UDC (338.48-043.86):005.593
DOI https://doi.org/10.37734/2518-7171-2022-1-7

DEVELOPMENT OF TECHNOLOGY OF BUNDED JUICE ON THE BASIS OF FERTILIZED BIRCH JUICE

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Abstract. The purpose *of the article is to develop the technology of blended juices based on fermented birch sap.*

Objectives of the article. *The aim of the work was to develop biotechnology of production of fermented birch sap on the basis of preliminary selection of the most effective strains of microorganisms for fermentation, study of therapeutic and prophylactic properties of developed fermented birch sap by establishing the impact of a new product on metabolic processes and metabolic syndrome. determination of biological activity of the developed product against opportunistic pathogens.*

Research methodology*. Different variants of blending ingredient ratios were developed and studied according to a set of organoleptic and physicochemical parameters.*

The degree of preservation of L-ascorbic acid after heat treatment was determined on model solutions. For this purpose, solutions of lactic acid in concentrations of 0.05%, 0.1%, 0.3%, 0.5% were prepared in distilled water, and ascorbic acid in concentrations of 0.005% and 0.010% was added to them. Organic acids were determined by high performance liquid chromatography in the reverse phase variant by photometric detection on a Waters instrument (USA). Quantitative determination of organic acids was performed according to standard solutions.

Results. *Freshly harvested birch juice is biologically unstable In the process of collection, it is contaminated with spontaneous microbiota and its shelf life before processing, although dependent on storage temperature, but is usually limited to 2 days. Therefore, it is important to prolong its shelf life by developing biotechnological methods to preserve the therapeutic and prophylactic properties of the original juice.*

Conclusions.*So, modeling the loss of L-ascorbic acid during heat treatment allows us to draw an important conclusion for the technology, namely synthetic ascorbic acid should be added to blended juices based on fermented birch, that is after the fermentation process to establish an acidic environment. In terms of biochemical and microbiological composition, the most valuable can be considered fermented beverages – products of cultivation of mono or associated cultures of microorganisms. This is due to the ability of microorganisms to produce biologically active substances necessary for the normal functioning of the human body. The main difference and advantage of such beverages over conventional blending products is that bioactive substances are not introduced artificially, but are formed naturally during fermentation. If the source product is limited relative to a number of BAS or has a need to improve organoleptic characteristics, it is advisable to blend it with carriers of the desired properties.*

Key words: *biotechnology, fermented birch sap, therapeutic and prophylactic properties, antimicrobial activity.*

Problem statement in general and connection with the most important scientific or practical tasks. Birch sap is an excellent health drink that has valuable preventive and curative properties, contains organic acids, trace elements, sugars and substances that have antimicrobial activity.

Birch sap is widely used due to therapeutic and prophylactic effects on the body: in some lung diseases, bronchitis, tuberculosis as a tonic, kidney stones, boils, gout, joint disease, eczema, herpes as a stimulant of metabolism in the body [1].

Birch sap has a purifying, anti-inflammatory, diuretic effect, promotes rapid release of metabolic products and is quite valuable in intoxications and diseases caused by metabolic disorders in the body [2]. The juice is used in vascular diseases, atherosclerosis, it makes wiping for psoriasis, scabies. In a number of reference books [1, 3] it is noted that birch sap serves as a refreshing and tonic drink.

Freshly harvested birch sap is biologically unstable In the process of collection, it is contaminated with spontaneous microbiota and its shelf life before processing, although dependent on storage temperature, but is usually limited to 2 days. Therefore, it is important to prolong its shelf life by developing biotechnological methods to preserve the therapeutic and prophylactic properties of the original juice.

Analysis of recent research and publications. In recent decades, the production of fermented juices with the use of microorganisms or enzyme preparations has increased significantly, but we have not found information on the technology of fermented birch sap. There are no data on the use of certain enzyme preparations or species and strains of microorganisms for the fermentation of birch sap.

Formulation of the goals of the article (task statement). Identify raw materials that can be used to improve the taste of the studied juices and set the parameters of heat treatment of raw materials. To select the optimal ratios of new types of juices to conduct research on the optimal proportions of fermented birch sap and ingredients for making blends.

Table 1

Dependence of ascorbic acid content on the amount of lactic acid in model solutions during heat treatment (n = 3, P≥0.95)

Solutions in which 5 mg of ascorbic acid are artificially added					
Lactic acid, %	0,05	0,1	0,3	0,5	0,6
L-ascorbic acid, mg / 100 g	1,32	2,64	3,32	3,90	4,1
Loss of L-ascorbic acid, %	72	47	34	22	18
Solutions in which 10 mg of ascorbic acid are artificially introduced					
Lactic acid, %	0,05	0,1	0,3	0,5	0,6
L-ascorbic acid, mg / 100 g	1,76	3,08	4,96	6,87	7,50
Loss of L-ascorbic acid, %	82	69	50	31	25

Develop different versions of the ratios of blending ingredients and conducted their research on a set of organoleptic and physicochemical parameters.

Results. The degree of preservation of L-ascorbic acid after heat treatment was determined on model solutions. For this purpose, solutions of lactic acid in concentrations of 0.05%, 0.1%, 0.3%, 0.5% were prepared in distilled water, and ascorbic acid in concentrations of 0.005% and 0.010% was added to them.

After heat treatment – exposure of prepared solutions of lactic acid of different concentrations with added ascorbic acid at a temperature of 100 0C for 5 minutes – the content of ascorbic acid clearly depended on the concentration of lactic acid. The dependence of the content of ascorbic acid on the amount of lactic acid in the model solutions is shown in (table 1).

According to table 1, which illustrates the effect of heat treatment on the loss of L-ascorbic acid, it is seen that the amount of L-ascorbic acid when applying it in 0.05%; 0.1%; 0.3%; 0.5% – no solutions of lactic acid in a concentration of 0.005% were, respectively: 1.3; 2.6; 3.3; 3.9 mg / 100 g, and when applied at a concentration of 0.01% – 1.7; 3.1; 5.0; 6.9 mg / 100 g (Fig. 1).

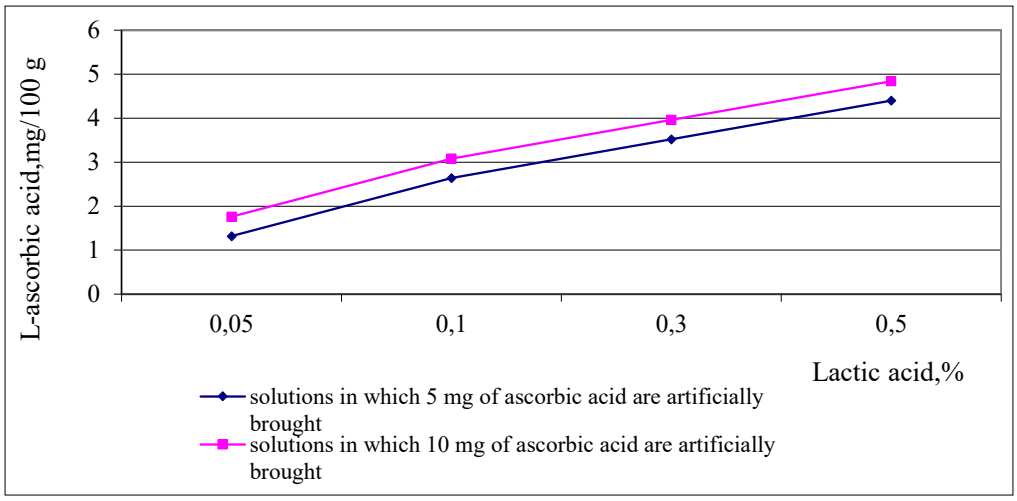

Fig. 1. Dependence of L-ascorbic acid content on the amount of lactic acid in model solutions

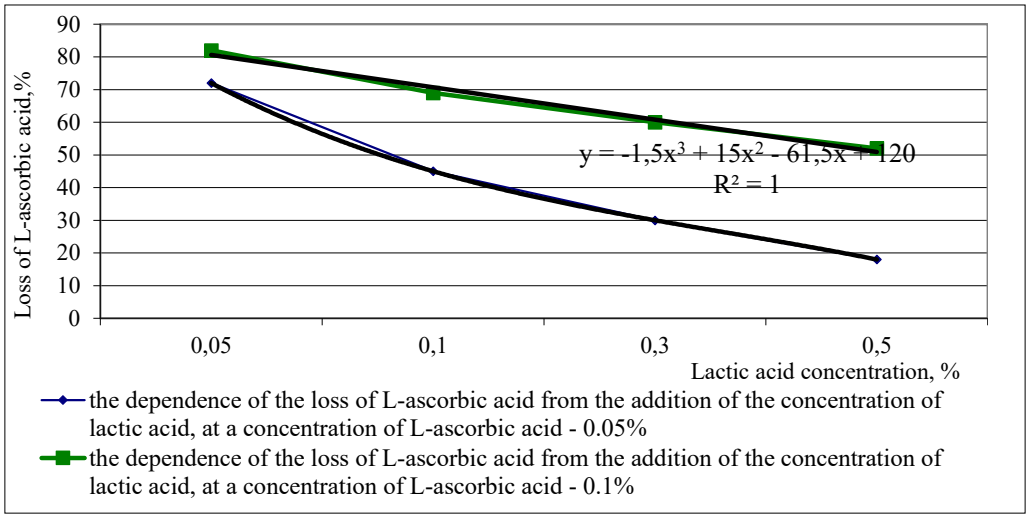

Fig. 2. Dependence of L-ascorbic acid losses on lactic acid addition

The graphs presented in Fig. 1 and 2 indicate that there is a close correlation between these two factors – the more lactic acid in the solution, the better it retains L-ascorbic acid. However, losses L-ascorbic acid was higher in the variant where more ascorbic acid was added, which is confirmed by other authors [4].

So, modeling the loss of L-ascorbic acid during heat treatment allows us to draw an important conclusion for the technology, namely synthetic ascorbic acid should be added to blended juices based on fermented birch, that is after the fermentation process to establish an acidic environment.

Given the characteristics of fermented birch sap, namely its limitation relative to a number of BAR, including L-ascorbic acid, carotenoids, pigment complex, discoloration and partial opacity, it is advisable to conduct research on the choice of ingredients for enriching fermented birch sap.

Directions for creating blended juices based on fermented birch are presented in Figure 3.

Raw materials that can be used to improve the taste of the studied juices were determined and the parameters of heat treatment of raw materials were set. To select the optimal ratios of new types of juices, the optimal proportions of fermented birch sap and ingredients for making blends were studied.

Different variants of blending ingredient ratios were developed and studied according to a set of organoleptic and physicochemical parameters.

The ratio of components in the development of recipes for blended juices based on fermented birch sap are shown in table 2.

Blending juices were made according to the technology used in the canning industry for the production of blended juices [3] with the exception of the method of adding sugar – it was prepared on the main component of blends – fermented birch sap.

Birch-cherry juice at a ratio of 1: 1 had a pleasant taste, the predominance of cherry, at a ratio of 1:0.8 also felt very cherry juice, and at a ratio of 1:0.6, it had the highest taste. At a ratio of 1:0.4, the juice acquired an empty taste, and had a less intense color.

Birch-apple blend had similar properties. The most acceptable result was a ratio of 1:0.4. Variants 1: 1 and 1:0.6 received the same total tasting score, but the juice had a unique taste at a ratio of 1:0.8.

The best option for making birch-elderberry juice is the ratio of components – 1:0.2. Option – 1:0.5 had a very good appearance, pleasant aroma, but it can not be drunk because of the bitterness of elderberry juice, which is also unpleasant in the third option (1:0.3). The ratio of 1:0.1 had a not very attractive appearance, lactic acid was well felt in taste and smell.

Birch-cabbage juice received a low average score due to unattractive color and unpleasant aroma of cabbage. To improve the color used elderberry juice, aroma – coriander extract. These measures have significantly improved the appearance of the juice and its aromatic properties.

Elderberry juice not only gave a more attractive color, but also to some extent improved the taste of birch-cabbage juice, giving it a spicy tartness.

Birch-carrot juice in a ratio of 1:0.5 is an extraordinary, thirst-quenching drink. This juice in different versions differs sharply in taste, but has almost the same aroma and appearance. Coriander extract was added to birch and carrot to get rid of the smell of carrots. This juice also stratifies – particles of carrot juice settle to the bottom and it has two colors: the lower – orange, the upper – with a hint of yellow, in addition, it must be further homogenized.

Organoleptic evaluation of the basic variants of blends, based on fermented birch sap, was performed after three months of storage of canned food (Table 3).

Table 2

Recipes for blended juices

The name of the experimental juice samples	The ratio of components
Birch and cherry	1:0,4; 1:0,6; 1:0,8; 1:1
Birch and apple	1:0,4; 1:0,6; 1:0,8; 1:1
Birch and elderberry	1:0,1; 1:0,2; 1:0,3; 1:0,5
Birch and cabbage	1:0,25, 1:0,5; 1:0,75; 1:1
Birch and cabbage with the addition of elderberry juice	1:0,5; 1:0,2; 1:0,75; 1:1
Birch and carrot	1:0,3; 1:0,5; 1:0,75; 1:1
Birch with the addition of carrot and apple juice	1:0,4; 1:0,6; 1:0,8; 1:1

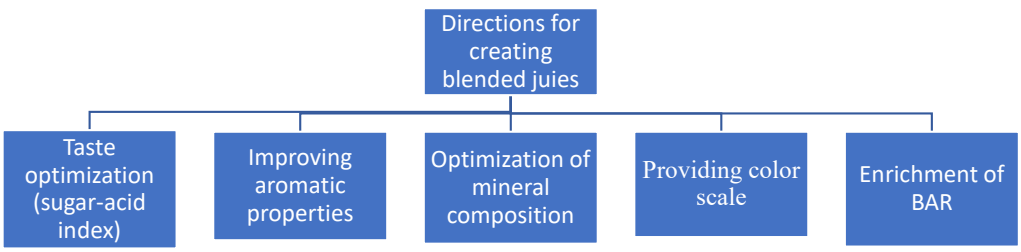

Fig. 3. Directions for creating blended 1

Table 3

Organoleptic indicators of basic variants of blends

The name of canned food	Appearance	Taste	flavor	Consistence
Birch and elderberry juice (ratio 1:0.5)	Fuzzy color with a brown tinge, cloudy	Original, but the taste and bitterness of elderberry	Typical aroma of elderberry	Liquid
Birch-cabbage juice (ratio 1:0,25)	Slightly yellowish cloudy color	Empty, unconcentrated	Aroma of sauerkraut	Liquid
Birch-cabbage juice with the addition of elderberry (ratio 1: 0.5)	Dark burgundy color with a brown tinge and a small amount of sediment	Taste of sauerkraut fermented juice with sourness	The smell is not pronounced, with a hint of cabbage	Liquid
Birch-carrot juice (ratio 1:0.3)	Orange, with flesh	Vague, sour, carrot flavor	Typical carrot, with a scent of lactic acid	Heterogeneous, the particles of pulp settle to the bottom
Birch-cherry juice (ratio 1:0.4)	Cherry red color	Tart, sour, distinctly cherry flavor	Cherry, with a faint odor of fermented birch sap	Heterogeneous, pulp particles settle to the bottom
Birch-apple juice (ratio 1:0.4)	Light brown muddy color	The taste is pleasant, sour, there is a taste of apple juice	The smell of lactic acid with the aroma of apple juice is well expressed	Homogeneous with the flesh
Birch sap with the addition of carrot and apple (ratio 1:0.4)	Bright yellow color	The taste of carrot juice prevails, pleasant with sourness	Pleasant, dominated by apple, barely noticeable carrot juice	Heterogeneous, the particles of pulp settle to the bottom

Physico-chemical parameters of the basic variants of blends based on fermented birch sap were studied after 6 months of storage of canned food. Their results are shown in Fig. 4.

The results of research on the organoleptic properties of blends, which were developed, are shown in Fig. 4. As a result of the work on organoleptic and physicochemical parameters as final options for production, we can offer the following experimental samples of juices:

– birch-cherry juice (ratio 1:1) — original, has satisfactory organoleptic properties, pleasant taste and contains biologically active substances;

– birch-apple juice (ratio 1:0.4) — pleasant, has refreshing properties, contains biologically active substances, although the content of vitamin C is somewhat low;

– birch-elder juice (1:1 ratio) needed improved color and taste.

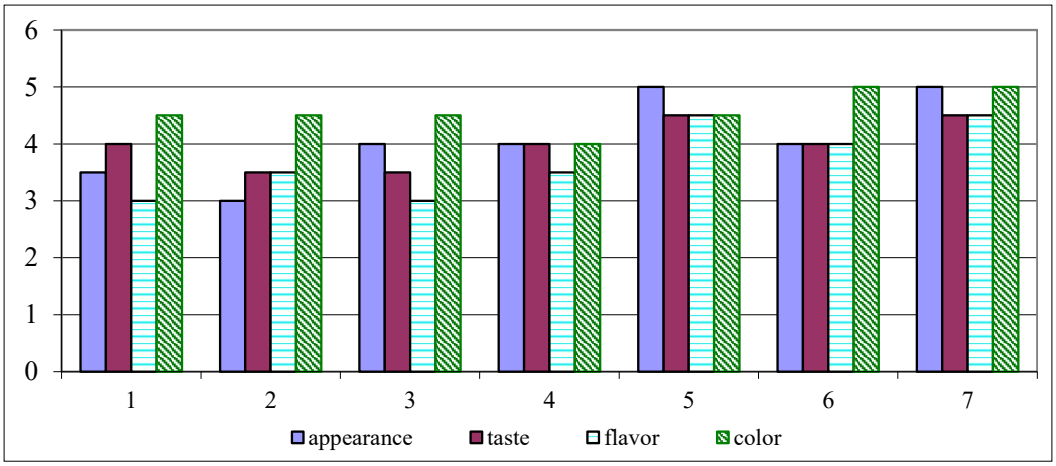

Fig. 4. Tasting evaluation of blends based on fermented birch sap

1 – birch-elder juice; 2– birch-cabbage juice; 3 – birch cabbage juice with the addition of elderberry juice; 4 – birch-carrot juice; 5 – birch-cherry juice; 6 – birch-apple juice; 7 – birch sap with the addition of carrot and apple juice

In order to determine the biological value of fermented birch sap and the most successful blends based on it – birch-apple and birch-cherry, the content of carboxylic and phenolic acids in these juices was analyzed. Raw materials for juice production were collected in Poltava region.

In apple juice, on the contrary – malic acid is contained in a concentration of 0.1 M, and the share of citric is less than 1% of the total acid.

Organic acids were determined by high performance liquid chromatography in the reverse phase variant by photometric detection on a Waters instrument (USA). Quantitative determination of organic acids was performed according to standard solutions.

The chromatogram of a standard mixture of hydroxy acids is shown in Fig. 5

Ascorbic, lactic, succinic, malic and two unidentified acids with a yield time of Rf 4.67 and Rf 7.83 were found in birch-apple juice (Fig. 6).

In birch-cherry juice, in addition to the above, citric acid was also found (Fig. 7). This phenomenon is quite natural, because the stone fruits, including cherries (and therefore their juice) contain a significant amount of citric acid.

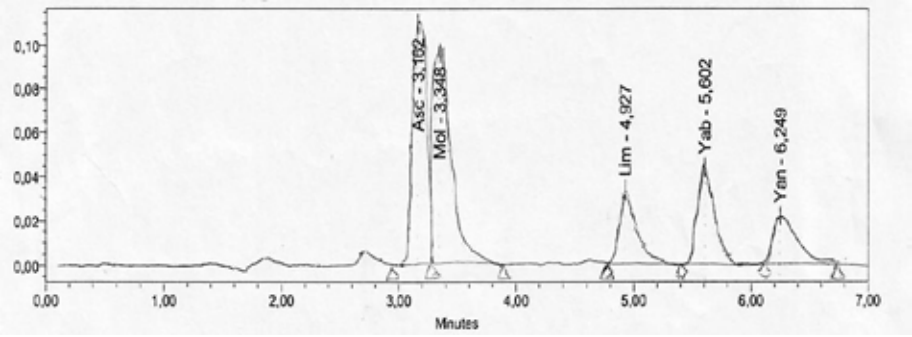

Fig. 5. Chromatogram of a standard mixture of hydroxy acids
Asc – ascorbic acid; Mol – lactic acid; Lim – citric acid; Yan – succinic acid; Yab – malic acid.

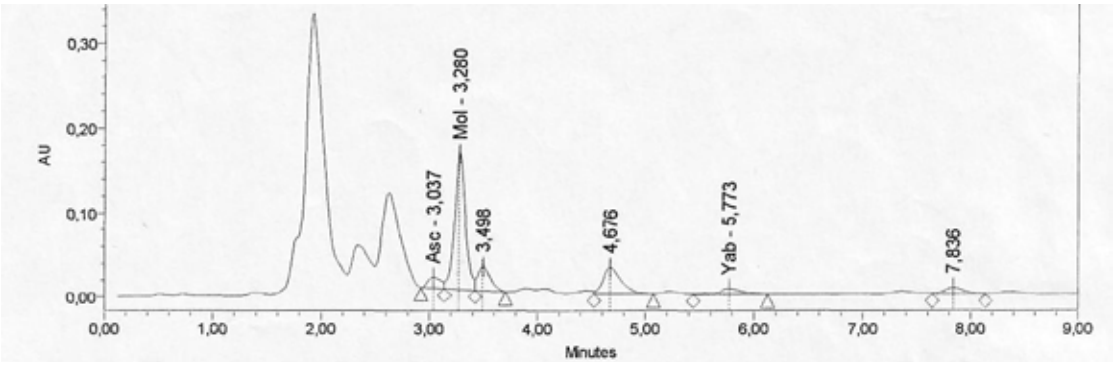

Fig. 6. Chromatogram of hydroxy acids of birch – apple juice
Asc – ascorbic acid; Mol – lactic acid; Yab – malic acid.

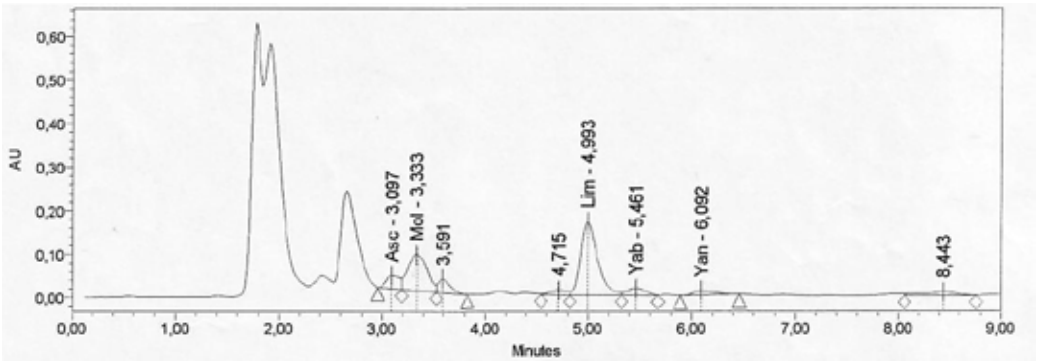

Fig. 7. Chromatogram of hydroxy acids of birch-cherry juice
Asc – ascorbic acid; Mol – lactic acid; Lim – citric acid; Yan – succinic acid; Yab – malic acid.

The content of organic acids in blended juices is given in table 4.

Table 4

Content of organic acids in blended juices, mg / 100 g

The name of the juice	Acid				
	lactic	malic	chlorogenic	caffeic	succinic
Fermented birch sap (control)	507	–	–	–	216
Birch – apple	369	2,9	27,9	1,1	188
Birch – cherry	452	6,2	22,1	17,5	321

Apparently, the content of carboxylic and phenolic acids in blends clearly depends on their formulation. If only lactic, succinic and unidentified, possibly acetic acid, was found in the fermented birch sap, lactic, malic and two phenolic acids – chlorogenic and caffeic – were found in the birch-apple blend. Birch-cherry juice was the richest in biologically active acids, as it contains five acids, in terms quantitative (amount) is 714.6 mg / 100 g, and birch-malic and birch – respectively contain 653.0 and 586 mg / 100 g.

It is known that the gradual metabolism of sorbose by lactobacilli only until the formation of pyruvic acid. However, from this moment the mechanism of the process changes, because in the complex of enzymes of lactic acid bacteria there is no carboxylase, as a result of which instead of splitting pyruvic acid into carbon dioxide and acetaldehyde it is catalyzed by the enzyme reductase into lactic acid.

In blended juices, malic, chlorogenic and caffeic acids come from the fruit component, because they are part of the chemical composition of raw materials, and succinic – from both birch and fruit juices, so its amount in all studied juices is highest after lactic. It is not logical that the content of succinic acid in birch-apple juice is lower than in birch, although fresh apple juice contains it no less than fermented birch. In the latter, succinic acid accumulates during the fermentation of fresh juice.

It is worth emphasizing the biological value of succinic acid. It stimulates the respiration of cells and tissues, relieves the toxic effects of a number of drugs, normalizes the cardiovascular system and liver, has a beneficial effect on atherosclerosis of coronary vessels and brain [5].

Thus, fermented birch sap and its mixtures contain a significant amount of biologically active oxy and phenolic acids, and blending fermented birch sap with fruit is the only way to create a natural drink enriched with lactic, succinic, malic, chlorogenic and caffeic acids.

Therefore, on the basis of fermented birch sap, rich in minerals that are easily digestible, it is advisable to produce different birch-fruit mixes, balanced in biologically active compounds and mineral composition, and using raw materials with different chemical composition for blending juices, you can adjust their mineral composition in the desired ratio.

Based on the analysis of carboxylic acids, phenolic acids and mineral composition of fermented birch sap and some blends based on it, we have developed eighteen names of blends as domestic raw materials (apple, cherry, cranberry, grape, strawberry, black currant, cranberry, chokeberry) and from the "exotic" (lemon, orange, passion fruit, mango).

It was also advisable to use non-traditional raw materials (elderberry, lemon balm, nepeta or lemongrass and lophanthus, infusions of dried pears, rose hips and linden flowers). This is due to the fact that these raw materials contain a significant amount of biologically active substances, so they are classified as medicinal plants. Plant treatment is quite relevant today due to the complex action on the body of biologically active substances (vitamins, essential oils, tannins, alkaloids, glycosides, saponins, macro- and microelements, etc.). Significant role of medicinal plants in the prevention of various diseases, including respiratory, nervous, cardiovascular, gastrointestinal and others.

The range of new blended juices based on fermented birch is 14 items: birch-apple juice with sugar; birch-orange juice with sugar; birch-cherry juice with sugar; birch and cranberry juice with sugar; birch-lemon-chokeberry juice with sugar; birch-elder juice with sugar; birch-lemon juice with sugar; birch-passion fruit juice with sugar; birch-mango juice with sugar; birch-chokeberry juice with sugar; birch-grape juice with sugar; birch-strawberry juice with sugar; birch-currant juice with sugar; Home birch juice with infusion of dried pears and sugar.

In the manufacture of blends with infusions of herbs, rose hips, dried fruits pre-prepared infusions of the above components. To do this, rose hips and dried fruits were sorted, where burnt fruits were selected, affected by agricultural pests, molds and removed impurities. Then the raw material was washed, rinsed and crushed into pieces (diameter of the lattice holes 5 mm). Herbs were ground on shredders of any design or by hand.

The crushed raw material in the calculated amount was loaded into a double-walled boiler with a stirrer and filled with fermented birch sap, mixed thoroughly. The boiler was sealed with a lid. The mass was brought to a boil, linden flowers, rose hips and dried fruits were kept at low boil for 3… 5 minutes. Then the heating was stopped and infused for 10 … 12 hours. (rose hips, dried fruits) or 20 minutes (linden flowers).

After extraction, the infusion was drained from the precipitate, filtered and sent to vacuum devices. Sugar was passed through a sieve with a hole size in sieves not exceeding 3 mm with a magnetic trap and before mixing was dissolved in a small amount of juice heated to a temperature of 30…40 °C.

Concentrated juices were added according to the consumption rates of raw materials.

Concentrates of aromatic substances, as if they had not been added to concentrated juice before, were added to the finished blend before bottling in an amount of 2% (by volume) to the concentrated juice [31].

It is allowed to replace concentrated juices with natural ones of the same name.

The fermented birch sap was fed to vacuum apparatus, where it was mixed with pre-prepared components according to the recipe and mixed thoroughly.

When making birch-mango, birch-passion fruit, birch-orange juice, the blend after mixing can be homogenized or finished through sieves with a diameter of 0.4…0.8 mm. After mixing, the blended juice was sent for heating and bottling. Lamellar, tubular, vacuum apparatus, and cooking boilers were used for heating. The juice intended for bottling, followed by pasteurization, was heated to a temperature of 85…86 °C.

Heated juice was packaged in pre-prepared glass jars and bottles. Automatic fillers are used to pack the juice into jars. The juice was bottled in bottles EK-17 or other types.

Filled jars and bottles are immediately sealed. Bottles on sealing machines, cans – on automatic vacuum-sealing machines at a residual pressure of 53… 47 kPa. Banks were closed with lacquered pre-prepared lids. The sealed container with sap was immediately sent for pasteurization according to the technological instructions for the production of fermented and blended birch sap [117].

According to organoleptic parameters, the juices met the requirements specified in table 6.

According to physical and chemical indicators, the juices met the requirements specified in Table 7.

It should be noted a much lower cost of the proposed juices based on fermented birch sap compared to known blended juices due to the continuation of the birch sap processing season and a smaller share of blending and sugar in new formulations.

In addition, the high acidity of fermented birch sap, due to lactic acid (pH about 3.8) makes it possible not to add citric acid to the blend, which also affects the cost of production.

Conclusions. So, on the basis of fermented birch sap, rich in mineral elements that are in an easily digestible form, it is advisable to produce various birch and fruit mixes balanced in biologically active compounds and mineral composition, and using raw materials with different chemical composition for the manufacture of blended juices, it is possible to adjust their mineral composition in the desired ratio.

It also turned out to be expedient to use unconventional raw materials (elderberry, lemon balm, nepets or coils of lemon and lofant, infusions of dried pears, rose hips and linden flowers). This is due to the fact that this raw material contains a significant amount of biologically active substances, due to which they are classified as medicinal plants. Treatment with plants is quite relevant in our time due to the complex effect on the body of biologically active substances (vitamins, essential oils, tannins, alkaloids, glycosides, saponins, macro- and microelements, etc.).

Significant role of medicinal plants in the prevention of various diseases, in particular, respiratory, nervous, cardiovascular, gastrointestinal and others.

Table 6

Organoleptic characteristics of blended juices

Indicator	Characteristic
Appearance and consistency	Transparent or opaque homogeneous, homogeneous liquid or liquid mass. The presence of sediment, particles and hangs, which are due to the peculiarity of raw materials, without foreign inclusions is allowed.
Taste and smell	The taste and smell are well expressed, inherent in the used types of raw materials after heat treatment. Extraneous taste and smell are not allowed
Color	Homogeneous in full mass, inherent in the color of the juice, which is added as a blend

Table 7

Physicochemical indicators of blended juices

Name of juice	Mass fraction of soluble solids, %	Mass fraction of titrated acids (based on lactic acid), %	Mass fraction sediment, %
Birch sap with sugar	5,0	0,4…0,6	2,0
Birch-apple juice with sugar	7,0	0,3…0,6	3,0
Birch-orange juice with sugar	9,0	0,4	3,5
Birch-cherry juice with sugar	6,0	0,4	2,5
Birch-cranberry juice with sugar	9,0	0,9	2,0
Birch-lemon-aronium juice with sugar	11,0	0,5	2,5
Birch-elder juice with sugar	9,0	0,5	1,5
Birch-lemon juice with sugar	9,0	0,5	2,5
Birch sap – passion fruit with sugar	9,0	0,4	1,0
Birch-mango juice with sugar	9,0	0,25	2,5
Birch-aronium juice with sugar	8,0	0,5	3,5
Birch-grape juice with sugar	7,0	0,5	3,5
Birch-strawberry juice with sugar	6,0	0,5	3,5
Birch-currant juice with sugar	9,0	0,6	3,5

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Розробка технології купажованих соків на основі збродженого березового соку.

Анотація. ***Мета статті*** *полягає у розробці технології купажованих соків на основі забродженого березового соку.*

Цілі статті. *Метою роботи було розроблення біотехнології виробництва збродженого березового соку на основі попереднього відбору найбільш ефективних штамів мікроорганізмів для ферментування, дослідження лікувально-профілактичних властивостей розробленого збродженого березового соку шляхом встановлення впливу нового виду продукту на метаболічні процеси організму та його дію при захворюваннях на метаболічний синдром, а також визначення біологічної активності розробленого продукту відносно умовно- патогенних мікроорганізмів.*

Методика дослідження. *Розробляли різні варіанти співвідношень інгредієнтів купажування та проводили їх дослідження за комплексом органолептичних та фізико-хімічних показників.*

Ступень збереження L–аскорбінової кислоти після термічної обробки визначали на модельних розчинах. Для цього на дистильованій воді готували розчини молочної кислоти в концентраціях 0,05%, 0,1%, 0,3%, 0,5% і вносили в них аскорбінову кислоту в концентрації 0,005% та 0,010%. Органічні кислоти визначали методом високоефективної рідинної хроматографії в обернено–фазовому варіанті при фотометричному детектуванні на приладі фірми Waters (USA). Кількісне визначення органічних кислот проводили згідно стандартним розчинам.

Результати. *Щойно зібраний березовий сік є біологічно нестабільним. В процесі збирання він контамінується спонтанною мікробіотою і терміни його зберігання до переробки хоча і залежать від температури зберігання, але обмежуються, як правило, 2 добами. Тому актуальним є пролонгування термінів його зберігання за рахунок розробки біотехнологічних способів збереження лікувально- профілактичних властивостей вихідного соку.*

Висновки. *Таким чином, моделювання втрат L–аскорбінової кислоти при термічній обробці дає змогу зробити важливий для технології висновок, а саме синтетичну аскорбінову кислоту слід вносити у купажовані соки на основі збродженого березового, тобто після закінчення процесу бродіння, щоб в них вже встановилось кисле середовище.*

З точки зору біохімічного і мікробіологічного складу найбільш повноцінними можна вважати ферментовані напої – продукти культивування моно або асоційованих культур мікроорганізмів. Це зумовлено здатністю мікроорганізмів продукувати необхідні для нормального функціонування організму людини біологічно активні речовини. Основна відмінність і перевага таких напоїв над звичайними продуктами купажування полягає в тому, що біоактивні речовини не вносяться штучно, а утворюються природним шляхом у процесі бродіння. Якщо вихідний продукт лімітований відносно ряду БАР або має необхідність у поліпшенні органолептичних показників доцільно проводити його купажування з носіями бажаних властивостей.

Ключові слова: *біотехнологія, зброджений березовий сік, лікувально- профілактичні властивості, антимікробна активність.*