Pavlenko, Svitlana; Verkhivker, Yakov; Myroshnichenko, Iena

Article

Development of technology for production of functional fruit drinks

Reference: Pavlenko, Svitlana/Verkhivker, Yakov et. al. (2021). Development of technology for production of functional fruit drinks. In: Technology audit and production reserves 4 (3/60), S. 46 - 49.
http://journals.uran.ua/tarp/article/download/237867/237431/547719.
doi:10.15587/2706-5448.2021.237867.

ISSN 2664-9969

UDC 664.8.036.5
DOI: 10.15587/2706-5448.2021.237867
Article type «Reports on Research Projects»

Svitlana Pavlenko,
Yakov Verkhivker,
Elena Myroshnichenko

DEVELOPMENT OF TECHNOLOGY FOR PRODUCTION OF FUNCTIONAL FRUIT DRINKS

The object of research is the technology of functional fruit and vegetable juice products enriched with collagen. The subject of research is various types of collagen, formulations and parameters of technological operations for the production of functional juice drinks. The research is aimed at the develop technology, recipes for a new assortment of fruit and vegetable drinks enriched with collagen. Also it is aimed at the preserve the functional properties of collagen in canned juice products after high-temperature processing and create food products for everyday consumption to solve age-related and other problems associated with human health. In the course of the study, standard methods were used to determine the organoleptic indicators of various types of collagen, juice products, as well as to determine the mass fraction of moisture, carbohydrates, fats, proteins in the developed fruit and vegetable drinks enriched with collagen. Also, to confirm the presence and preservation of collagen in finished products, the electrophoresis method was used to determine the atomic mass unit of the constituent substances after complete drying of the samples. The proposed methods make it possible to assess the quality of the developed collagen-enriched drinks, prove the presence and preservation of a biologically active additive in the finished product after using the sterilization mode parameters – temperature and time, when receiving canned products. The developed formulations and technology make it possible to consider functional fruit and vegetable juice-containing products enriched with a biologically active additive collagen as effective and useful. An easily digestible food product for everyday consumption is proposed for solving age-related and other problems related to human health, with regulation of the pH value for effective use of the beneficial properties of this additive. In contrast to existing functional juice products, the proposed formulations and technology make it possible to obtain juice-containing fruit and vegetable blended products with a biologically active additive collagen. The technology minimizes the impact of collagen on the organoleptic characteristics of the developed recipe compositions of finished products and preserves its beneficial biologically active properties in the finished canned product after heat sterilization.

Keywords: *fruit and vegetable functional juice products, plant and animal collagen, organoleptic and biochemical parameters, heat sterilization.*

Received date: 14.04.2021
Accepted date: 26.05.2021
Published date: 31.07.2021

How to cite
Pavlenko, S., Verkhivker, Y., Myroshnichenko, E. (2021). Development of technology for production of functional fruit drinks. Technology Audit and Production Reserves, 4 (3 (60)), 46–49. doi: http://doi.org/10.15587/2706-5448.2021.237867

1. Introduction

Products containing collagen hydrolyzate play a special role in the prevention of joint diseases [1, 2]. Drinks are the most technologically advanced product for creating new types of functional nutrition [3, 4].

Therefore, the possibility of developing drinking products with collagen, which will be a prophylactic agent for diseases of the joints, skin for various groups of the population, people leading an active lifestyle, going in for sports, seems relevant [5].

Thus, *the object of research* is the technology of functional fruit and vegetable juice products enriched with collagen. *The aim of research* is to develop technology, formulations for a new assortment of collagen-enriched fruit and vegetable drinks.

2. Methods of research

Beef, pork, and fish collagens manufactured by GELITAAG (Germany) [6] and plant collagen, which is the substance of the pulp of tomato fruits, were used. Fruit and vegetable juices with pulp or blends made from semi-finished mashed potatoes and concentrates of various domestic and foreign manufacturers were taken as basic compositions in the development of recipes.

The following indicators were determined: organoleptic indicators according to DSTU 8449:2015; mass fraction of protein according to the Kjeldahl method DSTU GOST 25011-2017; mass fraction of moisture according to DSTU GOST 3626-73; mass fraction of carbohydrates according to DSTU 4855:2007; mass fraction of fats according to DSTU 4941:2008; electrophoresis method according to DSTU GOST 31475-2012.

3. Research results and discussion

Organoleptic indicators of collagen in assortment, in dissolved and dried state, were determined: smell, taste, stability of an aqueous solution. It was found that, according to the organoleptic characteristics, pork and fish collagens either have a pungent smell and taste, or give the formation of suspensions, flakes and sediment upon dissolution. Collagen of vegetable origin (tomato) has a specific, characteristic smell of tomatoes, so it can only be used in juice products, the formulation of which includes tomato products. Therefore, for research, collagen of animal origin, beef, in dry form was selected.

Research has been carried out to develop a range of juice products. In this regard, a range of juice-containing products was selected, into which collagen can be introduced without deteriorating the appearance of the drinks, from the point of view of the buyer and the appearance of unusual organoleptic sensations in the consumer. The assortment is represented by nectars and drinks, which, due to the presence in the composition of a sufficiently large amount of fruit pulp (6–12 %), hide from the consumer the presence of a jelly-like substance in the volume of the product. The uniform distribution of the pulp throughout the grocery volume, provided by the process of homogenization of the product during its manufacture, does not allow unusual organoleptic sensations to appear when consuming the finished product [7, 8].

When developing formulations of juice-containing blended products enriched with collagen, the basic formulations of nectars and beverages with pulp were taken as a basis in accordance with DSTU 4283 «Canned food. Juices and juice products» [9, 10]. Seven types of juice products were selected: Peach nectar, Banana-Strawberry nectar, Apple-Guava-Banana nectar, Apple-Pear nectar, Blueberry-Blackberry-Raspberry drink, Beet-Mango-Apple nectar, Apple-Mint drink.

Studies have been carried out to determine the mass fraction of beef collagen that can be used in the production of juice products. The experiments have been carried out using the product «Nectar» Beet-mango-apple», as the most sensitive in terms of organoleptic characteristics – color, taste and smell from the studied juice-containing products. The component included in it is beet juice, which colors the product in a bright burgundy tone. The addition of dry collagen, which is white, changes the color of the drink. The smell of the original recipe contains a mango aroma, which changes even taking into account the fact that beef collagen is odorless in terms of organoleptic characteristics. The mass fraction of collagen in the nectar formulation varied from 5.0 to 20.0 % of the total mass of the product, which was introduced due to a decrease in the main juice component in the formulation. This interval was chosen to determine the effect of the type of collagen on the mass fraction of protein and to determine the content of the mass fraction of amino acids in the final product – methionine, tryptophan and hydroxyproline. These amino acids characterize the presence of collagen in the product and the absence of its denaturation into gelatin. Analyzing the experimental data, it can be noted that an increase in the collagen supplement in the formulation from 5 % and more leads to a deterioration in the «drinking» quality of juice products, that is, the appearance of a thick consistency. Therefore, the concentration of collagen supplements in juice-containing products was selected at the level of 5 % of the total product formulation.

Organoleptic studies of the obtained samples of nectars and beverages with pulp, enriched with collagen, were carried out, which made it possible to determine the optimal formulations. The results show that products (nectars, drinks), with the addition of collagen in an amount of 5 %, fully satisfy consumer requirements for organoleptic indicators, including consistency, and comply with regulatory documents.

Biochemical analyzes of juice products were carried out to determine the mass fraction of moisture, carbohydrates, fats, proteins, presented in Table 1.

Experimental data have shown that the ratio between the mass fractions of carbohydrates, fats and proteins in juice drinks depends on the recipe of the drink and varies in a fairly wide range. The introduction of the collagen component into the product formulation changes not only the mass fraction of moisture, but also affects the mass fraction of protein in the product. The amount of collagen component in the formulation of 5.0 % does not lead to a significant difference between the values of the mass fraction of protein in the finished product and in absolutely dry matter after freeze-drying of product samples.

To confirm the presence and safety of collagen in juice products, studies were carried out using the electrophoresis method, which made it possible to determine the atomic mass unit of the constituents of the substance after its complete drying. Electropherograms were obtained for samples of pure collagen and then compared with similar electrophoresograms for samples of ready-made juice products with additives in the form of an absolutely dry solution of chemically pure beef collagen. Analysis of the data obtained showed that the solution of pure collagen contains protein fractions with an atomic mass in the range from 45 kDa to 97 kDa. If the collagen in the product has not undergone any physical changes, then similar values should be obtained in finished products – with collagen additives to the main recipe. The studies carried out have shown the absence of collagen in the products, this suggests that during the technological heat treatment of products after the introduction of the additive into it, collagen catabolism (breakdown) occurs.

After adding a collagen additive to the drink, the only technological operation that can affect its decomposition and denaturation is the final heat treatment of the finished product – sterilization. Such processing is carried out at a sufficiently high temperature, taking into account the pH of the product (for example, for the nectar «Beet-mango-apple» pH=4.4). The used mode of sterilization of the product in the current heat exchanger was: heating to a temperature of 103 °C, holding at this temperature for a certain time and cooling to a filling temperature of 22±3 °C in consumer containers under aseptic conditions. At a temperature of 103 °C, collagen denaturation occurs, the protein breaks down and it is almost impossible to determine its presence in the finished product. Therefore, it is proposed to process the collagen solution in the «in-line» heat exchanger at 40±3 °C and to keep the collagen at this temperature for 60 seconds. This processing mode does not lead to the breakdown of collagen protein, since this temperature is close to the temperature of normal functioning of the collagen supplement source. This heat treatment makes it possible to obtain an industrially sterile collagen supplement solution, due to the chemical purity, which is guaranteed by the manufacturer.

ISSN 2664-9969

Table 1

Biochemical parameters of juice products with collagen

Availability of additive	Moisture content, %	Mass fraction of carbohydrates, %		Mass fraction of fats, %		Mass fraction of proteins, %	
		in the original product, %	on absolutely dry matter, %	in the original product, %	on absolutely dry matter, %	in the original product, %	on absolutely dry matter, %
Peach nectar							
Collagen free	83.5	15.93	83.31	0.549	2.87	0.117	0.61
With beef collagen	83.0	15.93	79.45	0.549	2.74	0.223	1.11
Banana-Strawberry nectar							
Collagen free	87.4	10.82	74.76	0.540	3.73	1.190	8.82
With beef collagen	85.5	10.82	71.26	0.540	3.56	1.290	8.49
Apple-Guava-Banana nectar							
Collagen free	73.9	22.08	45.71	1.910	3.95	2.089	6.39
With beef collagen	72.9	22.08	59.46	1.910	5.14	3.090	8.32
Apple-Pear nectar							
Collagen free	79.1	11.90	69.73	0.806	4.72	0.674	4.31
With beef collagen	86.51	11.90	76.31	0.806	5.17	0.785	5.03
Blueberry-Blackberry-Raspberry drink							
Collagen free	97.10	2.61	76.13	0.145	4.23	0.119	3.95
With beef collagen	97.08	2.61	86.62	0.145	4.81	0.170	5.64
Beet-Mango-Apple nectar							
Collagen free	78.70	17.96	66.27	0.78	2.88	2.01	7.40
With beef collagen	78.64	17.96	66.12	0.78	2.87	2.62	9.64
Apple-Mint drink							
Collagen free	99.30	0.679	93.01	0.03	4.52	trays	0.78
With beef collagen	99.28	0.679	93.76	0.03	4.14	0.01	1.38

The mixing of a sterilized juice drink and an industrially sterile solution of a collagen supplement is carried out under aseptic conditions, and the resulting mixture is further cooled in a single flow [11].

When implementing the developed technology, substances known in the food industry are used for the production of products. The only limitation may be heat treatment, the parameters of which must be developed for those biologically active components that will be used in the production of the final product. The presented results of scientific data allow in practice to expand the range of useful products that have a positive effect on homeostasis. A possible development of the presented study consists in the use of various food additives, which make it possible to create products by characteristics aimed at improving the functioning of the human body.

4. Conclusions

The study shows that the most preferred is collagen of animal origin – beef as a biological additive in fruit and vegetable nectars and drinks, in the amount of 5 %. When developing formulations of juice-containing blended products enriched with collagen, the basic formulations of nectars and beverages with pulp are taken as a basis. Juice products, which contain collagen added in an amount of 5 %, fully meet consumer requirements for organoleptic indicators for this food product, including consistency, in accordance with the current regulatory and technical documentation. Biochemical studies have shown that the collagen component changes not only the mass fraction of moisture, but also affects the mass fraction of protein in the product. The amount of collagen component in the formulation of 5.0 % does not lead to a significant difference between the values of the mass fraction of protein in the finished product and in absolutely dry matter after freeze-drying of product samples. To preserve the prepared collagen component in the finished juice product, its addition must be made after high-temperature sterilization of beverages under aseptic conditions. The developed technology has no restrictions, since during its implementation, substances known in the food industry are used for the production of products. The only limitation may be heat treatment, the parameters of which must be developed for those biologically active components that will be used in the production of the final product. The above studies allow, in practice, to expand the range of products manufactured. A possible development of the presented study consists in the use of various food additives, which make it possible to create products by characteristics aimed at improving the functioning of the human body.

References

1. Paul, C., Leser, S., Oesser, S. (2019). Significant Amounts of Functional Collagen Peptides Can Be Incorporated in the Diet While Maintaining Indispensable Amino Acid Balance. *Nutrients, 11 (5),* 1079. doi: http://doi.org/10.3390/nu11051079
2. Bilek, S. E., Bayram, S. K. (2015). Fruit juice drink production containing hydrolyzed collagen. *Journal of Functional Foods, 14,* 562–569. doi: http://doi.org/10.1016/j.jff.2015.02.024
3. Novikova, I. V., Antipova, L. V., Romanyuk, T. I., Bovva, O. A., Kudryashov, M. S. (2020). Development of technology for «Shorley» type beverages with collagen. *Proceedings of the Voronezh State University of Engineering Technologies, 82 (3),* 50–57. doi: http://doi.org/10.20914/2310-1202-2020-3-50-57

4. Lima, R. B. de, Amaral, C. L., Minatti, J. (2020). Collagen peptides combined with type II in joint pain of the elderly. Revista *Científica Multidisciplinar Núcleo Do Conhecimento, 7,* 115–127. doi: http://doi.org/10.32749/nucleodoconhecimento.com.br/nutrition/collagen-peptides
5. Gorelikova, G. A., Mayurnikova, L. A., Stepanova, O. A. (2008). Vliyanie rastitelnykh ekstraktov na kachestvo i funktsionalnye svoystva sokosoderzhaschikh napitkov. *Pivo i napitki, 4,* 40–41.
6. *Kollagen GELITAAG Germaniya. Luchshiy v mire peptidniy gidrolizat, pitevoy.* Available at: https://mfin.com.ua/cosmo/?query
7. Antipova, L. V., Storublevtsev, S. A., Getmanova, A. A. (2018). Collagen drinks for functional nutrition. *Proceedings of the Voronezh State University of Engineering Technologies, 80 (3),* 97–103. doi: http://doi.org/10.20914/2310-1202-2018-3-97-103
8. Zyuzina, A. V., Makarova, N. V. (2009). Napitki na osnove yablochnogo soka. Izvestiya vuzov. *Pischevaya tekhnologiya, 4,* 5–7.
9. Borisenko, E. V., Alekseeva, Yu. I., Dikun, M. Yu., Klimova, S. A. (2003). Bezalkogolnye napitki na naturalnom rastitelnom syre. *Pivo i napitki, 5,* 50–52.
10. Filonova, G. L., Kovaleva, I. L., Komarkova, N. A. (2012). Pischevaya kombinatorika v tekhnologiyakh polikomponentnykh kontsentratov s ispolzovaniem rastitelnogo syrya i napitkov na ikh osnove. *Pivo i napitki, 4,* 22–25.
11. Verkhivker, Y. G., Miroshnichenko, E. M. (2018). Modern types of consumer packaging and food packaging. *Journal of biochemical Engineering & Bioprocess Technology, 3,* 52–56.

Svitlana Pavlenko, *Postgraduate Student, Department of Bioengineering and Water, Odessa National Academy of Food Technologies, Odessa, Ukraine, ORCID: https://orcid.org/0000-0002-8888-5266*

✉***Yakov Verkhivker,*** *Doctor of Technical Sciences, Professor, Department of Bioengineering and Water, Odessa National Academy of Food Technologies, Odessa, Ukraine, e-mail: yaverkhivker@gmail.com, ORCID: https://orcid.org/0000-0002-2563-4419*

Olena Myroshnichenko, *PhD, Associate Professor, Department of Bioengineering and Water, Odessa National Academy of Food Technologies, Odessa, Ukraine, ORCID: https://orcid.org/0000-0002-7376-8008*

✉*Corresponding author*