Improvement technologies of aqueous-alcoholic infusions for the production of syrups

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Abstract

Introduction. The aim is scientific justification and innovative technologies of aqueous-alcoholic infusions (AAI) for producing syrups in confectionery products, for giving them functional and health qualities.

Materials and methods. Methods of investigation: redoxometry – determination of antioxidant capacity of AAI from plant raw materials; pH-metry; methods of determining of the organoleptic indicators.

Results and discussion. The minimal theoretically expected meaning of Eh_{min} for plant water-alcohol extracts was got, which has meanings from 203,0 mV (ginger root) to 480,9 mV (Sudan rose), and actually measured Eh_{act} – 82,0 mV (strawberry leaves) to 246,0 mV (ginger root). Thus, the minimum quantity of redox reaction (RR) is – 42,3 mV and typical for ginger root, and the highest meaning 266,0 mV has the AAI from guilder rose fruits. The pH level for AAI has meaning from 2,985 (Sudanese rose) to 7,605 (ginger root) that infusios have reactions from acidic to slightly alkaline.

The groups of infusions for antioxidant ability were defined: infusions with low activity – 3 samples (25%), among them are ginger roots, apple fruits, elderberry fruits; infusions with middle activity – 4 samples (33%), among them the lowest meaning 133,4 mV has cinnamon, and the most – 171,8 mV has cherry leaves; infusions with the high activity – 5 samples (42%), among them are rowan – 234,3 mV, cherry – 247,5 mV, Sudanese rose – 260,4 mV, guelder rose – 266 mV and buckthorn – 282,4 mV.

Conclusion. The most promising sources of natural antioxidants for usage in syrups technology for impregnation of confectionery product were defined.

Introduction

Today the market of confectionery products is expanding day by day in number and variety. There is a large number of new varieties of confectionery products with health and functional purpose, too.

Modern consumer imparts particular importance to the consequences, connected with consumption of confectionery. It is known, that this group of products consisting of large amounts of fats and carbohydrates, is very caloric, but in a few number it satisfies organism with necessary substances in the daily ration. Therefore, the creation of confectionery products, in less measures has a harmful impact on the organism, constantly are maintained for satisfaction of buyer's desires.

A wide range of confectionery products are based on the using of different raw materials which are substitutes for existing, but with more useful properties. On the one hand, it provides the product with the functional properties, on the other – in different ways the taste indicators of the usual, for consumer recipe selection change. Consequently, the question of searching of key moments of influence on the body and their solutions with minimal impact on its organoleptic become relevant.

The main tool that provides the vital functions of any organism and regulates the ratio of energy for maintaining of homeostasis (relative dynamic constancy of composition and properties of the internal environment and sustainability of basic physiological functions of organism) and is spent on the regeneration of cells, is a change of the speed of redox reactions (RR). This speed depends on the concentration and the ratio of oxidized and reduced forms of substances in the body, including substances from food and drinks. Therefore, one of the most important factors of the indicator regulations of RR is redox potential (RP).

In the confectionery industry, one of the ways to influence on the antioxidant properties of the product – is the infusion of plant components into the alcohol – raw materials, namely syrups for impregnation of products.

So, syrups for impregnation should not only perform its basic technological function – to moisturize and to improve the organoleptic indicators of confectionery, and should enrich the finished product with useful for the human body substances and provide desired properties.

It is possible, due to the leading to the recipe of herbal extracts, which are prepared by infusion of plant raw materials (both aromatic and non-aromatic), based on aqueous-alcoholic and wine-cognac raw materials.

In consequence of extracting of plant raw material into the raw alcohol material, an enrichment of the last by nutrients (vitamins, minerals, organic acids, polyphenolic compounds) is held, which increases the antioxidant properties of the solution.

Therefore, the purpose of our work is to study the antioxidant activity of infusions from raw plant materials on aqueous-alcoholic and wine-cognac raw materials, identification of the most promising sources of natural antioxidants for use in syrup technology for impregnation in the confectionery industry and determine the best composition of syrup for impregnation of confectionery products of these infusions.

The object of study is the characteristics and indicators of quality of AAI, brandy infusions from plant raw materials, syrups for impregnation, organoleptic properties (color, smell, taste); physicochemical indicators (pH, RP).

The subject of study is aqueous-alcohol solution (control); AAI from plant raw materials: ginger root, apple fruits, cherry fruits, strawberry fruits, elderberry fruits,

buckthorn fruits, rowan fruits, guilder fruits, leaves of cherry, strawberry leaves, cinnamon, hibiscus flowers; brandy 3*, syrups for impregnation.

For the preparation of infusion of aqueous-alcoholic solution with a volume fraction of ethanol – 40% (vodka «Khortytsya»); ordinary brandy (brandy «Shabo» 3*); plant raw materials – according to the current regulatory documents, permitted for using in the confectionery industry by central executive body in the department healthcare were used. The using of other raw materials and auxiliary materials can be, in accordance to the current regulatory documents, permitted for the use of the central executive body in the department of healthcare.

Vodka – alcohol drink with strength of 37,5 % to 56,0 %, received by special adsorbent processing of aqueous-alcoholic solution with added ingredients or without them, followed by filtering.

By organoleptic indicators vodka must meet the requirements, fixed in the table 1.

Table 1

Organoleptic indicators of vodkas

The name of indicator	Characteristics
Appearance	Transparent liquid without impurities and sediment
Color	Colorless liquid
Taste and flavor	Typical for vodka, without foreign taste and aroma, in particular vodkas a slightly perceptible characteristic flavor

By physicochemical indicators vodka must meet the requirements, fixed in the table 2.

Table 2

Physicochemical indicators of vodkas

The name of indicator	Meaning
Strength, %	37,5 – 56,0
Alkalinity	1,0-3,5
Mass concentration (MC) of aldehyde, in terms of acetaldehyde in anhydrous alcohol (AA), mg/dm^3, no more	8,0
MC of fusel oil in terms of the mixture of isoamyl and isobutyl alcohols (1:1) in AA, mg/dm^3, no more	2,0
MC of fusel oil in terms of the mixture of propyl, isobutyl and isoamyl alcohols (3:1:1) in AA, mg/dm^3, no more	3,0
MC of esters in terms of acetic-ethyl in AA, mg/dm^3, no more	3,5
Volume fraction of methanol in terms of AA, %, no more	0,005

Brandy – spirits with a distinctive bouquet and flavor, are made by blending of brandy alcohols, obtained by method of distilling of brandy wine materials on special copper apparatus with fractionation, aged at least for 3 years in the oak barrels, stainless or enameled places with oak stave.

By organoleptic indicators brandy 3* must meet the requirements, fixed in the table 3.

Table 3

Organoleptic indicators of brandy 3*

The name of indicator	Characteristics
Transparency	Transparent, with glitter, no foreign inclusions
Color	From light golden to light brown with a golden hue
Taste and flavor	Typical for brandy of particular name, without other tones

By physicochemical indicators brandy 3*, fixed in the table 4.

Table 4

Physicochemical indicators of brandy 3*

The name of indicator	Meaning
Strength, %	40
MC of sugars, in terms of inverted, g/dm^3	10-15
MC of methanol in terms of AA,%, no more	1,0

Alcohol infusion – semi-finished product, which is prepared by infusion of plant raw materials (both aromatic and non-aromatic) in aqueous-alcoholic and wine-cognac solutions with strength from 40% to 90%.

Infusions need to produce in accordance to the technological instructions and regulations with keeping of public healthcare standards and rules, adopted, according to the established order of the central executive body in the department of healthcare.

By organoleptic indicators alcohol infusions must meet the requirements, fixed in the table 5. By physicochemical indicators extracts must meet the requirements, fixed in the table 6.

Table 5

Organoleptic indicators of extracts

The name of indicator	Characteristics
Appearance	Transparent, liquid is without sediment and impurities, opalescence is permissible, which disappears after filtering
Color, taste and flavor	Inherent for plant raw material from which they are made, without foreign taste and smell

Table 6

Physicochemical indicators of extracts

The name of indicator	Meaning
Volume fraction of ethyl alcohol, %	20,0 – 90,0
Mass fraction of essential oil, %	0,0 – 15,0
MC of total extract, g/100 cm^3	0,1 – 20,0

Syrups for impregnation – it is semi-finished products of confectionery manufacture,

appointed to hydrate and improve the flavor properties of confectionery.

In the confectionery industry syrups for impregnation four types are made:

– syrup for impregnation (formulation № 95), with moisture 46-54%, which consists of sugar, water, rum essences, brandy or dessert wine;

– syrup for impregnation (fortified) (formulation № 96), with moisture 46-54%, which consists of sugar, water, rum essences, brandy or dessert wine, and brandy for fortifying;

– coffee syrup for impregnation (formulation № 97), with moisture 46-54%, which consists of sugar, water, rum essences, brandy or dessert wine, and natural fried ground coffee;

– agar-sugar syrup (formulation № 98), with moisture 17-23%, which consists of sugar, water, starch syrup, agar.

Coffee syrup № 97 has strongly pronounced coffee taste and aroma, and it is used only in one formulation of the cake «Kavovyj». Because of small volume of its production, it is impractical to improve its formulation. The formulation of the sugar-agar syrup № 98 does not include alcohol raws. Thus, the improvment of syrup formulations for impregnation № 95 and № 96 were conducted. They are alcohol and most common in confectionery industry. Hierarchical structures of using syrups for impregnation, shown in № 95 and 96 in Figure 1-3.

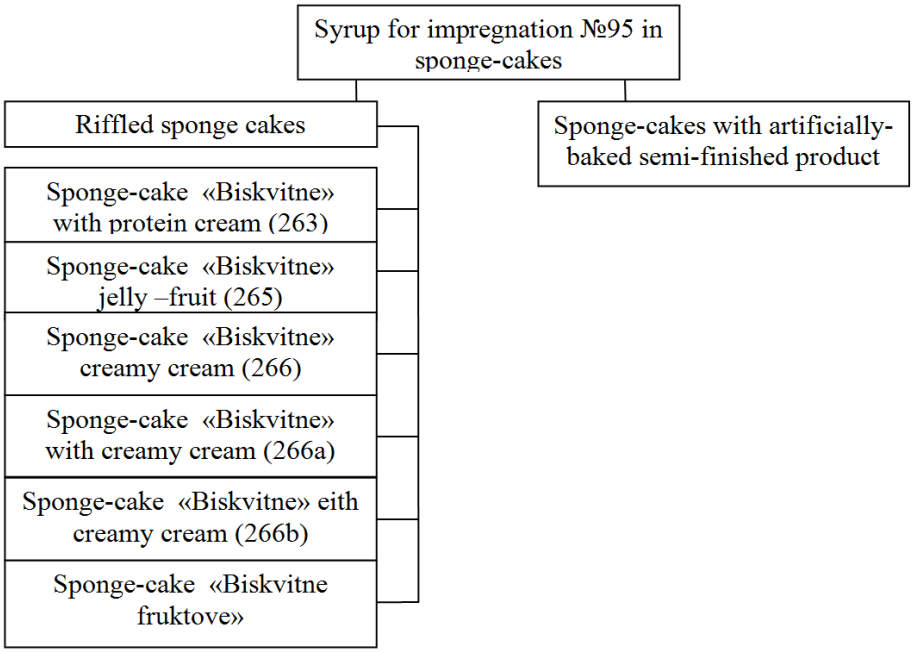

Figure 1. Hierarchical structure of sponge-cakes with using of syrup №95

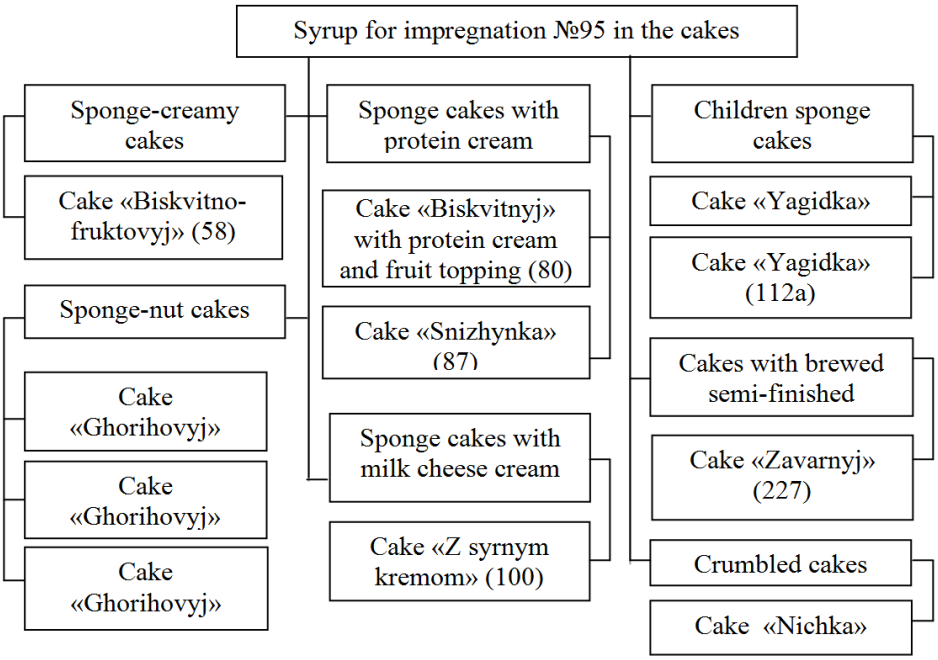

Figure 2. Hierarchical structure of cakes with using of syrup №95

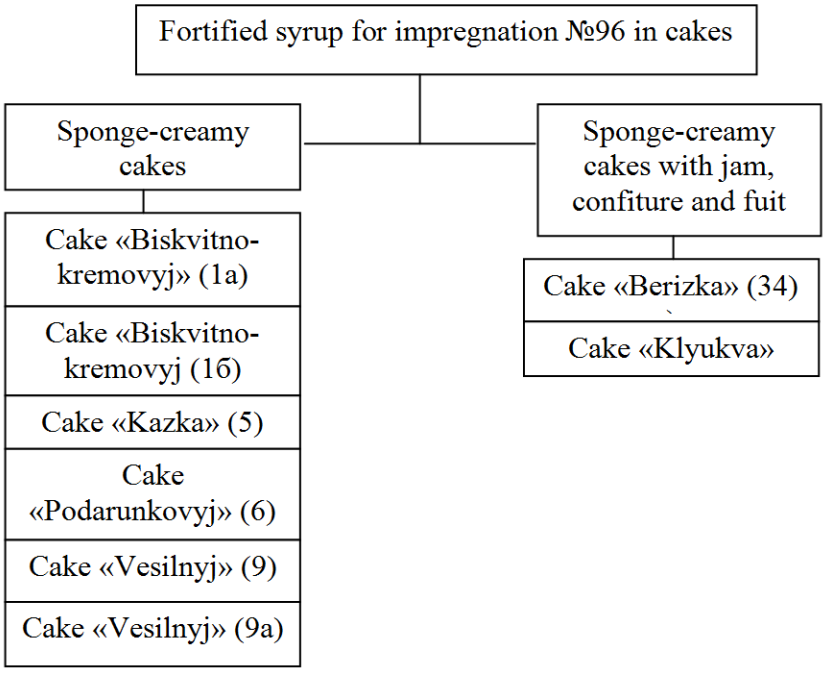

Figure 3. Hierarchical structure of cakes with using of syrup №96

The main raw material of syrups for impregnation is sugar; water prepared. Raw materials, which are used in syrups technology must meet the requirements of regulatory documents.

Sugar – a food which is purified and crystallized sucrose in a view of individual crystals (crystal sugar) or separate pieces (pressed sugar). By organoleptic, physicochemical, microbiological indicators and toxic elements, sugar must comply.

Materials and methods

The first stage – the preparation of infusions. Plant raw materials were minced into a size of 3x3 mm, suspensions of 4 g were placed into the glass bottles, were filled by 100 ml of alcohol solvent with volume fraction of rectified ethyl alcohol 40 %. Bottles were closed by lids, were placed in a thermostat for 48 hours at 40 °C. The resulting infusions were cooled to 20 °C. Then infusions were filtered.

The indicator of active acidity pH was measured on the pH-meter pH 150MI with a combined glass electrode ESK-10603. ORP was measured on the pH- meter pH 150M with a combined glass electrode ESK-10603.

Potential of hydrogen (pH) is a quantitative characteristic of acidity or alkalinity of the water environment, which is determined by the activity of hydrogen ions (a_{H^+}) or otherwise, the ratio of the ions concentration of hydronium H_3O^+ and hydroxyl OH^-, while the acidity and alkalinity characterize the quantitative content in the aquatic environment of substances, which can neutralize in accordance to alkali and acid [9-12].

For not activated inorganic solutions in steady state, there is a right formula that relates the rate of active acidity of pH and RP [1]:

$$Eh_{min} = 660–60 \cdot pH, \text{ mV} \quad (1)$$

where Eh_{min} – minimal theoretically expected meaning of the RP;
pH – active acidity of tested solution.

Acquired meanings of Eh_{min} were compared with the actual measurements of Eh_{act} of solution. The shift of RP to the side of the recovered meanings – recovery energy (RE) was determined by the formula:

$$RE = Eh_{min}–Eh_{act}, \text{ mV} \quad (2)$$

where RE – the shift of RP to the side of recovered meanings (resilence);
Eh_{min} – minimal theoretically expected meaning of RP;
Eh_{act} – actual measured RP.

The size of pH is in the range from 1 to 14, if in the water there is a reduced content of free hydrogen ions (pH> 7) compared with ions OH^-, the water will be alkaline, and with a high content of H^+ ions (pH <7) – acid. In cases, when the water – neutral, on this pH=7.

RP – an indicator of biological activity of solutions [2], which describes a deviation in the liquid environment from ion balance of free electrons [3].

Changing of the concentration of free electrons leads to a change of its electron charge and into accordance to RP [3]. If the RP is positive, it indicates the oxidative abiliity of the solution, and the negative – the recovery. Thus, the size of RP allow to evaluate the energy of processes, namely the activity of ions in the RR [2].

During redoxometry (metering by the platinum electrode into camparison with silver chloride electrode) RP of internal environment of organism of healthy person has meaning less than zero (-100...-200 mV). By this RP of drinking water from the city water network, depending on the place of watershed, season, water system (except electrochemical activation) is always above zero (+100...+ 400 mV).

These differences of RP of internal environment of the human body and drinking water means that the activity of electrons in the internal environment is much higher than the activity of electrons in water. Herewith, in the body the necessary change of RP of drinking water is held, due to electric power consumption of cell membranes, namely the highest level of energy, energy, which actually is the end product of the biochemical chain of transformation of nutrients. The amount of energy, expended by the body to achieve biological compatibility of water, is proportional to its amount and the difference of RP of water and internal environment [4].

Except of drinking water, person consumes aquaeous and aqueous-alcoholic solutions, food, RP which is positive. When such products reach into the tissues, the subtracting of electrons from cells and tissues that consist of 80-90% of water occurs. As a result, the biological structure of the organism (cell membranes, organelles of cells, nucleic acids, etc.) subjects to oxidative destruction, body wears down, ages, vital organs lose their function.

When aqueous solutions or foods with negative RP, similar to the meaning of RP of internal environment of the human body, enter into the body, the electrical energy of cell membranes are not spent on correcting the activity of electrons of these aqueous solutions or foods, therefore, the products are immediately assimilated, because they have biological compatibility on this parameter.

If aqueous solutions or foods have more negative RP than RP of internal environment, they fed it by this energy, which is used by cells as an energy reserve of antioxidant protection of the body from the adverse effect of the environment [7].

So, if the human body optimally uses aqueous-alcohol solutions and foods in metabolic processes, the meaning of RP must conform the meaning of RP of internal environment of organism or has more negative meanings.

The second stage – cooking of syrup. Sugar was leaded into the boiling water at a ratio weight of 1:1,1 and boiled it to the density of 1,22-1,25 kg/dm^3 at constant stirring with removing foam, received syrup was cooled to the temperature of 20 °C and was filtered. Blending of sugar syrup was carried out with the addition of rum essence, brandy 3* and (or) plant AAI. In the result, the transparent viscous syrup with humidity of 46-54% with rum, cognac flavor, with notes of plant raw material was got, which was extracted into the added extracts [5].

According to the research the tasting evaluation was conducted and the most optimal composition of syrup formulation for impregnation was determined.

Results and discussions

As a control, vodka «Khortytsya» and brandy «Shabo» 3* were used.

During the study all plant AAI are grouped by antioxidant activity, infusions of low activity (from 0 to 100 mV); infusions with middle activity (from 100 to 200 mV); infusions with high activity (from 200 mV and higher).

Improvement of syrups for impregnation of confectionery products by AAI from plant raw materials.

For the study, 12 samples were selected from plant raw materials – fruits, roots, leaves, flowers (Figure 4).

After all stages of infusion preparations, which are shown in Figure 5, the researches of

them were carried out by organoleptic and physicochemical indicators [6].

The samples were evaluated by organoleptic characteristics. The results of organoleptic evaluation of infusions are presented in the table 7.

Table 7

Organoleptic characteristics of vodka extracts from plant raw materials

№	Name	Color	Smell	Taste	Overall, point
0	Vodka (control)	transparent	alcohol	burning, synthetic aftertaste	9,610
1	Ginger infusion	feculent, light-yellow	alcohol, brightly expressed, gingery	bitter, burning, intense	9,630
2	Apple infusion	transparent, light-strawed	a faint smell of alcohol, fresh	savorless, sour	9,650
3	Strawberry fruits infusion	transparent, saturated yellow	berry-alcohol, yeast	Sour-bittered, astringent aftertaste	9,640
4	Infusion of cherry leaves	transparent, yellow-green	tart, wood	bitter, tart, saturated	9,510
5	Infusion of srawberry leaves	transparent, brown	rubber	spicy	9,620
6	Herry fruits infusion	transparent, light-pink	light cherry	of fresh fruits	9,650
7	Cinamon infusion	ruby-brown	cinamon	tart, oak	9,625
8	Hibiscus infusion	ruby-saturated	brightly fruit	sweet and sour, tart,	9,670
9	Elder infusion	feculent, gray-purple	earthy	of mushrooms, sweet	9,645
10	Buckthorn infusion	transparent, light-strawed	bright, fruit, oily	Easy bitter taste, acerbity	9,635
11	Rowan infusion	transparent, light-pink	alcohol, plant	light bitter, tart	9,655
12	Guelder rose infusion	Transparent, slightly orange	light medical	soft, tart, bitter aftertaste	9,600

Figure 4. Samples of plant raw materials:
a –ginger root; b –apple fruits; c – strawberry fruits; d –cherry leaves; e – strawberry leaves, f – cherry fruits; g – cinamon; h – Hibiscus flowers; i – elder fruits; j – buckthorn fruits; k – guelder rose fruits; l – rowan fruits

Figure 5. The AAI from plant raw materials and control

The results of measurements and calculations of indicators of antioxidant capacity of samples are given in table 8. Samples are presented in order of increasing of its energy recovery.

The control sample at t=20 °C has meaning pH – 7,65, Eh_{min}=201,0 mV, Eh_{act}=274,0 mV, RR=-73 mV. Control organoleptic properties: color – colorless; flavor – alcohol; taste – moderately hot, empty.

The level of pH for AAI have meaning from 2,985 (Sudan rose) to 7,605 (ginger root), that infusions have reactions from acidic to slightly alkaline.

The minimal theoretically expected meaning of RP Eh_{min} for plant infusions have meaning of 203,0 mV (ginger root), to 480,9 mV (Sudan rose), and the actual measured RP solution Eh_{act} from 82,0 mV (strawberry leaves) to 246,0 mV (ginger root). Thus, the minimal meaning of the recovery ability (RE) is -42,3 mV and typical for ginger root, and the highest meaning is 266,0 mV AAI from the guelder rose fruits.

Table 8

Indicators of redox capacity of AAI plant at t=20 °C

Raw	Org	pH	Eh_{min}	Eh_{act}	RE
Vodka (control standard)	9,610	7,650	201,0	274	-73,0
Ginger infusion (root)	9,630	7,605	203,7	246	-42,3
Elder infusion (fruits)	9,645	7,505	209,7	122	87,7
Apple infusion (fruits)	9,650	5,640	321,6	233,5	88,1
Cinnamon infusion (bark)	9,625	5,960	302,4	169	133,4
Strawberry infusion (fruits)	9,640	4,770	373,8	228,5	145,3
Strawberry infusion (leaves)	9,620	6,945	243,3	82	161,3
Cherry infusion (leaves)	9,510	6,470	271,8	100	171,8
Rowan infusion (fruits)	9,655	4,995	360,3	126	234,3
Cherry infusion (fruits)	9,650	4,400	396	148,5	247,5
Hibiscus infusion (flowers of Sudanese rose)	9,670	2,985	480,9	220,5	260,4
Guelder rose infusion (fruits)	9,600	4,325	400,5	134,5	266,0
Buckthorn infusion (fruits)	9,635	3,760	434,4	152	282,4

Hence, investigated plant material, depending on the antioxidant activity can be divided into the following groups:

– infusions of low activity – 3 samples (25%), including ginger root, apple fruits, elderberry fruits;

– infusions of middle activity – 4 samples (33%), of which the lowest meaning is 133,4 mV of cinnamon, and most – 171,8 mV has cherry leaves;

– infusions with high activity – 5 samples (42%), of which rowan – 234,3 mV, cherry – 247,5 mV, Sudanese rose – 260,4 mV, guelder rose – 266,0 mV and buckthorn – 282,4 mV.

The tracker of physicochemical characteristics of plant extracts is shown in Figure 6 – in ascending order of recovery energy.

Graphical dependence of organoleptic indicators of plant infusions and their recovery energy (antioxidant capacity) is shown in Figure 7 – in order of increasing of recovery energy.

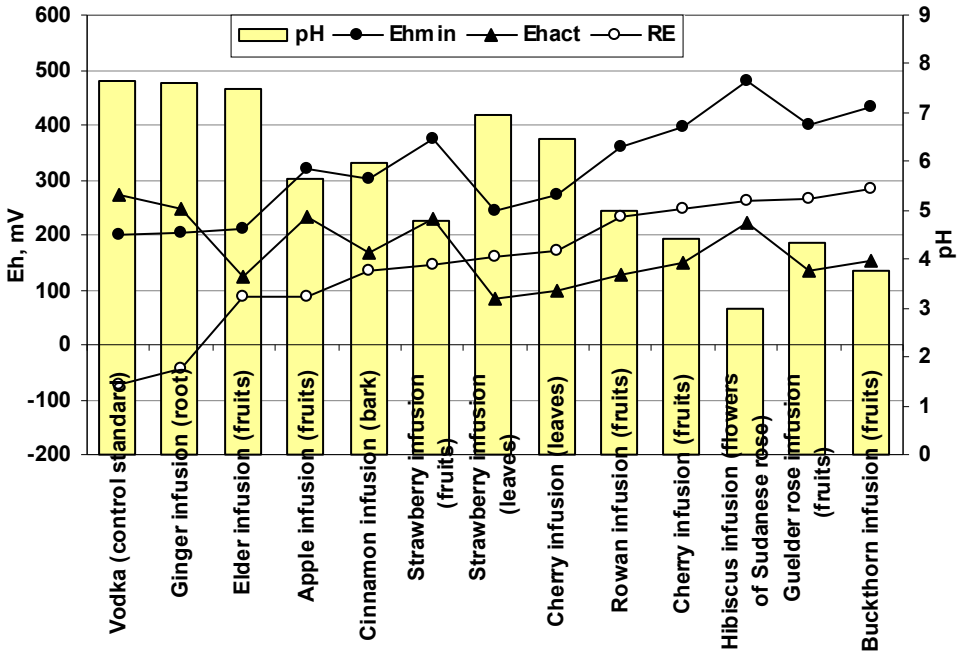

Figure 6. Graphical dependence of physicalochemical indicators of AAI of raw plant materials

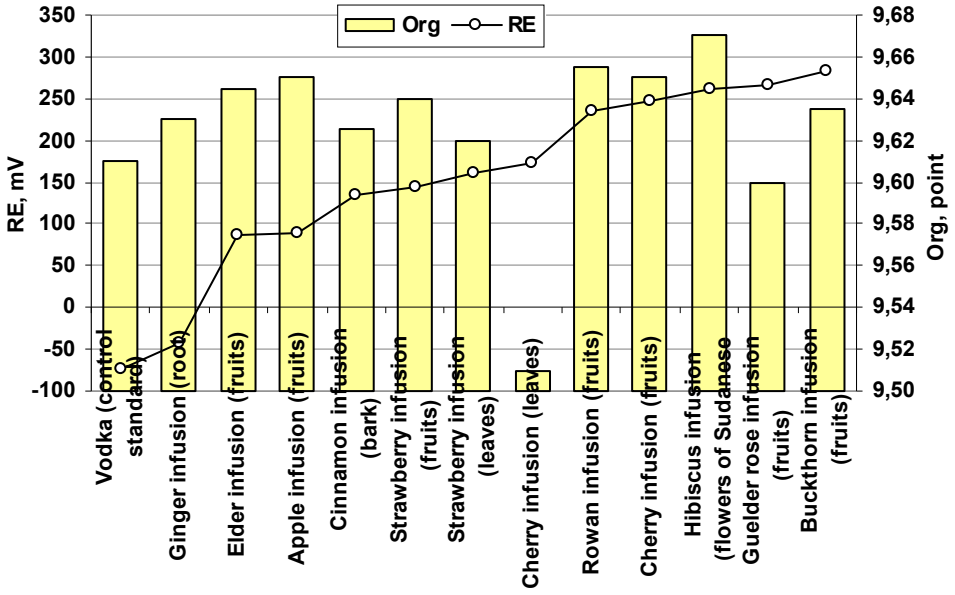

Figure 7. Graphical dependence of organoleptic indicators and recovery energy of plant AAI

Thus, extracts of elder, cherry, Sudanese rose, guilder rose and buckthorn showed the most important antioxidant capacity. Herewith, they received a relatively high points by its organoleptic characteristics.

Infusions of plant raw materials include the most important micronutrients, providing strong antioxidant properties.

Polyphenolic substances strengthen blood vessels, so products with syrup can be recommended for the diets of people with heart failures. Antioxidant properties of the product are also increased due to the polyphenolic compounds. So, the product has radioprotective effect. Minerals improve the blood, maintain acid-alkaline balance, strengthen the cardiovascular system and help to resist infectious diseases. Vitamin A neutralizes viruses, and also has anticarcinogenic effect.

Thus, infusions from raw plant materials are recommended in technology of decorated semi-finished products in the confectionery industry to provide them with functional and health properties [8].

Improving of syrup for impregnation №95.

Three samples of plant material infusions with the highest antioxidant properties (Hibiscus, guelder rose, buckthorn) were used to improve syrup for impregnation of confectionary by the compostion №95, which has a ratio of components – table 9.

The disadvantages of this composition of ingredients are: set meaning of RP of the syrup, which must change the speed and the direction of RP in the body; predictable (standard) organoleptic properties; increased cost.

Table 9

The composition of syrup for impregnations № 95

Raw	Content, wt. %
Sugar	45,51
Water	50,07
Rum essence	0,17
Brandy or dessert wine	4,25

The main task was to create a syrup for impregnation of confectionary products with addition of plant AAI, which allow to increase the redox properties of the product, that will increase the immunity of the human body, will improve the metabolism, will affect positively on the cardiovascular system, except these, will provide finished products with improved consumer properties and will reduce the cost of the finished product by replacing of the part of brandy into the plant AAI.

Syrups were prepared on the base of composition № 95 with different ratios of components, which differs from classic composition by using of brandy and additionally – AAI of buckthorn or Sudanese rose, or guilder rose for blending of syrup, the results of which are presented in table 10.

Table 10

The ratio of syrup components

№	Recipe components, wt. %					Conlusions
	Sugar	Water	Rum essence	Brandy	Aqueous-alcoholic extracts of Sudanese rose, or guilder rose, or buckthorn	
1	45,46	50,01	0,15	4,00	0,38	The composition of the recipe provides the receiving of syrups with satisfactory physicochemical and organoleptic indicators, but it is not enough tenriched with biologically active substances
2	45,48	50,03	0,16	3,00	1,33	The composition of the recipe provides the recievingof syrups with good physicochemical and organoleptic indicators, but it is enough enriched with biologically active substances
3	45,50	50,05	0,17	2,00	2,28	
4	45,52	50,07	0,18	1,00	3,23	
5	45,54	50,09	0,19	0,00	4,18	The composition of the recipe provides the receiving of syrups with satisfactory physicochemical and organoleptic indicators, but it is enough enriched with biologically active substances, but with degraded organolaptic indicators

The problem is solved by the way, that the composition of the syrup consists of sugar, water, essence of rum, brandy and plant AAI, into the ratio of components, the results of which are presented in the table 11.

Table 11

The composition of improved syrup formulations for impregnation of confectionery products (Pat. 110712 Ukraine)

Raw	Content, wt. %
Sugar	45,48-45,52
Water	50,03-50,07
Rum essence	0,16-0,18
Brandy	1,00-3,00
AAI of Sudanese rose, guilder rose or buckthorn	1,33-3,23

Consequently, the proposed composition of the syrup for impregnation of confectionery products, with the addition to the formulation of plant AAI can increase the redox properties of the finished product, it will provide it with improved consumer properties and will reduce the cost of the finished product.

The improving technology of fortified syrup № 96.

The famous fortified syrup composition for impregnation of confectionary products by the composition № 96 with the ratio of the components is presented in Table 12.

Table 12

The recipe composition of syrup for impregnation of confectionary products № 96

Raw	Content, wt.%
Sugar	43,35
Water	47,68
Rum essence	0,16
Brandy or dessert wine	4,05
Brandy	4,76

The disadvantages of this composition of ingredients are:

– set meaning of the RP of syrup, which must change the speed and the direction of redox processes in the body, regulate the biological activity and slow down the negative processes in the human body;

– predictable (standard) organoleptic properties;

– increased costs.

The main goal is to create fortified syrup for impregnation of confectionary products with addition of plant AAI, which will increase the redox properties of the product and will increase the immunity of the human body, will increase its opposition to harmful environmental factors, will improve metabolism, will improve the cardiovascular system, besides these, will provide the finished with improved consumer properties and will reduce the cost of the finished product, due to the replacement of brandy for fortifying for plant aqueous-alcoholic extracts .

Syrups were prepared on the base of formulation № 96 with different ratios of components that differ from classic formulation, so that for fortifying of syrup, AAI of buckthorn, Sudanese rose or guelder rose were used.

Making of syrup was begun with the fact, that sugar was leaded into the boiling water at a weight ratio of 1:1,1 and was boiled down to the density of 1,22-1,25 kg/dm^3 with constant stirring, removing the foam, the obtained syrup was cooled to 20 ºC and was filtered. Blending of syrup was carried out with the addition of rum essences and brandy 3*. At the end, the fortifying of the received syrup was carried out by plant AAI of buckthorn, Sudanese rose or guelder rose.

Results of the study are presented in table 13.

The goal is solved in, so that to the part of the fortified syrup, sugar, water, rum essence, brandy or dessert wine are included, and for fortifying of syrup, plant AAI by the formulation is used, in the ratio of components, is presented in the table 14.

Consequently, the proposed composition of fortified syrup for impregnation of confectionery products, by the addition to the formulation of plant AAI can increase the redox properties of the finished product, it will provide its with improved consumer properties and will reduce the cost of the finished product.

Table 13

The ratio of the components of fortifying syrup

№	Recipe components, wt. %					Conclusions
	Sugar	Water	Rum essence	Brandy	AAI of Sudanese rose, or guilder rose, or buckthorn	
1	43,32	47,65	0,15	5,88	3,00	The composition of the recipe provides the receiving of syrups with satisfactory physicochemical and organoleptic indicators, but it is not enough enriched with biologically active substances
2	43,34	47,67	0,16	4,83	4,00	The composition of the recipe provides the recievingof syrups with good physicochemical and organoleptic indicators, but it is enough enriched with biologically active substances
3	43,36	47,70	0,17	3,77	5,00	
4	43,38	47,72	0,18	2,72	6,00	
5	43,40	47,74	0,19	1,67	7,00	The composition of the recipe provides the receiving of syrups with satisfactory physicochemical and organoleptic indicators, but it is enough enriched with biologically active substances, but with degraded organolaptic indicators

Table 14

The composition of improved syrup composition for impregnation of confectionary products (Pat. 110713 Ukraine)

Raw	Content, wt. %
Sugar	43,34-43,38
Water	47,67-47,72
Rum essence	0,16-0,18
Brandy or dessert wine	2,72-4,83
AAI of buckthorn, cherry or rowan	4,00-6,00

Conclusions

1. Theoretically reasonable prospect of using plant infusions in the manufacture of syrups for impregnation of sponge semi-finished products.

2. The antioxidant activity of infusions from plant raw materials on aqueous-alcoholic and wine-cognac raw materials was investigated.

3. The most promising sources of natural antioxidants for using of syrups technology for impregnation in the confectionery industry were defined.

4. The rational proportions of plant syrups for impregnation of confectionery products were defined.

5. The syrup formulations for impregnation of sponge semi-finished products were developed and patented.

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