FORMATION OF CONSUMPTION PROPERTIES OF SWEET PEPPER (CAPSICUM ANNUUM L.) SAUCE

Antonina Dubinina
Department of Merchandising and Goods' Examination
Kharkiv State University of Food Technology and Trade
333 Klochkivska str., Kharkiv, Ukraine, 61051
tovaroved206@ukr.net

Tetiana Letuta
Department of Merchandising and Goods' Examination
Kharkiv State University of Food Technology and Trade
333 Klochkivska str., Kharkiv, Ukraine, 61051
tovaroved206@ukr.net

Galina Selyutina
Department of Merchandising and Goods' Examination
Kharkiv State University of Food Technology and Trade
333 Klochkivska str., Kharkiv, Ukraine, 61051
tovaroved206@ukr.net

Tetiana Shcherbakova
Department of Merchandising and Goods' Examination
Kharkiv State University of Food Technology and Trade
333 Klochkivska str., Kharkiv, Ukraine, 61051
tovaroved206@ukr.net

Vita Afanasieva
Department of Marketing and Trade Entrepreneurship
Kharkiv Trade and Economic Institute of Kyiv National Trade and Economic University
8 O. Yarosha lane, Kharkiv, Ukraine, 61045
vitaaf@ukr.net

Olha Yudicheva
Department of Commodity and commercial activities in the construction
«Kyiv National University of Construction and Architecture»
31 Povitroflotsky ave., Kyiv, Ukraine, 03037,
olga.iudicheva@gmail.com

Olena Kalashnyk
Department of entrepreneurshipandlaw
Poltava State Agrarian Academy
1/3 Skovorody str., Poltava, Ukraine, 36003
kalashnik1968@meta.ua

Antonina Samoylenko
Department of Commodity and commercial activities in the construction
Kyiv National University of Construction and Architecture
31 Povitroflotsky ave., Kyiv, Ukraine, 03037
270655@ukr.net

Abstract

The aim of the study is to form consumption properties of a green sweet pepper sauce with a balanced content of macro- and microelements. Due to the use of Xanthium strumarium and chitosan a new product has high organoleptic properties that attract a consumer and increase its competitiveness at the market.

Sweet green pepper that relates to most valuable vegetable cultures as to food value and taste was chosen as a main component of a sauce. For giving it a necessary consistence and for decreasing a time of thermal processing, there was used chitosan. According to results of the conducted studies, it was established, that among studied types of chitosan, advantages as to forming a consistence belongs to food acid-soluble chitosan with particle sizes up to 0,5 mm in amount 0,5 %.For preserving the natural green color, pepper fruits were preliminarily processed in 1 % decoction of Xanthium strumarium at temperature 75ºC during 15 min. For increasing its food value, the recipe was added with spicy-aromatic vegetable raw materials: garlic, dill, parsley, celery.

The sauce quality was formed by mathematical modeling using general criteria of optimization of organoleptic parameters. There were also determined specific criteria of optimization of the recipe composition taking into account their daily need. As a result of the conducted studies the composition of recipe components for the sauce was optimized: sweet pepper 80 %, garlic leaves – 5 %, parsley leaves,dill – 5 %, celery leaves – 5 %, salt – 1,5 %, sugar – 0,5 %, chitosan – 0,5 %.

There were studied organoleptic parameters of the developed sauce, characterized by a pleasant bright-green color, homogenous paste-like consistence, pleasant taste and smell. The used stabilizing factors allowed to get the sauce with the increased content of essential factors of nutrition. They participate in the increase of protective forces of the organism, so allow to recommend them in prophylactic, child and dietary nutrition.

Keywords: sweet pepper, chitosan, Xanthium strumarium, sauce, consumption properties.

DOI: 10.21303/2504-5695.2018.00793

© Antonina Dubinina, Tetiana Letuta, Galina Selyutina, Tetiana Shcherbakova, Vita Afanasieva, Olha Yudicheva, Olena Kalashnyk, Antonina Samoylenko

1. Introduction

The quality of nutrition, provided by consuming fruits and vegetables, is actively reviewed, because in the last decades great demographic and social changes took place, the share of sick and old people increased, life and labor conditions changed. The external environment becomes a source of polluting raw materials and food products.

The consumption market contains only few products that alongside with good organoleptic parameters, and acceptable price have also the brightly expressed treating-prophylactic effect at the expanse of their additional enrichment with vitamins, mineral substances or biologically active supplements [1].

Among vegetable plants, included in the human nutritive ration, pepper occupies one of main places, because its fruits have not only high taste, dietary and nutritive properties, but are also remarkable for the content of vitamins, mineral elements, chlorophylls, phenol compounds and other BAS. That is why sweet pepper is highly appreciated in dietary nutrition. It is recommended as a polyvitaminic product at hypertension and avitaminosis, it increases appetite and stimulates digestion [2].

It is known, that losses of nutritive substances at preparation stages of raw materials and further thermal processing essentially decrease the food value of a ready product. Main characteristics, taken into account by consumers at selecting food products, according to specialists, include color, texture, taste and smell [3, 4].

The change of the natural color of sweet pepper negatively influences not only antioxidant properties of a ready product, formed also at the expanse of chlorophylls, but a consumer's choice of one or another product [5].

But as a result of disturbing the full-value rational nutrition of the population, naturally reflected on health, a problem of developing new functional and safe food products with high organoleptic parameters that, undoubtedly, attract a consumer and generally increase their competitiveness at the market, appears urgently.

The aim of the research is to form consumption properties of the sweet pepper sauce with a balanced easily assimilated composition of macro- and micronutrients. Pepper of green varieties was used as a raw material.

2. Materials and Methods

For preparing the sauce, there were used fruits of green sweet pepper (Capsicum annuum L.) to widen the assortment of products of different colors, and also spicy-aromatic vegetable raw materials: garlic, dill, parsley, celery.

For getting a certain consistence, there was used chitosan CAS 9012-76-4 (Beijing, China (Mainland). It has unique physiological and ecological properties such as bio-compatibility, bio-destruction, physiological activity at the absence of toxicity, ability to selective binding of heavy metals, organic compounds and so on. Introduction of chitosan positively influences rheological characteristics of ready products and increases their quality at the expanse of reaching the necessary consistence. Chitosan provides the even distribution of recipe components at mixing and gives the sauce the cream-like consistence. At the same time this substance has antibacterial and antifungal properties, it is used as a potential food preservative [6, 7].

For determining the content of dry substances in sweet pepper and developed sauce, there was used the drying method [8], sugars were determined by the photocolorimetric method [9], starch, cellulose – by Bertrand method [10], organic acids by the method of titration in recalculation for apple acid [11], pectin substances – by the method, described in [10]. Mineral elements Ca, Mg were determined by the titration method, P – by the photometric methods, other ones – by the atomic-absorption method [12]. The content of vitamins B1 and B2 was determined by the fluorimetric method, vitamin C – by the method of titration by 2,6- dichlorophenolindophenol [12]. For determining the content of substances of the pigmentary complex of sweet pepper and developed sauce, the spectrophotometric method was used [13].

All experiments were repeated fivefold. The research results were statistically processed using the correlation-regression analysis. The experimental data were processed by Fisher-Student method at reliability level 0,95. The results of the experiment were processed in Microsoft Excel 2010.

2. 1. Experimental procedures

Sweet green pepper that relates to most valuable vegetable cultures as to food value and taste was chosen as a main component of a sauce.

One of main quality criteria of sauces is their consistence. A sauce is a dispersed (structured) system, where the role of a disperse medium belongs to the water solution of saccharides, organic acids, mineral and other substances. The use of chitosan in the technology is determined by functional properties and practically complete correspondence to requirements, offered to food supplements.

Based on the literary data, it was established, that the experimentally set permitted norm of chitosan is 0,5 % of a product mass. It is known, that the interaction between structure-creators and water results in their swelling and solution, accompanied by changes of values of the effective viscosity [7, 14].

There was conducted the study of the dynamics of solubility of acid-soluble low-molecular food chitosan, and chitosan succinate, used for products. The analysis of the curves of viscosity changes in the system "chitosan-water" in time, beginning from the moment of their preparation (**Fig. 1**), testifies that the solubility dynamics is unequal in different time intervals. This process may be divided in two stages, typical for hydration processes of polymers.

The first stage is characterized by the effective viscosity growth to maximal values (maximal growth at intervals of the curves), the second stage – reaching of relatively stable viscosity values by the systems. As it can be seen on the data, in first (1…2)·3600 s of the interaction between polysaccharides and water the effective viscosity of suspensions of polysaccharides grows in average by 10…20 % of the initial one depending on a chitosan type. The maximal viscosity value is observed at using food acid-soluble chitosan with the particle sizes less 0,5 mm.

The second stage of hydration is characterized by the effective viscosity decrease by 3…5 % comparing with the maximal one and stabilization of values. The duration of balanced systems creation also depends on a dispersion degree of the initial parameters. Thus, for example, the particle size of the first chitosan sample is 3–4 mm. And for reaching maximal viscosity values at the indicated dispersion degree, no less than 3–4 hours are necessary that is coordinated with the obtained data. Food acid-soluble chitosan with the particle size less 0,5 mm was used in the further studies.

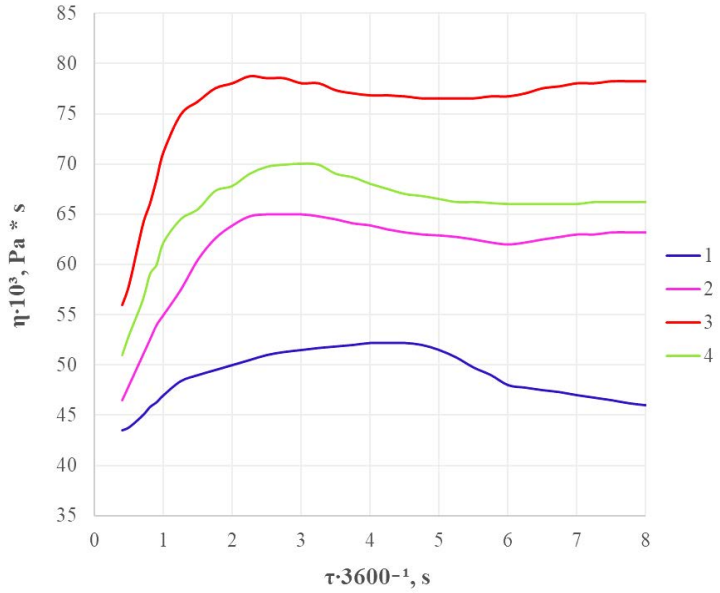

Fig. 1. Viscosity changes (η) of systems "chitosan-water" in time (τ): 1 – food acid-soluble chitosan (particle size 3–4 mm); 2 – food low-molecular chitosan (particle size 1,1–1,5 mm); 3 – food acid-soluble chitosan (particle size less 0,5 mm); 4 – chitosan succinate (sublimation drying) (particle size less 2 mm)

According to the preliminary studies, for keeping the natural green color, cleaned and comminuted fruits of sweet pepper were processed by the parameters, determined using the multifactor experiment: keeping in 1 % Xanthium strumarium decoction at temperature 75 ºC during 15min.

For raising the food value of the ready product, its recipe was added with spicy-aromatic vegetable raw materials: garlic, dill, parsley, celery. Their use allows to enrich the sauce with many healthy components, such as essential oils, ascorbic acid, mineral substances, vitamins A, B2, B6, P, PP and other.

The quality of sauces was formed by PC using general criteria of optimization of organoleptic parameters that determine their food and biological value. For this aim there were used general optimization criteria of organoleptic parameters. Among the specific criteria of optimization of the recipe composition there were selected the content of vitamins, mineral substances, cellulose, taking into account their daily need.

As a result of the conducted studies the composition of recipe components for the sauce was optimized: sweet pepper 80 %, garlic leaves – 5 %, parsley leaves,dill – 5 %, celery leaves – 5 %, salt – 1,5 %, sugar – 0,5 %, chitosan – 0,5 %.

3. Results

The experimental studies allowed to formulate correctly organoleptic parameters of the developed pepper sauce. The vegetable raw materials contain practically no components, able to bind moisture, released from cells at processing. This fact causes a necessity to use supplements, able to provide formation of the necessary consistence.

A disperse phase – particles of comminuted products – creates the "space frame" of the product by molecular connections with thin layers of the dispersion medium. Its density determines the consistence. Chitosan (0,3…0,5 %) is used for getting these characteristics to the sauce.

Having used the organoleptic method, it was determined that the pepper sauce has a weak salty taste and pleasant smell due to introduction of spicy-aromatic raw materials in it (**Table 1**).

In the process of vegetables processing there take place changes of the raw material composition, connected with a change of space orientation of cellular structures, coagulation and denaturation of protein substances. The temperature influence is connected with inactivation of enzymes, transformation processes of pigmentary complex substances, partial destruction of some vitamins and so on.

Table 1
Organoleptic quality parameters

Parameter	Sauce of sweet pepper
Outlook	Thin dispersed rubbed mass
Smell	Pleasant smell of vegetables and spicy fragrance
Color	Bright-green
Taste	Pleasant-salty with the expressed taste of sweet pepper and leaf vegetables

The conducted studied for comparing the chemical composition of the raw materials and new sauce, based on sweet pepper, demonstrated that this sauce differs by higher content of dry substances (20,39 %) comparing with the raw materials (6,59 %). It determines its consistence and food value (**Table 2**). The food value is determined by the complex of proteins, fats, carbohydrates, mineral substances, vitamins. The higher content of these substances, the higher food value of the ready product is. The protein content increase to 1,35 % was determined in the composition of the developed sauce. It is conditioned by introducing chitosan in the sauce composition. The content of pectin substances also increased to 2,43 %. The content of cellulose in the sauce is within daily need (3,96 %). The increase of food fibers positively influences treating-prophylactic properties of the sauce.

It is known, that at blanching mineral elements and vitamins partially move to the solution. The analysis of the mineral composition of the sweet pepper sauce testifies to the increase of the content of potassium, magnesium, phosphorus, iron and copper in it at the expanse of using spicy-aromatic raw materials (**Table 3**).

Table 2
Chemical composition of raw material and sweet pepper sauce

Parameters	Content, %	
	Fresh pepper (raw material)	Sweet pepper sauce
Dry substances	6,59	20,39
Proteins	0,63	1,35
Carbohydrates:	5,48	17,79
Sugars	3,30	11,20
Cellulose	1,20	3,96
Starch	0,11	0,20
Pectin substances	0,87	2,43
Organic acids	0,28	1,04
Energetic value, kcal/100 g	15,95	50,23

Table 3
Mineral composition of raw material and sweet pepper sauce, mg %

Components	Sweet pepper (raw material)	Sweet pepper sauce
Mineral elements		
Potassium	139,00	468,05
Calcium	6,37	21,50
Magnesium	12,00	38,61
Phosphorus	15,00	47,54
Iron	0,65	1,96
Copper	0,10	0,31
Vitamins		
C	126,18	184,47
B_1	0,01	0,03
B_2	0,06	0,04

The data of **Table 2** testify to the essential influence of the processing method on the vitamin composition of the sauce. It is favored by the softer thermal processing regime of pepper at the expanse of the increasing acidity. Taking into account the quantitative content of the main raw material in the sauce, there was noticed the content increase of vitamins C, B1 B2 in the product, comparing with the raw material.

The results of studying the content of chlorophylls a and b, general content of carotenoids in the studied samples testify to the high content of carotenoids and chlorophylls in the sweet pepper sauce comparing with the raw material (**Table 4**).

Table 4

Content of substances of the pigmentary complex in the raw material and sweet pepper sauce, mg %

Product name	Chlorophyll a	Chlorophyll b	Chlorophyll a+b	Carotenoids
Pepper (raw material)	2,37	1,20	3,57	2,06
Sweet pepper sauce	3,12	1,97	5,09	3,95

It is explained by the fact that the stabilization property of Xanthium strumarium decoction to chlorophyll was used in the technology of the pepper sauce, and also by the protective effect of chitosan polysugar. The content of chlorophyll b is explained by more stability at thermal processing comparing with chlorophyll a. Carotenoids, which content in the sauce was almost twice more than in the raw material, were more stable.

4. Conclusions

Based on the experimental data, there was determined the recipe composition of the paste-like products of green sweet pepper. It provides the high organoleptic parameters, given consistence and corresponds to the requirements of balance by the vitamin, mineral and carbohydrate content.

For getting the paste-like consistence and decrease of the term of thermal processing, there was used vegetable polysugar chitosan with the protective effect as to substances of the pigmentary complex. For preserving the pleasant green color, the stabilization property of Xanthium strumarium decoction was used.

There were studied organoleptic parameters of the developed sauce, characterized by the pleasant bright-green color, homogenous paste-like consistence, pleasant taste and smell.

The high food value of the new product was proved, based on the complex studies; that allows to recommend it in prophylactic, child and dietary nutrition.

Further studies will be directed on the objective estimation of the color of the new product comparing with the raw material and storage terms.

References

[1] Fabbri, A. D. T., Crosby, G. A. (2016). A review of the impact of preparation and cooking on the nutritional quality of vegetables and legumes. International Journal of Gastronomy and Food Science, 3, 2–11. doi: https://doi.org/10.1016/j.ijgfs.2015.11.001

[2] Juániz, I., Ludwig, I. A., Bresciani, L., Dall'Asta, M., Mena, P., Del Rio, D. et. al. (2016). Catabolism of raw and cooked green pepper (Capsicum annuum) (poly)phenolic compounds after simulated gastrointestinal digestion and faecal fermentation. Journal of Functional Foods, 27, 201–213. doi: https://doi.org/10.1016/j.jff.2016.09.006

[3] Azarnia, S., Boye, J. I., Warkentin, T., Malcolmson, L., Sabik, H., Bellido, A. S. (2011). Volatile flavour profile changes in selected field pea cultivars as affected by crop year and processing. Food Chemistry, 124 (1), 326–335. doi: https://doi.org/10.1016/j.foodchem.2010.06.041

[4] Lemos, M. A., Aliyu, M. M., Hungerford, G. (2015). Influence of cooking on the levels of bioactive compounds in Purple Majesty potato observed via chemical and spectroscopic means. Food Chemistry, 173, 462–467. doi: https://doi.org/10.1016/j.foodchem.2014.10.064

[5] Chuah, A. M., Lee, Y.-C., Yamaguchi, T., Takamura, H., Yin, L.-J., Matoba, T. (2008). Effect of cooking on the antioxidant properties of coloured peppers. Food Chemistry, 111 (1), 20–28. doi: https://doi.org/10.1016/j.foodchem.2008.03.022

[6] Laplante, S., Turgeon, S., Paquin, P. (2005). Effect of pH, ionic strength, and composition on emulsion stabilising properties of chitosan in a model system containing whey protein isolate. Food Hydrocolloids, 19 (4), 721–729. doi: https://doi.org/10.1016/j.foodhyd.2004.08.001

[7] Chantarasataporn, P., Tepkasikul, P., Kingcha, Y., Yoksan, R., Pichyangkura, R., Visessanguan, W., Chirachanchai, S. (2014). Water-based oligochitosan and nanowhisker chitosan as potential food preservatives for shelf-life extension of minced pork. Food Chemistry, 159, 463–470. doi: https://doi.org/10.1016/j.foodchem.2014.03.019

[8] DSTU 7804:2015. Produkty pererobliannia fruktiv ta ovochiv. Metody vyznachannia sukhykh rechovyn abo volohy (2016). Kyiv: Derzhspozhyvstandart, 19.

[9] DSTU 4954:2008. Produkty pereroblennia fruktiv ta ovochiv. Metody vyznachennia tsukri (2009). Kyiv: Derzhspozhyvstandart, 17.

[10] Kucherenko, N. E., Babenyuk, Yu. D., Vasil'ev, A. N. (1988). Biohimiya. Kyiv: Vishcha shkola, 128.

[11] DSTU 4954:2008. Produkty pereroblennia fruktiv ta ovochiv. Metody vyznachennia tytrovanoi kyslotnosti (2009). Kyiv: Derzhspozhyvstandart, 9.

[12] Andrieieva, L. V., Verbytskyi, P. I., Vishchur, O. I. et. al. (2004). Fizioloho-biokhimichni metody doslidzhen u biolohiyi, tvarynnytstvi ta veterynarniy medytsyni. Lviv: In-t biolohiyi tvaryn UAAN, 399.

[13] Ermakov, V. A. (1986). Biohimicheskie metody issledovaniya. Moscow: Nauka, 355.

[14] Synytsya, A., Blafková, P., Synytsya, A., Čopíková, J., Spěváček, J., Uher, M. (2008). Conjugation of kojic acid with chitosan. Carbohydrate Polymers, 72 (1), 21–31. doi: https://doi.org/10.1016/j.carbpol.2007.07.011