exceeded, can cause side effects (for example, alkaloids, saponins). The allergenic potential of extracts can cause individual allergic reactions. When developing a recipe, it is necessary to ensure the consistency of the content of active substances (flavonoids, polyphenols, essential oils, etc.). When developing extracts and balsams, it is necessary to take into account the stability of active substances to temperature treatment, pH environment, light and oxygen, the compatibility of the extract with other ingredients of the product, the possibility of influencing the taste, aroma and color of the product. The presence of a raw material base of stable quality opens up wide opportunities for further research.

4. Conclusions

In the research work using the above-ground parts of 10 types of medicinal edible leafy cultivated and wild herbal plants and watermelon pulp, an extract (tincture), the basis of a balsam called "Ganja", was obtained. The extract was prepared in different versions with the addition of sugar, drinking spring water, 96% ethyl alcohol and with the addition of watermelon juice according to the proposed technology, using short-term heat treatment.

Using well-known research methods, the mineral composition and the main quality, including organoleptic and physicochemical indicators of non-alcoholic and alcoholic drinks such as balsam in 3 versions, stored at room temperature and in the refrigerator, were determined.

A general technological scheme and recipes for extracts for the preparation of balsams were developed. When obtaining extracts (infusions) in the third variant, sweet watermelon juice was used to prepare the balsam, which contains nitrates, which act as a preservative. Preference was given to this variant, since in this case the balsam is prepared from a plant extract without boiling, which helps to preserve nutrients. The rational composition of the selected components for the tincture recipe was established, the essential oil composition of the prepared drinks was determined. Using the chromatograph mass spectrometry method, it was found that the essential oil base of the prepared drinks in all 3 variants of balsams is 5-hydroxymethylfurfural (13.73 ÷ 34.65%); *n*-hexadecanoic acid (11.12 ÷ 34.96%); heptadecanoic acid (12.67 ÷ 18.16%). These components, along with other chemical indicators, characterize the bouquet and taste of the developed balsam "Ganja". Among the essential oil compounds, traces of seven components involved in the formation of the taste and aroma of balsams were found. The organic substances identified in the balsams, when present in moderate amounts in the diet, exhibit antioxidant properties, which extends the shelf life of the finished product.

The prepared balsam is a concentrated herbal preparation with a high content of biologically active compounds. It contains organic acids, vitamins, minerals, proteins, lipids, carbohydrates, and tannins extracted from medicinal plants.

The specified infusion is classified as a plant adaptogen with pronounced tonic properties. Its use helps to reduce physical and psycho-emotional fatigue, as well as maintain the functional balance of the body under intense stress.

In gastronomic practice, the infusion can be used as an aperitif, activating salivation and stimulating appetite before the main meal. For preventive purposes, especially during periods of increased risk of viral and infectious diseases, the drug is used in combination with tea or honey. Small doses (several teaspoons) can have an immunomodulatory, diaphoretic and mucolytic effect.

Conflict of interest

The authors declare that they have no conflict of interest in this research, whether financial, personal, authorial or otherwise, that could influence this research and its results presented in this article.

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Nusrat Gurbanov, *PhD, Associate Professor, International Centre for Master's and Doctoral Studies, Azerbaijan State University of Economics, Baku, Azerbaijan, ORCID: https://orcid.org/0009-0002-5076-5354*

Mardan Tagiyev, *PhD, Associate Professor, Department of Food Engineering and Expertise, Azerbaijan Technological University, Ganja, Azerbaijan, ORCID: https://orcid.org/0000-0003-4664-4082*

Aygun Jafarova, *Assistant, Department of Mechanical Engineering and Logistics, Azerbaijan Technological University, Ganja, Azerbaijan, ORCID: https://orcid.org/0009-0001-0770-1753*

Elza Omarova, *Doctor of Philosophy in Engineering, Associate Professor, Department of Engineering and Applied Sciences, Azerbaijan State University of Economics, Baku, Azerbaijan, ORCID: https://orcid.org/0000-0003-3888-6372*

✉***Afet Gasimova,*** *PhD, Associate Professor, Department of Food Engineering and Expertise, Azerbaijan Technological University, Ganja, Azerbaijan, ORCID: https://orcid.org/0000-0002-9814-4488, e-mail: afet-kasumova@rambler.ru*

Gultakin Gasimova, *Doctor of Philosophy in Biology, Acting Assistant Professor, Department of Ecology and Nature Conservation, Ganja State University, Ganja, Azerbaijan, ORCID: https://orcid.org/0009-0001-2876-4155*

Aymira Huseynova, *Assistant, Department of Food Engineering and Expertise, Azerbaijan Technological University, Ganja, Azerbaijan, ORCID: https://orcid.org/0009-0005-7086-4802*

✉*Corresponding author*