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THE USE OF TOMATO POWDER IN PRODUCTION OF MAYONNAISE

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Abstract. It has been studied how tomato powder can be used in the production of mayonnaise. The content of essential amino acids in tomato powder has been compared with the FAO/WHO norms. Fresh plum tomatoes contain 0.158g of non-essential amino acids (in terms of 100g of dry matter), which covers 4.37% of the body's requirements according to the standardised values approved by FAO/WHO. Tomato powder contains 0.14g of non-essential amino acids. The amount of essential amino acids in fresh tomatoes is 0.216g per 100g, and in powder, it is 0.181g per 100g. The amino acids that determine the intensity of sweetness have been established to amount to 0.165g in 100g of fresh tomatoes and to 0.116g in 100g of powder. So, in the course of drying, the product's taste qualities related to feeling sweetness are reduced. It has been determined that the organoleptic properties of a product can be improved by adding tomato powder in the amount 1.8–2.2% and using a blend of oils. The mayonnaise samples obtained were cream-coloured with red particles of tomato powder. The samples had a soft structure and a more uniform and viscous texture than the control sample. The microscopic method has shown the homogeneous consistency of the product obtained. It has been noted that the absence of structure-forming agents does not reduce the quality indicators and does not impair the consistency of the finished product. According to the organoleptic parameters, the dose of tomato powder has been determined, which improves the taste of mayonnaise and does not make it oversweet. The research results show the prospects of using tomato powder not only as a carotene-containing raw material, but also as a raw material with a high content of amino acids. Besides, the use of tomato powder can modify the taste of such a product as mayonnaise.

Key words: plum tomato fruit, amino acids composition, tomato powder, quality, mayonnaise.

Introduction. Formulation of the problem

The research relates to the vegetable and food concentrate industries and is important for manufacture of special purpose products.

The current state of the environment and the high level of stressful situations call for special attention to the people's nutrition. In particular, with the deteriorating environmental situation and the increasing incidence of cardiovascular disease, there is a growing interest in foods produced using natural raw materials. This leads to developing special purpose products. In different countries of the world, concepts of healthy nutrition are based on consuming organic food and manufacturing food products of enhanced biological value. Thus, the rational nutrition scheme suggested in the United Kingdom [1] includes fruit and vegetables (33%), bread, cereals, and potatoes (33%), meat, fish, and alternative productssuch as beans (12%), milk and dairy products (15%), fats and sugar (8%). Among vegetables consumed both fresh and cooked, tomatoes occupy one of the first places. Development of the technologies of manufacturing tomato products raises the demands to the tomato hybrids and varieties, to their shape, ripeness, dry matter content.

However, the amino acid composition of tomatoes still remains understudied. That is why it is so topical a task to research the amino acid composition of tomato powder used as a component of food products and its effect on the sensory characteristics of the finished product.

Analysis of recent research and publications

The content of free amino acids tomatoes is not something constant. It depends on the growing conditions [2]: lack of nitrogen and molybdenum in the soil reduces the amount of free amino acids. This accounts for the intensity of the taste of tomatoes collected on a farm.

In their works, such scientists as J. Kirimura, A. Shimizu, A. Kimizuka, T. Ninomiya, N. Katsuya [3], S. Shiffman, K. Moroch, J. Dundar [4], J. Solms [5], Ming-Ho Yu [6] and others studied the effect of the amino acid content on the sensory characteristics of tomatoes with different degrees of ripeness and of different colours.

Every amino acid has a certain functional value for a human organism [2]:

– glutamic acid takes part in the protein and carbohydrate exchange of acetylcholine and adenosine triphosphate, and in potassium ion transport;

– aspartic acid improves the collateral blood circulation, cardiovascular tone, and potentiates the action of trace elements (Fe, Cu, Zn, and others);

– methionine takes part in the synthesis of adrenalin, creatine, and other biologically important compounds, activates vitamins (ascorbic acid, folate, and others), hormones, enzymes;

– glycine improves metabolic processes in brain tissues in case of hypoxia, arrhythmia, iron-deficiency anaemia, atherosclerosis;

– histidine is used in case of hepatitis, stomach or peptic ulcer;

– cysteine is good for eye diseases, cataract, lenticular opacity.

Studies by Adel A. Kader, M. Allen Stevens et al [7], and other scientists have allowed establishing that the content of amino acids (glutamic acid, glutamine, asparagines, and alanine) depends on the ripeness of tomatoes when harvested. S. Shiffman, K. Moroch, and J. Dundar [4] show in their works that the content of alanine, asparagines, and glutamine determine the intensity of sweetness of tomatoes. Glutamic acid also effects on the acidity of a product. So, the special value in the composition of tomatoes is that of amino acids which form their taste qualities.

Most tomato products are made from highly concentrated paste. However, it does not comply with the modern requirements of nutritional science, because its formulation includes stabilisers, colourants, and flavourants [8]. Vinegar and chilli pepper added to the traditional recipe prevents tomato products from being used in child and prophylactic nutrition. That is why creating natural products, which, if consumed regularly, can regulate the body's functioning is an important task.

The latest studies by scientists throughout the world prove the advantages of consuming tomato products, which are functional due to lycopene [9-11]. In particular, it relates to canned, salted, and concentrated tomato products, which have already become traditional in the everyday diet. However, less common tomato products are becoming popular, too – those dried to their equilibrium moisture content and moisture limit [12]. These dried products will solve the problem of processing off-sized tomatoes and make it possible to expand the range of domestic food.

It is known that compounds a product contains, which are responsible for its functionality, change during drying. In particular, the substances that concentrate in the products of processing tomatoes include ß-tocopherol, ß-carotene (in ketchups), phytofluene (in juices, boiled tomatoes, and ketchups), lycopene and phytoene (in juices, sauces, and ketchups). This is because when tomatoes are heated, the lycopene formula changes from the trans into a cis form. The latter is digested more quickly and easily [12,13] and is healthier, especially for people with cardiovascular disease [14,15,19-22]. Besides, tomato powder is high in amino acids, which can be used to enhance the taste of mayonnaise [16,17]. In scientific literature, no information is found on a possible change in the amino acid composition of plum tomatoes after drying, that is why we find it necessary to study this issue.

The purpose of the research is studying the amino acid composition of fresh and dried tomato fruits and considering possible applications of tomato powder in the production of mayonnaise.

The research objectives:

- to quantify the amino acid composition of red plum tomato fruit;
- to recommend how to use tomato powder as a source of amino acids in manufacture of special-purpose mayonnaise.

Research materials and methods

The plum tomatoes used were of the cultivar Popilna grown in the zone of insufficient irrigation in the experimental fields of the Institute of Horticulture of the National Academy of Agrarian Sciences. The plot is located near the village of Borki, Kiev Region, Ukraine. The plum tomatoes were washed, cut into 5×5×5 mm dice, and dried in a TSU type convection dryer in the Institute of Engineering Thermophysics (Ukraine National Academy of Sciences). The dryer's technical description is as follows: heat consumption 500–600kkal/kg evaporated moisture, productivity 2.5kg/h by evaporated moisture, and the power was set as 1kV.

The parameters of the drying mode: the temperature of the heat carrier (air) at the beginning of drying was 100°C, after 15min of drying, the temperature was lowered to 60°C, the heat carrier rate 2.5m/s, the moisture content 10g/kg dry air, the layer thickness

15mm. The dried tomato fruit obtained had 7.2% of dry matter. They were powdered in a ball mill into particles smaller than 2mm. The dry matter content of the tomatoes was determined according to DSTU ISO 2173:2007 "Products from fruit and vegetables. Determination of soluble dry substances by refractometry (ISO 2173:2003, IDT)". The free amino acids were determined by the generally accepted method [20-22] with certain changes in the fresh fruit and in the tomato powder. This change consisted in the following.

The fresh fruit were crushed into mush. 4.0g of the sample tested (mushed tomato fruit or tomato powder) was placed into a test tube, and 1 ml of 6N muriatic acid was added. Then the test tube was sealed with argon. The sample was hydrolysed at 110°C in a thermostat during 24 hours. The extract was dried till obtaining dry solids, which were diluted with buffer solution (pH 2.2). Then it was diluted with distilled water by 2.5 times. To remove soluble protein, 1 volume part of 10% sulphosalicylic acid (SSA) was added to 4 parts of the hydrolysate and kept for 30 minutes in a cold place. The destructive protein was separated by centrifuging, and the purified sample was analysed.

Chromatograms of free amino acids were obtained by the multispectrum 4.1, and by the peak areas, the free amino acid content was calculated. Ti identify amino acid, standard amino acid samples were used.

The mayonnaise samples were prepared without adding tomato powder (control) and with different quantities of tomato powder (0.2 to 2.6%) added in three replications. To improve the taste of the mayonnaise a blend of oils was added (sunflower refined and maize unrefined). The mayonnaise samples were made as follows. Purified water (up to 10%) with the temperature 60–80°C, table salt (1.4%), sugar (1.3%), and mustard preliminarily steamed in water (7.5%) were placed into a container and stirred for 10 min at 60–80°C. Then the pasteurisation temperature was raised to 90–100°C, and the mixture was stirred for another 20 minutes. Then the temperature was lowered to 60–65°C, and eggs (without shells, 25.5%) or egg powder and tomato powder were added. The mixture was stirred at this temperature for amother 20–25 minutes. The product was cooled down to the temperature 20–25°C. Into the basic mixture thus prepared, the oil blend (55.6% of de-odorised refined sunflower oil and 5.6% of unrefined maize oil) was slowly poured in, the mixture being constantly stirred. Thus mayonnaise samples with different tomato powder contents were obtained.

The photomicrographs of the samples were taken with an electronic microscope URL2 of the type Color CMOS Sensor (1600×1200; 800×600).

Results of the research and their discussion

The amino acid composition of fresh tomatoes and its changes after their drying have been studied. The chromatograms obtained have allowed identifying the presence of 16 free amino acid in the tomato fruit. By the mean value of the three replications and by all the peak areas, the quantitative and qualitative composition of amino acids has been calculated (Table 1).

Table 1 – Qualitative and quantitative composition of amino acids contained in plum tomato fruit (crushed fresh and dried), g/100g of the dry matter

No	Acid	FAO/WHO [18]	Contents in	
			fresh	dried
1	Aspartic acid	–	0.053	0.046
2	Threonine	0.34	0.019	0.001
3	Serine	–	0.016	0.016
4	Glutamic acid	–	0.097	0.068
5	Proline	–	0.016	0.018
6	Glycine	–	0.012	0.016
7	Alanine	–	0.015	0.002
8	Valine	0.35	0.013	0.016
9	Methionine	0.25	0.004	0.003
10	Isoleucine	0.28	0.015	0.019
11	Leucine	0.66	0.022	0.025
12	Tyrosine	–	0.007	0.015
13	Phenylalanine	0.63	0.023	0.023
14	Histidine	0.18	0.019	0.014
15	Lyzine	0.58	0.022	0.023
16	Arginine	0.35	0.021	0.016
	Total	3.62	0.374	0.321

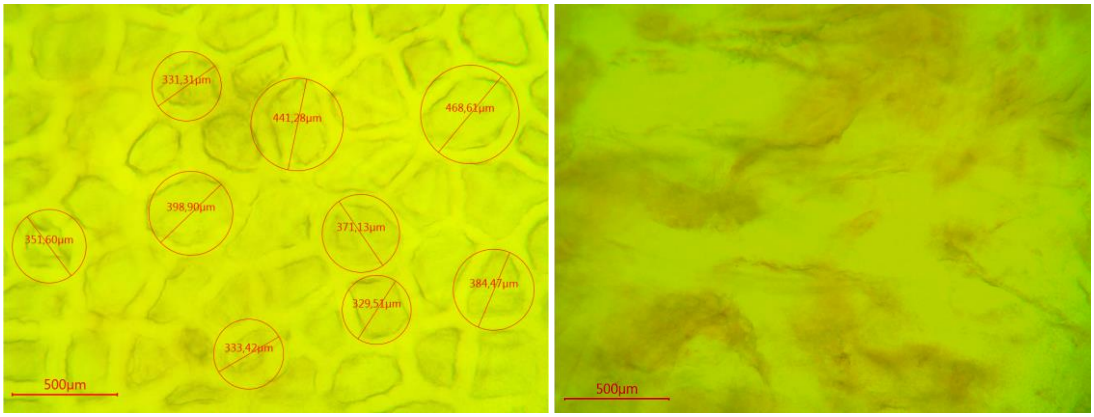
The fresh plum tomato fruit contain 0.158g of non-essential amino acids in 100 g d. m., which makes 4.37% of the body's requirement according to the official FAO/WHO standards. In the tomato powder, this parameter is 0.14g in 100g. The total essential amino acids make 0.216g in 100g of fresh tomato fruit, and 0.181g in 100g of powder. It has been noted that the sum of amino acids (alanine, aspartic acid, and glutamic acid) determining the intensity of sweetness is 0.165g in 100g oft fresh tomatoes and 0.116g in 100g of powder. Thus, drying results in a partial loss of amino acids and the taste qualities of the product deteriorates (sweetness is reduced). The mayonnaise samples obtained were cream-coloured with red particles of tomato powder. The samples had a soft structure and a more uniform and viscous texture than the control sample.

The absence of structure-forming agents does not reduce the quality indicators and does not worsen the consistency of the finished product [17]. According to the organoleptic parameters, the dose of tomato powder has been determined (1.8–2.2%), which improves the taste of mayonnaise

The analysis of the sensory qualities of the product depending on the added amount of tomato powder is presented in Table 2. According to studies by foreign researchers, the taste qualities depend on the sum of amino acids (glutamic acid, alanine, aspartic acid) and form the demand for a product. It has been established that the optimum amount of the powder added is 1.8–2.2%. With this quantity, the product's structure and consistency are not destroyed, and a pleasant taste is sensed.

Table 2 – Effect of the tomato powder on the taste qualities of mayonnaise

Sample	Amount of tomato powder, %	Conclusion
1	–	The product has a pleasant tender taste, bright yellow colour, soft structure, and homogeneous viscous consistency.
2	0.2	The product has a pleasant tender taste, a slight sourish tone is felt. Has a bright yellow colour with inclusions of tomato powder, soft structure, and homogeneous viscous consistency.
3	0.6	The product has a pleasant tender taste, a slight sourish tone is felt. Has a bright yellow colour with inclusions of tomato powder, soft structure and homogeneous viscous consistency. The emulsion stability is 98%.
5	1.0	The product has a pleasant tender taste, a slight sourish tone is felt. Has a light yellow-orange tint with inclusions of tomato powder, soft structure, and homogeneous viscous consistency. The emulsion stability is 98%.
6	1.4	
7	1.8	The product has a pleasant tender taste, a slight off-tone is felt. Has a yellow-orange colour with inclusions of tomato powder, soft structure, and homogeneous, more viscous consistency. The emulsion stability is 98%.
8	2.2	The product has a pleasant tender taste, a slight pleasant taste of tomatoes is felt. Has an intense yellow-orange colour with inclusions of tomato powder, soft structure, and homogeneous consistency. The emulsion stability is 98%.
9	2.6	The product has a tender taste with an off-tone characteristic of tomatoes, an intense yellow-orange colour with inclusions of tomato powder, soft structure, and homogeneous consistency. The emulsion stability is 98%.



а *б*

Fig. 1. Photomicrographs of the mayonnaise samples: a – fat globules; b – fat emulsion with tomato powder

The photomicrographs of 67% fat emulsion of mayonnaise (Fig. 1a) show the homogeneity and dense consistency of the product obtained (control) and evenly distributed tomato powder added to the mayonnaise emulsion (Fig. 1b, sample 8). During homogenisation, tomato powder is evenly distributed about the product's volume of which causes destruction of fatty globules.

Conclusion

The amino acid composition of fresh and dried plum tomato fruit has been studied. It has been found that fresh plum tomatoes contain 0.158g of non-essential amino acids, which covers 4.37% of the body's requirements according to the standardised values approved by FAO/WHO. 0.14g of non-essential amino acids is contained in 100g of tomato powder. The total of essential amino acids in fresh tomatoes is 0.216g per 100g, and in powder, it is 0.181g per 100g. The amino acids that determine the intensity of sweetness have been established to amount to 0.165g in 100g of fresh tomatoes and to 0.116g in 100g of powder. So, in the course of drying, the product loses its sweetness. It has been determined that the optimum amount of powder added is 1.8–2.2%. This quantity strengthens the taste qualities of the product and makes it sweeter.

It has been shown that tomatoes can be a promising raw material not only due to their lycopene content, but also as raw material containing essential amino acids. Besides, using tomato powder allows forming the taste qualities of such a product as mayonnaise. It will allow increasing the range of fat-and-oil products and creating a line of natural mayonnaises with a high nutritional value, which is a promising direction of industrial development and improvement of people's health nationwide.

References:

1. Furuta S, Nishiba Y, Suda I. Fluorometric assay for sereening antioxidative activity of vegetables. Journal Food Sci. 1997;62(3):526-528. https://doi.org/10.1111/j.1365-2621.1997.tb04422.x
2. Izmajlov S. Azotnyj obmen v rasteniyah. Moskow: Nauka; 1986.
3. Kirimura J, Shimizu A, Kimizuka A, Nikomiya, Katsuya N. The contribution of peptides and amino acids to the taste of foodstuffs. Journal Agr. Food Chem 1969;17(4):689-695. https://doi.org/10.1021/jf60164a031
4. Stevens MA, Adel AK, Albright-Holton M, Algaze M. Genotypic variation for flavor and composition in fresh market tomatoes. Journal Amer. Soc. Hort. Sci. 1977;102(5):680-689.
5. Solms J. The taste of amino acids, peptides, and proteins. Journal Agr. Food Chem. 1969;17(4):686-688. https://doi.org/10.1021/jf60164a016
6. Ming-Ho Yu. Amino acids as Precursors of Volatile Components in Tomato Fruit [dissertation]. Utan State University. Logan, Utan; 1967. Available from: https://digitalcommons.usu.edu/etd/4992.
7. Shiffman S, Moroch K, Dundar J. Taste of acelylated amino acids. JournalChem Senses Flavor, 1975;1(4): 387-401. https://doi.org/10.1093/chemse/1.4.387.
8. Gavrish SF, Galkina SN. Tomat: obrobka ta pererobka produkciї. Journal Produkti harchuvannya. 2005;5:15-18.
9. Campbell JK, Canene-Adams K, Lindshield BL, Boileau TWM, Clinton SK. Tomato phytochemicals and prostate cancer risk. Journal of nutrition. 2004;134(12):3486S-3492S. https://doi.org/10.1093/jn/134.12.3486S.
10. Kim L, Rao V, Rao L. Effects of lycopene on prostate LNCaP cancer cells in culture. Journal Med Food 2002;5(4):181-187. https://doi.org/10.1089/109662002763003320.
11. Muratore G, Licciardello F, Maccarone EJ. Evaluation of the chemical quality of a new type of small-sized tomato cultivar, the plum tomato (*Lycopercicon licopersicum*). It Journal Food Sci. 2005;17(1):75-81.
12. Jang SH, Lim JW, Kim H. Mechanism of beta-caroteneinduced apoptosis of gastric cancer cells: involvement of ataxia-telangiectasia-mutated. Journal Ann NY Acad Sci 2009;1171(1):156-162. https://doi.org/10.1111/j.1749-6632.2009.04711.x.
13. Tonucci LH, Holden JM, Beecher GR, Khachik F, Davis CS, Mulokozi G. Carotenoid content of thermally processed tomato-based food products. Journal Agric. Food Chem. 1995;43(3):579-586. https://doi.org/10.1021/jf00051a005
14. Kotake-Nara E, Kushiro M, Zhang H, Sugawara T, Miyashita K, Nagao A. Carotenoids affect proliferation of human prostate cancer cells. J Nutr. 2001;131(12):3303-3306. https://doi.org/10.1093/jn/131.12.3303
15. Gloria N, Soares N, Brand C, Oliveira F, Borojevic R, Teodoro A. Lycopene and Beta-carotene Induce Cell-Cycle Arrest and Apoptosis in Human Breast Cancer Cell Lines. Anticancer Research 2014;34(3):1377-1386.
16. Kuznecova IV, YArmolyuk MA. Perspektivni napryami pererobki plodiv tomativ. Journal Prodovol'chi resursi. 2017;9:215-221.
17. Homichak LM, Kuznecova IV, Petrova ZHO, Shejko TV, Yarmolyuk MA. Innovacijni tekhnologiї karatinovmisnih harchovih produktiv. Strategiya kachestva v promyshlennosti i obrazovanii: XIV Mezhdunar. konferenciya 2018;Varna, Bolgariya. 4-7 iyunya. Varna, Bolgariya; 2018. p.130-134.
18. USDA Nutrient Data Bank numbers: raw tomatoes, 11529; catsup, 11935; tomato juice, 11540; tomato sauce, 11549; tomato soup, 06359. 2004. Available from: http://www.nal.usda.gov/ [accessed June 2004].
19. Guttenplan JB, Chen M, Kosinska W, Thompson S, Zhao Z, Cohen LA. Effects of a lycopene-rich diet on spontaneous and benzo(a)pyrene-induced mutagenesis in prostate, colon and lungs of the lacZ mouse. Cancer Lett 2001;164(1):1-6. https://doi.org/10.1016/S0304-3835(00)00705-9.
20. Mukherjee B, Ghosh MK, Hossain CM. Anticancer potential of vitamin A and beta-carotene: mechanistic approach. NSHM. J Pharm Healthcare Manag 2011;2(2):1-12. https://doi.org/10.1016/S0304-3835(00)00705-9
21. Pleshkova BP. Praktikum po biohimii rastenij. Moskow: Nauka. 1986.
22. Abou-Arab AE, Abou-Arab AA, Abou-Salem MF. Phisico-chemical assessment of natural sweetenerns steviosides produced from Stevia rebaudiana bertroni plant A. J of Food Science. 2010;4(5):269-281. https://doi.org/10.5897/AJFS.9000226.

ВИКОРИСТАННЯ ТОМАТНОГО ПОРОШКУ У ВИРОБНИЦТВІ МАЙОНЕЗУ

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Анотація. Досліджено можливість використання томатного порошку при виробництві майонезу. Здійснено порівняння вмісту незамінних амінокислот у порошку томатному та нормами, встановленими FAO/WHO. Свіжі плоди томатів-сливок містять 0,158г замінних амінокислот (у перерахунку на 100 г сухих речовин), що складає 4,37% від потреби організму згідно із затвердженими нормованими показниками FAO/WHO. У той же час, порошок томатний містить 0,14г замінних амінокислот. Сума незамінних амінокислот у плодах томатів свіжих складає 0,216г/100 г, у порошку – 0,181г/100г. За зміною амінокислот, що впливають на інтенсивність солодкості відмічено, що в свіжих томатах їхній вміст становить 0.6г та порошку – 0,116г. За сумою амінокислот, що впливають на інтенсивність солодкості відмічено, що в свіжих томатах їхній вміст становить 0,165г та в порошку – 0,116г. Отже, за сушіння послаблюються смакові якості продукту в напрямі відчуття солодкості. Визначено, що покращення органолептичних властивостей продукту досягається внесенням порошку томатного у кількості 1,8–2,2% та застосуванням купажу олій. Отримані зразки майонезу мали кремовий колір з червоними часточками томатного порошку. Водночас зразки мали м'яку структуру та однорідну більш в'язку консистенцію, ніж контрольний зразок. Мікроскопічними методом показано однорідність консистенції отриманого продукту. Відмічено, що відсутність структуроутворювачів не знижує

якісні показники і не погіршує консистенцію готового продукту. За органолептичними показниками визначено дозування томатного порошку, що покращує смакові якості майонезу і не надає приторний присмак. Отримані результати досліджень показують перспективність використання томатного порошку не тільки як каротиновмісної сировини але й як сировини з високим вмістом амінокислот. Крім того, застосування порошку томатного дозволяє формувати смакові якості такого продукту як майонез.

Ключові слова: плоди томатів-сливка, амінокислотний склад, порошок томатний, якість, майонез.

Список літератури:

1. Furuta S., Nishiba Y., Suda J. Fluorometric assay for sereening antioxidative activity of vegetables // J. Food Sci. 1997. Vol. 62, № 3. P. 526-528. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1365-2621.1997.tb04422.x.
2. Измайлов С.Ф. Азотный обмен в растениях: монография. Москва: Наука, 1986. 370 с.
3. The contribution of peptides and amino acids to the taste of foodstuffs / Kirimura J. et al // J. Agr. Food Chem. 1969. Vol. 17, Issue 4. P. 689-695. https://doi.org/10.1021/jf60164a031.
4. Genotypic variation for flavor and composition in fresh market tomatoes / Stevens M.A. et al // J. Amer. Soc. Hort. Sci. 1977. Vol.102,Issue 5. P. 680 689.
5. Solms J. The taste of amino acids, peptides, and proteins // J. Agr. Food Chem. 1969. Vol. 17, Issue 4. P. 686-688. https://doi.org/10.1021/jf60164a016 .
6. Ming-Ho Yu. Amino acids as Precursors of Volatile Components in Tomato Fruit: Graduate Theses and Dissertations. Utan State University. Logan, Utan, 1967. 128 P. URL: https://digitalcommons.usu.edu/etd/4992 (viewed 22.02.2020).
7. Shiffman S., Moroch K., Dundar J. Taste of acelylated amino acids. J. Chem Senses Flavor, 1975. Vol. 1, Issue 4. P. 387-401. https://doi.org/10.1093/chemse/1.4.387.
8. Гавриш С.Ф., Галкина С.Н. Томат: обробка та переробка продукції. Продукти харчування. 2005. №5. С. 15–18.
9. Tomato phytochemicals and prostate cancer risk / Campbell J.K. et al // Journal of nutrition. 2004. Vol. 134, Issue 12. P. 3486S-3492S. https://doi.org/10.1093/jn/134.12.3486S.
10. Kim L., Rao V., Rao L. Effects of lycopene on prostate LNCaP cancer cells in culture. J Med Food, 2002. Vol. 5(4). P. 181-187. https://doi.org/10.1089/109662002763003320.
11. Muratore G., Licciardello F., Maccarone E. J. Evaluation of the chemical quality of a new type of small-sized tomato cultivar, the plum tomato (*Lycopercicon licopersicum*) // It Jour Food Sci. 2005. Vol. 17, Is. 1. P. 75-81.
12. Jang S.H., Lim J.W., Kim H. Mechanism of beta-caroteneinduced apoptosis of gastric cancer cells: involvement of ataxia-telangiectasia-mutated. Ann NY Acad Sci. 2009. Vol. 1171. P. 156-162. https://doi.org/10.1111/j.1749-6632.2009.04711.x.
13. Carotenoid content of thermally processed tomato-based food products / Tonucci L.H.et al // J. Agric. Food Chem. 1995. Vol. 43(3). P. 579-586. https://doi.org/10.1021/jf00051a005.
14. Carotenoids affect proliferation of human prostate cancer cell / Kotake-Nara E., et al // J Nutr, 2001. Vol. 131 (12). P. 3303-3306. URL: https://doi.org/10.1093/jn/131.12.3303
15. Lycopene and Beta-carotene Induce Cell-Cycle Arrest and Apoptosis in Human Breast Cancer Cell Lines / Gloria N // Anticancer Research. 2014. Vol. 34, is.3-. P. 1377-1386.
16. Кузнєцова І.В., Ярмолюк М.А. Перспективні напрями переробки плодів томатів // Продовольчі ресурси. 2017. № 9. С. 215-221.
17. Інноваційні технології каратиновмісних харчових продуктів / Хомічак Л.М. та ін. // Стратегия качества в промышленности и образовании: материалы XIV междунар. конфер.Варна, Болгария, 4-7 июня. 2018 р. Болгарія: Варна, 2018. С. 130-134.
18. USDA. Nutrient Data Bank numbers: raw tomatoes, 11529; catsup, 11935; tomato juice, 11540; tomato sauce, 11549; tomato soup, 06359. - URL: http://www.nal.usda.gov. Google Scholar.
19. Effects of a lycopene-rich diet on spontaneous and benzo(a)pyrene-induced mutagenesis in prostate, colon and lungs of the lacZ mouse / Guttenplan J.B., et.al // Cancer Letters, 2001. Vol. 164(1): P. 1-6. https://doi.org/10.1016/S0304-3835(00)00705-9.
20. Mukherjee B., Ghosh M.K., Hossain C.M. Anticancer potential of vitamin A and beta-carotene: mechanistic approach // J Pharm Healthcare Manag. 2011. Vol. 2(2). P. 1-12. https://doi.org/10.1016/S0304-3835(00)00705-9
21. Плєшкова Б.П. Практикум по биохимии растений: уч. Пособие. Москва. 1986. 173 с.
22. Abou-Arab A.E., Abou-Arab A.A., Abou-Salem M.F. Phisico-chemical assessment of natural sweetenerns steviosides produced from Stevia rebaudiana bertroni plant // J. of Food Science. 2010. Vol. 4(5). P. 269-281. https://doi.org/10.5897/AJFS.9000226.