Chapter 6

IMPROVEMENT OF SEMIFINISHED PRODUCTS TECHNOLOGY: ANTIOXIDANT PROPERTIES OF AYURVEDIC SYRUPS

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INTRODUCTION

In the modern world, an increasing number of people are paying attention to a healthy lifestyle[1] and balanced nutrition[2] as crucial aspects. Following these trends, there is a growing trend towards the creation of products, particularly in the restaurant business[3], that not only satisfy consumers' taste preferences but also have a beneficial impact on human health[4]. In this context, Ayurveda, with its millennia-old history and focus on supporting a healthy lifestyle, including through proper nutrition[5], is of particular interest.

Among Ayurvedic food products, syrups stand out as natural sweeteners used in dishes and beverages, imparting them with a unique taste and aroma. However, in addition to their pleasant flavor, they also possess beneficial properties that can positively impact the body[6]. They contain various components and serve different purposes, contributing to both strengthening the body and satisfying culinary needs.

For example, many Ayurvedic syrups contain natural ingredients such as herbs[7], fruits, berries, honey, or maple syrup, making them safe for

[1] Quality rating of desserts based on fruit and berry raw materials / Koretska I. et al. *Ukrainian Journal of Food Science*. 2021. 9(1), pp. 71-87.

[2] Kuzmin O., Levkun K., Riznyk A. Qualimetric assessment of diets. *Ukrainian Food Journal*. 2017. 6(1). pp. 46-60.

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[4] Kuzmin O.V., Rizhenko V.V. Prospects of using alcohol in citrus infusions in the technology of the restaurant. P*rospects and priorities of research in science and technology* : collective monograph. Riga : Izdevnieciba "Baltija Publishing", 2020. Vol. 2. P. 1-19.

[5] Chandra S. Ayurvedic research, wellness and consumer rights. *Journal of Ayurveda and Integrative Medicine*. 2016. 7(1). pp. 6-10.

[6] Effects of Bilwa-Lajadi syrup in emesis gravidarum – an exploratory single arm open labeled trial / Singh D. et al. *Journal of Ayurveda and Integrative Medicine*. 2022. 13(2). 100522.

[7] AYUSH 64, a polyherbal Ayurvedic formulation in Influenza-like illness – Results of a pilot study / Gundeti M.S. et al. *Journal of Ayurveda and Integrative Medicine*. 13(1). 2022.

consumption and adding additional health benefits. Compared to commercial syrups, which often contain added sugars and artificial additives, Ayurvedic syrups can be a healthy alternative for those concerned about their health.

Additionally, Ayurvedic syrups may contain various vitamins and minerals that contribute to overall strengthening of the immune system and health maintenance. Finally, replacing traditional sugar with Ayurvedic syrups can be beneficial for those watching their figure and wanting to maintain their health.

Among Ayurvedic syrups, those with antioxidant properties[8] stand out, as they can help combat free radicals[9], strengthen the body, and support it with natural substances[10]. Antioxidants are an integral part of many plants[11], which contain various phytonutrients[12] such as flavonoids, polyphenols, and vitamins[13], known for their restorative properties[14].

Improving the production technology of Ayurvedic syrups aims to maximize the content of these beneficial compounds and ensure their maximum stability and effectiveness. This may involve obtaining semi-finished products – aqueous-alcoholic extracts[15] with increased content of

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[9] Rajini P.S., Muralidhara M. Chapter Three – Therapeutic efficacy of ayurvedic polyherbal formulations (PHF): Interactive mechanisms and broad-spectrum activities against neurological disorders. Editor(s): M. Muralidhara, P.S. Rajini. *Ayurvedic Herbal Preparations in Neurological Disorders*. Academic Press, 2023. pp. 89-111.

[10] Study of the antioxidant capacity of water-alcohol infusions of coffee substitutes with improved technology of syrups / Kuzmin O. et al. *Prospective directions of scientific research in engineering and agriculture* : collective monograph. Boston : Primedia eLaunch, 2023. pp. 358-366.

[11] Antioxidant ability of alcoholic infusions from vegetable raw materials / Kuzmin O. et al. *Ukrainian Food Journal*. 2020. 9(4). pp. 795-808.

[12] Antioxidant characteristics of non-traditional spicy-aromatic vegetable raw materials for restaurant technology / Khareba O. et al. *Ukrainian Food Journal*. 2021. 10(2). pp. 301-320.

[13] Antioxidant characteristics of tea-herbal compositions / Kuzmin O. et. al. *Ukrainian Food Journal*. 2021. 10(4). pp. 807-827.

[14] Antioxidant characteristics of uncommon types of vegetable plants for restaurant technology / Shevchenko O. et al. *Prospective directions of scientific research in engineering and agriculture* : collective monograph. Boston : Primedia eLaunch, 2023. pp. 367-375.

[15] Antioxidant properties of water-alcohol infusions of tea-herbal compositions based on yerba mate / Shevchenko O. et al. *Ukrainian Food Journal*. 2022. 11(3). pp. 403-415.

active substances[16] from plant raw materials[17] and enhancing their bioavailability in the final product.

One of the traditional directions in improving technology is the application of maceration technology[18], which allows obtaining extracts with controlled content of extractive substances. Overall, refining the manufacturing technology of Ayurvedic syrups with antioxidant properties can enhance their effectiveness and contribute to the preservation of consumers' health[19].

The aim of the study is to improve the technology of semi-finished products with antioxidant properties in the production of Ayurvedic syrups. *Research object:* technology of producing water-alcohol infusions, technology of Ayurvedic syrups. *esearch subject:* water-alcohol infusions, Ayurvedic syrups.

Research methods: organoleptic characteristics were determined using the expert method[20]; the antioxidant capacity of the hydro-alcoholic extracts was assessed using the redoxometry and pH-metry methods[21].

Research tasks: to evaluate the organoleptic indicators and antioxidant capacity of semi-finished products – aqueous-alcoholic extracts for the technology of Ayurvedic syrups; to determine the rational proportions of introducing components to achieve the necessary concentration of active substances; to develop recommendations for the use of semi-finished products – aqueous-alcoholic extracts in the technology of Ayurvedic syrups and their purpose.

The tasks set aim to raise awareness of the importance of antioxidants in food products, particularly in Ayurvedic syrups, and to support further research in this area to improve the health of consumers in the restaurant industry.

[16] Kuzmin O.V., Rudyi V.V. Prospects for the use of alcohol infusions in alcoholic beverage technologies for restaurants. *Modern engineering research: topical problems, challenges and modernity* : collective monograph. Riga : Izdevnieciba “Baltija Publishing”, 2020. pp. 211-230.

[17] Naithani V., Nair S., Kakkar P. Decline in antioxidant capacity of Indian herbal teas during storage and its relation to phenolic content. *Food Research International*. 2006. 39 (2). pp. 176-181; Pyrzynska K., Sentkowska A. Herbal Beverages as a Source of Antioxidant Phenolics. *Natural Beverages*. 2019. pp. 125-142.

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[19] Kuzmin O., Kovalchuk Y., Velychko V., Romanchenko N. Improvement technologies of aqueous-alcoholic infusions for the production of syrups. *Ukrainian Journal of Food Science*. 2016. 4 (2). pp. 258-275.

[20] Antioxidant characteristics of non-traditional spicy-aromatic vegetable raw materials for restaurant technology / Khareba O. et al. *Ukrainian Food Journal*. 2021. 10(2). pp. 301-320.

[21] Antioxidant properties of water-alcohol infusions of tea-herbal compositions based on yerba mate / Shevchenko O. et al. *Ukrainian Food Journal.* 2022. 11(3). pp. 403-415.

1. The influence of plant raw materials on the organoleptic properties of water-alcohol infusions

To assess the organoleptic characteristics of water-alcohol infusions with a 40% by volume content of rectified ethyl alcohol, various types of plant raw materials were used (Fig. 1).

Subsequent infusion of the of plant raw materials in water-alcohol mixtures took place over a period of 14 days at a temperature of 20°C in a dark place.

The values of organoleptic indicators were assessed in points, as well as the value of a specific indicator averaged across all descriptors in a group. The assessment was conducted on a 10-point scale. The final evaluation of a specific sample indicator was determined by obtaining the average value of individual descriptors used to calculate the mean value of the main indicator («Color and Transparency», «Aroma», «Taste»).

The assessment of the influence of plant raw materials on the quality of water-alcohol infusions was carried out based on the criterion in the form of the sum of the products of component indicators f_j. Comparing different samples is possible when using the quality criterion and the «quality polygon» (as the area of the polygon), calculated as the sum of the areas of individual triangles formed by the rays of individual quality indicators, with the central angle[22].

Based on the evaluation results using the «quality polygon» method, quality profiles of individual samples were constructed, and quality criteria (S, points^2) were calculated for the presented samples.

Let's analyze the values of the investigated organoleptic indicators from the water-alcohol infusions with plant raw materials (Fig. 2–3).

The study was conducted in the following blocks: color and transparency, aroma, and taste. In the first block, 4 shades were distinguished: red, yellow, brown, green. The aroma was divided into: sweet, sour, bitter, herbaceous, spicy, alcoholic, berry, balanced. Taste was formed with such nuances: sweet, sour, bitter, herbaceous, spicy, alcoholic, berry, balanced.

[22] Quality rating of desserts based on fruit and berry raw materials / Koretska I. et al. *Ukrainian Journal of Food Science*. 2021. 9(1), pp. 71-87.

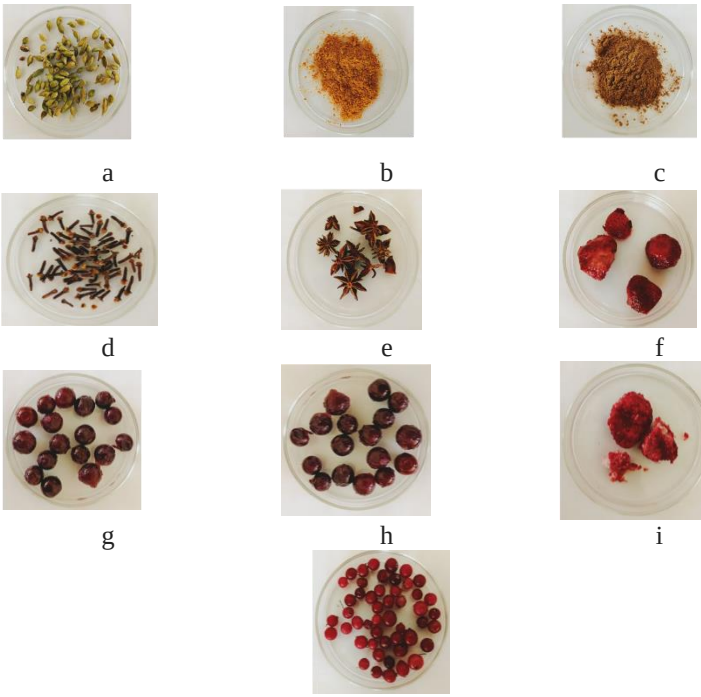


Fig. 1. Photo of plant raw material samples (a – dried cardamom, b – ground turmeric, c – ground cinnamon, d – dried star anise, e – dried cloves, f – frozen strawberries, g – frozen grapes, h – frozen blueberries, i – raspberries frozen, j – fresh cranberry)

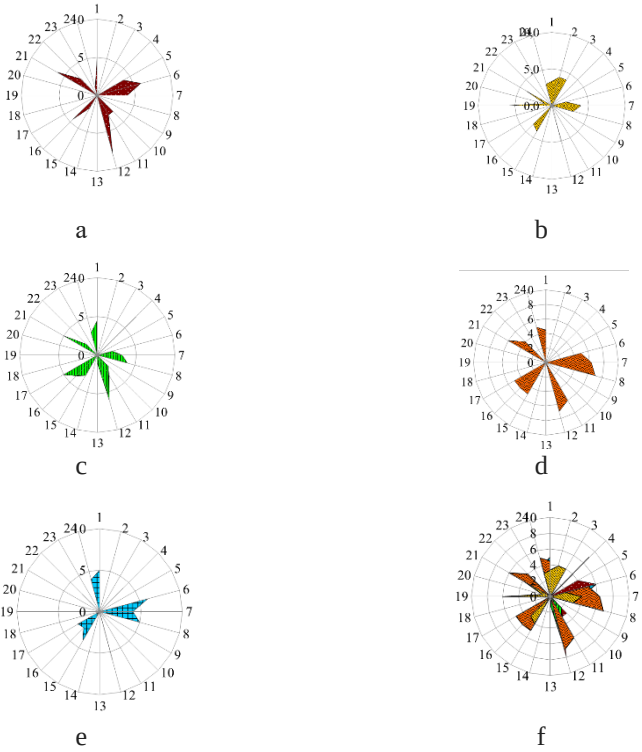


Fig. 2. Sensory profile of quality indicators of water-alcohol infusions from spices (a – cardamom, b – curcuma, c – cinnamon, d – star anise, e – clove, f – comprehensive indicator): 1 – color and transparency (2 – red, 3 – yellow, 4 – brown, 5 – green, 6 – transparency), 7 – aroma (8 – sweet, 9 – sour, 10 – bitter, 11 – herbaceous, 12 – spicy, 13 – alcoholic, 14 – berry, 15 – balanced), 16 – taste (17 – sweet, 18 – sour, 19 – bitter, 20 – herbaceous, 21 – spicy, 22 – alcoholic, 23 – berry, 24 – balanced)

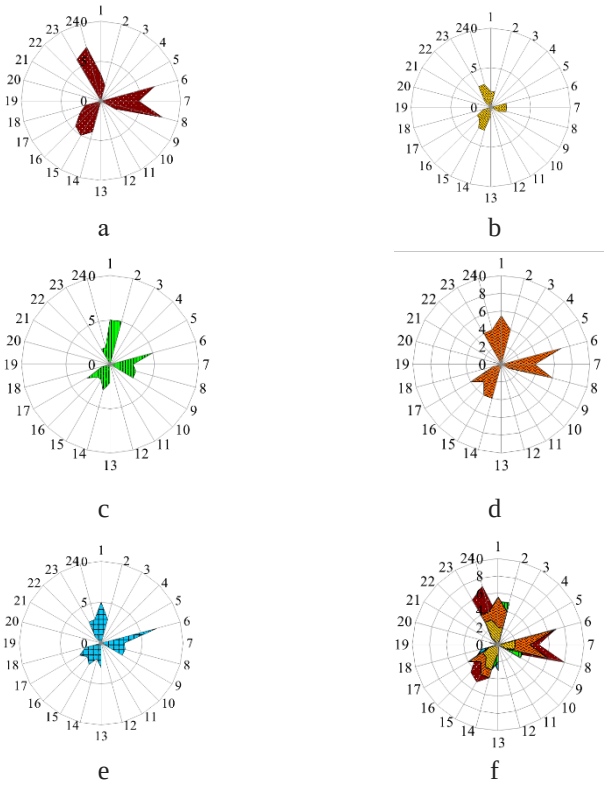


Fig. 3. Sensory profile of quality indicators of water-alcohol infusions from berries (a – strawberry, b – grape, c – bilberry, d – raspberry, e – cranberry, f – comprehensive indicator): 1 – color and transparency (2 – red, 3 – yellow, 4 – brown, 5 – green, 6 – transparency), 7 – aroma (8 – sweet, 9 – sour, 10 – bitter, 11 – herbaceous, 12 – spicy, 13 – alcoholic, 14 – berry, 15 – balanced), 16 – taste (17 – sweet, 18 – sour, 19 – bitter, 20 – herbaceous, 21 – spicy, 22 – alcoholic, 23 – berry, 24 – balanced)

Thus, out of all 5 samples of spices, color and transparency were most highly rated in the water-alcohol infusions from the cardamom and clove, with a score of 5 (Table 1). The lowest score for this indicator was obtained from the curcuma.

Table 1

Research of the organoleptic characteristics of water-alcohol infusions from spices

№	Indicator name	Cardamom		Curcuma		Cinnamon		Star anise		Clove	
		point	S, point^2	point	S, point^2	point	S, point^2	point	S, point^2	point	S, point^2
1	**Color and transparency**	5.0		3.3		4.5		4.5		5.0	
2	Red			4							
3	Yellow			4							
4	Brown					7		4		4	
5	Green	4									
6	Transparency	6		2		2		5		6	
7	**Aroma**	4.0		4.0		3.2		6.3		4.0	
8	Sweet			3		4		7		5	
9	Sour										
10	Bitter	3				2				1	
11	Herbaceous	3				3		6			
12	Spicy	8	63.45	5	36.65	6	41.34	7	103.22	6	34.18
13	Alcoholic					1					
14	Berry										
15	Balanced	2		4		3		5		4	
16	**Taste**	4.5		3.5		3.8		5.0		2.8	
17	Sweet					5		5		3	
18	Sour										
19	Bitter	8		6						1	
20	Herbaceous			1							
21	Spicy	6		4		5		6			
22	Alcoholic	3				2		4		3	
23	Berry										
24	Balanced	1		3		3		5		4	

According to the aroma assessment, the most pronounced and pleasant was in the water-alcohol infusions from the fruit star anise – 6.3. Taste had the highest score in the star anise – 5.0. The lowest score was given to the water-alcohol infusions from the clove – 2.8.

The most highly color and transparency were rated in the water-alcohol infusions from the raspberry, with a score of 5.5 (Table 2). When calculating the areas of the polygons, the sample with the highest value were the water-alcohol infusions from star anise and strawberry, reaching S – 103.22 and S – 98.91 points^2.

Table 2

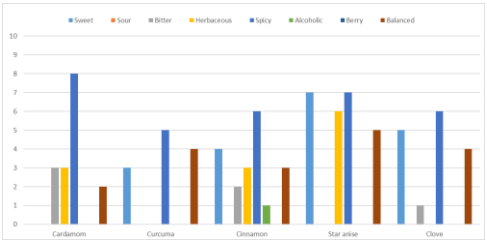
Research of the organoleptic characteristics of water-alcohol infusions from berries

№	Indicator name	Strawberry		Grape		Bilberry		Raspberry		Cranberry	
		point	S, point²	point	S, point²	point	S, point²	point	S, point²	point	S, point²
1	**Color and transparency**	3.0		2.0		5.0		5.5		5.0	
2	Red	2		2		5		4		3	
3	Yellow										
4	Brown	1									
5	Green										
6	Transparency	7		2		5		7		7	
7	**Aroma**	5.0		2.0		2.6		3.8		2.8	
8	Sweet	8		2		3		6		3	
9	Sour	2		1		3		1		3	
10	Bitter										
11	Herbaceous										
12	Spicy		98.91		24.99		41.88		67.54		48.18
13	Alcoholic			1		2				3	
14	Berry	4		3		3		4		2	
15	Balanced	5		3		2		4		3	
16	**Taste**	4.5		2.0		2.0		2.8		2.4	
17	Sweet	3		2		3		4		3	
18	Sour	2		1		1		1		2	
19	Bitter										
20	Herbaceous							1			
21	Spicy										
22	Alcoholic			1						1	
23	Berry	6		3		2		4		3	
24	Balanced	7		3		2		4		3	

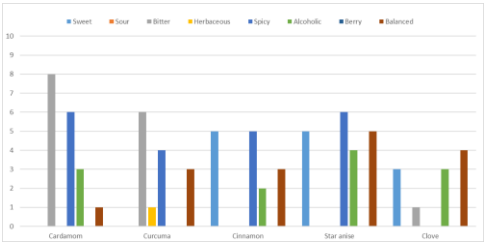
Based on the above, a graphical representation of the evaluation results was formed in the form of a profile of the studied samples, depicted in Fig. 4–5.

Therefore, by analyzing the taste-aromatic palette, it can be concluded that the star anise and the strawberry have a rich multifaceted taste, so it is reasonable to use them for further blending.

Color and transparency were most highly rated in the blend «Star anise 100% – Strawberry 0%», with a score of 4.5 (Table 3).

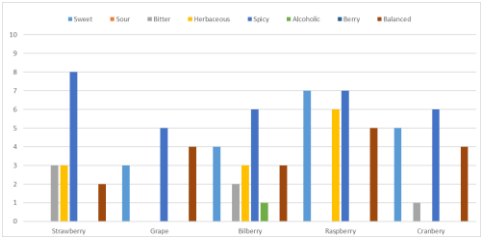


a

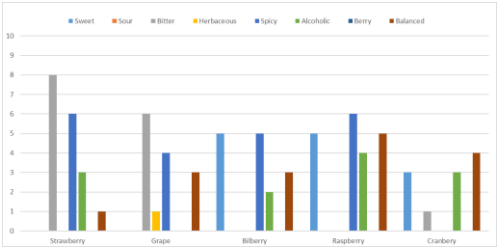


b

Fig. 4. The flavor (a) – aromatic (b) palette of water-alcohol infusions with spices



a



b

Fig. 5. The flavor (a) – aromatic (b) palette of water-alcohol infusions with berries

The lowest score for this indicator was obtained from the blends «Star anise 50% – Strawberry 50%» and «Star anise 0% – Strawberry 100%». According to the aroma assessment, the most pronounced and pleasant was the blend «Star anise 100% – Strawberry 0%». Taste had the highest score in the blend «Star anise 100% – Strawberry 0%» – 5. The lowest score was given to the blend «Star anise 50% – Strawberry 50%» water-alcohol infusions from the clove – 3.2.

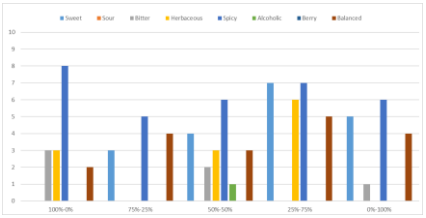
Table 3

Research of the organoleptic characteristics of water-alcohol infusions from spices

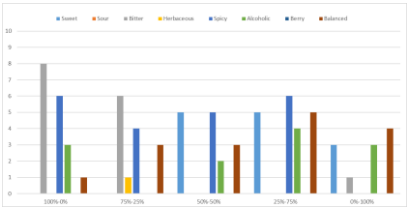
№	Indicator name	Blend «Star anise – Strawberry»									
		100%–0%		75%–25%		50%–50%		25%–75%		0%–100%	
		point	S, point^2	point	S, point^2	point	S, point^2	point	S, point^2	point	S, point^2
1	**Color and transparency**	4.5		4.0		3.0		4.0		3.0	
2	Red					1		2		2	
3	Yellow							3			
4	Brown	4		3		2				1	
5	Green										
6	Transparency	5		5		6		7		7	
7	**Aroma**	6.3		5.5		3.7		4.8		5.0	
8	Sweet	7		7		7		8		8	
9	Sour					1		2		2	
10	Bitter										
11	Herbaceous	6		5		4		4			
12	Spicy	7	112.22	6	80.65	5	52.44	5	108.14		98.91
13	Alcoholic										
14	Berry					1		4		4	
15	Balanced	5		4		4		6		5	
16	**Taste**	5.00		4.25		3.20		4.50		4.50	
17	Sweet	5		5		4		5		3	
18	Sour					1		2		2	
19	Bitter										
20	Herbaceous										
21	Spicy	6		5		5		5			
22	Alcoholic	4		3		2		2			
23	Berry					1		5		6	
24	Balanced	5		4		6		8		7	

When calculating the areas of the polygons, the sample with the highest value were the blends «Star anise 100% – Strawberry 0%» and blend «Star anise 25% – Strawberry 75%», reaching S – 112.22 and 108.14 points^2.

Based on the above, a graphical representation of the evaluation results was formed in the form of a profile of the studied samples, depicted in Fig. 6.



a



b

Fig. 6. The flavor (a) – aromatic (b) palette of the blends «Star anise – Strawberry»

The values of the investigated organoleptic indicators from the blends «Star anise – Strawberry» (Fig. 7). Therefore, by analyzing the taste-aromatic palette, it can be concluded that the blend «Star anise 25% – Strawberry 75%» have a rich multifaceted taste, so it is reasonable to use it for further innovative culinary technologies.

2. The influence of plant raw materials on the antioxidant properties of water-alcohol infusions

In addition to the extended organoleptic evaluation of water-alcohol infusions from different plant raw materials, studies were conducted: active acidity (*pH*), redox potential (Eh_{act}), minimum theoretical value of redox potential (Eh_{min}), infusion reduction energy (RE_{inf}), and plant raw material reduction energy (RE_{plant}).

The following plant raw materials were evaluated: dried cardamom, ground turmeric, ground cinnamon, dried star anise, dried cloves, frozen strawberries, frozen grapes, frozen blueberries, frozen raspberries, fresh cranberries. Let's consider each indicator more thoroughly for each type of plant raw material, omitting the water-alcohol infusions results for comparison.

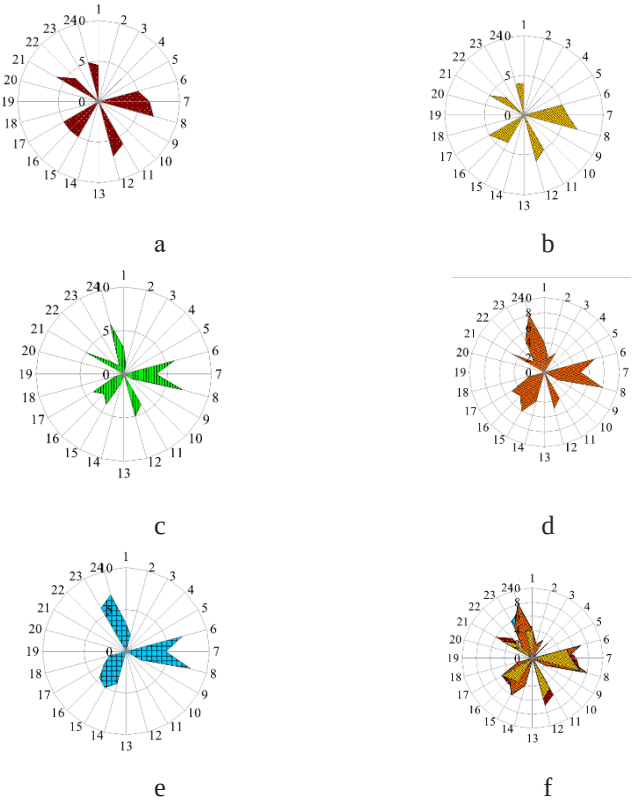


Fig. 7. Sensory profile of quality indicators of the blends «Star anise – Strawberry» (a – 100% – 0%, b – 75% – 25%, c – 50% – 50%, d – 25% – 75%, e – 0% – 100%, f – comprehensive indicator): 1 – color and transparency (2 – red, 3 – yellow, 4 – brown, 5 – green, 6 – transparency), 7 – aroma (8 – sweet, 9 – sour, 10 – bitter, 11 – herbaceous, 12 – spicy, 13 – alcoholic, 14 – berry, 15 – balanced), 16 – taste (17 – sweet, 18 – sour, 19 – bitter, 20 – herbaceous, 21 – spicy, 22 – alcoholic, 23 – berry, 24 – balanced)

The antioxidant capacity of water-alcohol infusions was determined by the redox and pH methods based on the volume fraction of rectified ethyl alcohol with 40% ethanol content at a water-alcohol infusions temperature of 20 °C.

Table 4 presents the results of the aforementioned studies for the plant raw materials. Graphical representations of the research are shown in Fig. 8–10.

Table 4

Results of plant raw materials investigations

Number	Raw material	*pH*	Eh_{min}, mV	Eh_{act}, mV	RE_{inf}, mV	RE_{plant}, mV	*S.e.*, points
1	Water-alcohol mixture	8.08	162.64	117	45.64	0.00	3.20
2	Cardamom	7.84	172.72	65	107.72	62.08	4.50
3	Curcuma	7.40	191.20	67	124.20	78.56	3.61
4	Cinnamon	6.25	239.50	110	129.50	83.86	3.81
5	Star anise	5.73	261.34	133	128.34	82.70	5.25
6	Clove	5.92	253.36	125	128.36	82.72	3.92
7	Strawberry	5.14	286.12	152	134.12	88.48	4.19
8	Grape	4.68	305.44	184	121.44	75.80	2.00
9	Bilberry	4.74	302.92	189	113.92	68.28	3.20
10	Raspberry	4.76	302.08	182	120.08	74.44	4.02
11	Cranberry	4.46	314.68	201	113.68	68.04	3.40
	min	4.46	172.72	65	107.72	62.08	2.00
	max	7.84	314.68	201	134.12	88.48	5.25

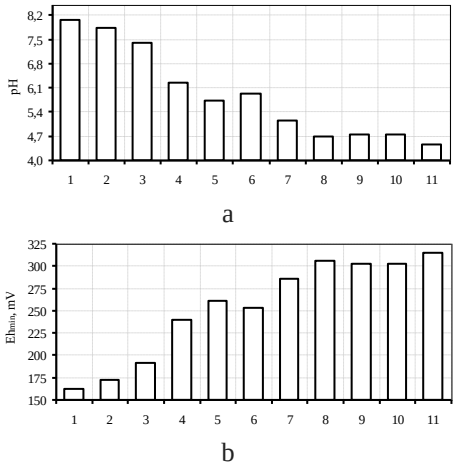


Fig. 8. Graphical representation of the research results of samples plant raw material (1 – water-alcohol mixture, 2 – cardamom, 3 – curcuma, 4 – cinnamon, 5 – star anise, 6 – clove, 7 – strawberry, 8 – grape, 9 – bilberry, 10 – raspberry, 11 – cranberry); a – active acidity (*pH*); b – minimum theoretical value of redox potential (Eh_{min})

Active acidity (*pH*) has a maximum value of 7.84 pH units in the cardamom, while the minimum value is 4.46 pH units in the cranberry. Some

of the highest indicators are found in the curcuma – 7.40 pH units and strawberry – 5.14 pH units.

The research of redox potential has the following results: the minimum value is Eh_{act} 65 mV in the cardamom, with the minimum theoretical value of redox potential (Eh_{min}) being 172.72 mV; the maximum value is Eh_{act} 201 mV in the cranberries, with the minimum theoretical value of redox potential (Eh_{min}) equal to the highest indicator as well – 314.68 mV. The minimum theoretical value of redox potential (Eh_{min}) with the highly indicator is found in the bilberry – 302.92 mV, with their actual redox potential (Eh_{act}) being 189 mV.

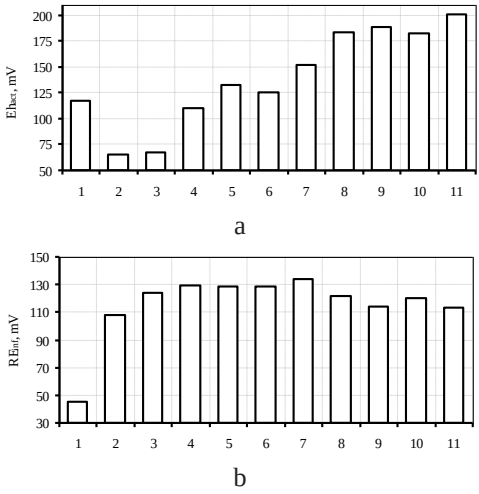


Fig. 9. Graphical representation of the research results of samples plant raw material (1 – water-alcohol mixture, 2 – cardamom, 3 – curcuma, 4 – cinnamon, 5 – star anise, 6 – clove, 7 – strawberry, 8 – grape, 9 – bilberry, 10 – raspberry, 11 – cranberry); a – redox potential (Eh_{act}); b – infusion reduction energy (RE_{inf})

The reduction capacity (reduction energy – RE_{inf}) is minimal at 107.72 mV in the cardamom. The reduction energy of plant raw material (RE_{plant}) is also minimal – 62.08 mV for the same raw material. The maximum value of reduction energy is RE_{inf} 134.12 mV for the strawberry, which also has the maximum value RE_{plant} 88.48 mV.

Therefore, by analyzing the results of the antioxidant capacity test, it can be concluded that the star anise and the strawberry have a rich multifaceted taste, so it is reasonable to use them for further blending.

Table 5 presents the results of the aforementioned studies for the blends «Star anise – Strawberry». Active acidity (*pH*) has a maximum value of 5.73 pH units in the blend «Star anise 100% – Strawberry 0%», while the minimum value is 5.14 pH units in the blend «Star anise 0% – Strawberry 100%».

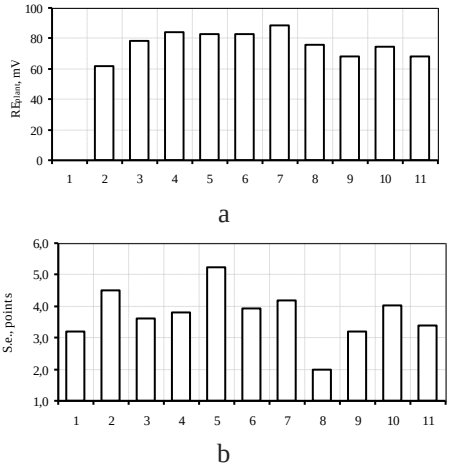


Fig. 10. Graphical representation of the research results of samples plant raw material (1 – water-alcohol mixture, 2 – cardamom, 3 – curcuma, 4 – cinnamon, 5 – star anise, 6 – clove, 7 – strawberry, 8 – grape, 9 – bilberry, 10 – raspberry, 11 – cranberry); a – plant raw material reduction energy (RE_{plant}); b – taste-aromatic palette (*S.e.*)

Table 5

Results of the blends «Star anise – Strawberry»investigations

№	Notation	Index	Contents of 1 infusion, %					Index
			100	75	50	25	0	
			Contents of 2 infusion, %					
			0	25	50	75	100	
1	pH	Water-alcohol infusion of star anise	5.73	5.52	5.43	5.27	5.14	Water-alcohol infusion of strawberry
2	Eh_{min}, mV		261.34	270.16	273.94	280.66	286.12	
3	Eh_{act}, mV		133.00	140.00	146.00	142.00	152.00	
4	RE_{inf}, mV		128.34	130.16	127.94	138.66	134.12	
5	RE_{plant}, mV		82.70	84.52	82.30	93.02	88.48	
6	*S.e.*, points		5.25	4.58	3.28	5.44	4.19	

The research of redox potential has the following results: the minimum value is Eh_{act} 133 mV in the blend «Star anise 100% – Strawberry 0%», with the minimum theoretical value of redox potential (Eh_{min}) being 261.34 mV; the maximum value is Eh_{act} 152 mV in the blend «Star anise 0% – Strawberry 100%», with the minimum theoretical value of redox potential (Eh_{min}) equal to the highest indicator as well – 286.12 mV.

The reduction capacity (reduction energy – RE_{inf}) is minimal at 128.34 mV in the blend «Star anise 100% – Strawberry 0%». The reduction energy of plant raw material (RE_{plant}) is also minimal – 82.70 mV for the same raw material. The maximum value of reduction energy is RE_{inf} 138.66 mV for the blend «Star anise 25% – Strawberry 75%», which also has the maximum value RE_{plant} 93.02 mV.

Graphical representations of the research are shown in Fig. 11.

Therefore, by analyzing the antioxidant capacity test, it can be concluded that the blend «Star anise 25% – Strawberry 75%» have a highest redox potential, so it is reasonable to use it for further innovative culinary technologies.

Furthermore, the combination of star anise and strawberries in the semi-finished product for the production of Ayurvedic syrup creates a synergistic effect, enhancing both the beneficial properties – antioxidant capacity and organoleptic indicators.

As a result of experimental research, an Ayurvedic syrup made from strawberries and star anise was obtained, which has a pleasant fruity taste with spicy notes. The color of the syrup corresponds to the shade of strawberries, indicating the preservation of the natural color of strawberries. The aroma of the syrup is intense and appetizing, combining the scent of strawberries with the spicy aroma of star anise.

Taking into account the percentage ratio of 25% star anise and 75% strawberries, as well as the volume of sugar syrup and the quantity of raw materials used, a balance and harmony of taste and aroma were achieved in the obtained syrup.

The obtained results are credible since the recipe was developed based on research and theoretical justification, and experimental trials confirmed the recipe's ability to create a syrup with the specified characteristics.

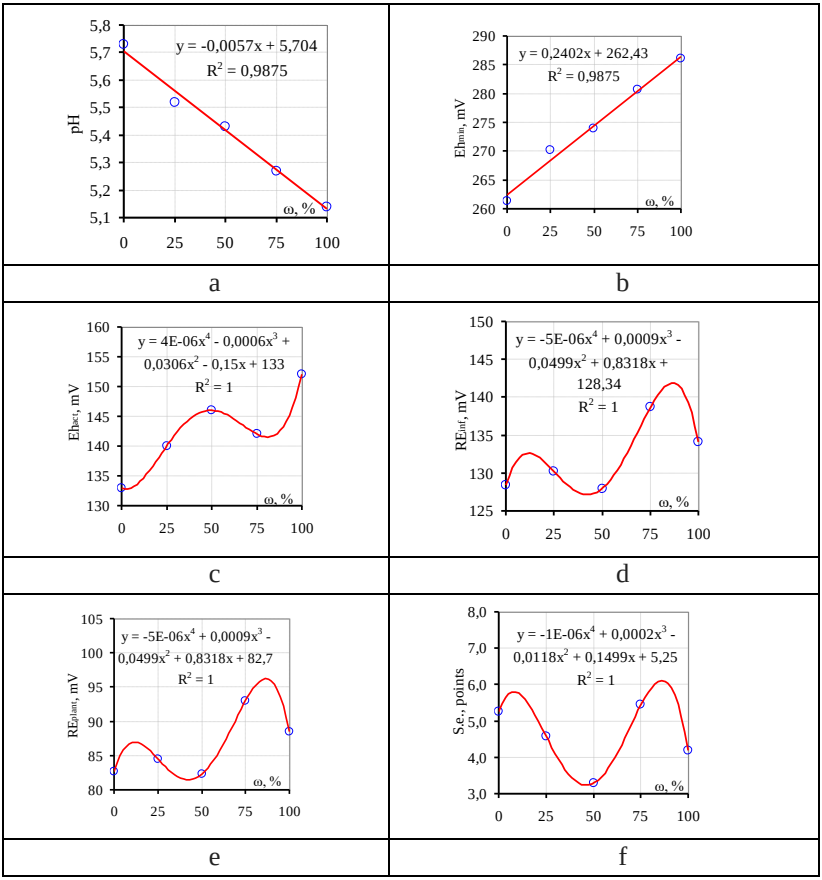


Fig. 11. Graphical representation of the research results of samples blend «Star anise – Strawberry» (a – active acidity (*pH*), b – minimum theoretical value of redox potential (Eh_{min}), c – redox potential (Eh_{act}), d – infusion reduction energy (RE_{inf}), e – plant raw material reduction energy (RE_{plant}), f – taste-aromatic palette (*S.e.*))

CONCLUSIONS

The experimental studies have shown that the blend «Star anise 25% – Strawberry 75%» exhibits the highest antioxidant potential among all raw material variants. This indicates the possibility of successful utilization of this blend for further development of innovative culinary products. Furthermore, the combination of star anise and strawberries in the semi-finished product for the production of Ayurvedic syrup contributes to a synergistic effect,

enhancing both the beneficial properties and the organoleptic characteristics of the product. The obtained results confirm the feasibility of developing a syrup with specified characteristics that could have a positive impact on consumers' health.

SUMMARY

The research findings underscore the importance of balanced nutrition and the use of natural ingredients in food products to support health. Considering the principles of Ayurveda, where every element of the body interacts with others, it is crucial to select products that promote harmony of body and soul.

During the study, it was found that star anise may have beneficial properties for the human body from the perspective of Ayurveda. Star anise contains phytoncides, which help eliminate harmful bacteria and viruses, as well as possessing anti-inflammatory properties.

Strawberries, known for their antioxidant properties, can enhance the immune system and contribute to overall strengthening of the body.

The combination of strawberries and star anise in Ayurvedic syrup may create a synergistic effect, enhancing their beneficial properties. Such a semi-finished product can be useful as a means to boost antioxidant characteristics, leading to immune system reinforcement and overall health maintenance.

These results underscore the importance of using natural ingredients in food products and their potential for preserving and improving health.

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