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ANTIOXIDANT NUTRITIONAL QUALITY AND THE EFFECT OF THERMAL TREATMENTS ON SELECTED PROCESSING TOMATO LINES

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ABSTRACT

The aim of this study was to choose the genotypes of industrial tomato for the content of bioactive components (ascorbic acid, β-carotene, lycopene, total phenols and flavonoids) in fruits and its preservation during thermal treatment (by drying with parallel warm air at 60°C) and making of tomato juice (by pasteurization – cooking at 100°C for 7 minutes). For this research, a comparative trial has been set up with 7 genotypes, 1 commercial variety (SP-109) and 6 selected lines (SPP, SPSM, SPRZ, SPRM-20, S-60 and SPO) of high inbreeding generations. Experimental design has been done according to standard method of growing industrial tomato in random block system with three replications. By analysing the cumulative results of all researched genotypes for processing industry, the best for drying and fresh consumption was SPRZ and for juice extraction, SPSM was the best line.

Key words: vitamin C, β-carotene, lycopene, phenols, flavonoids, drying, pasteurization, genotype selection

INTRODUCTION

Tomato is the most popular vegetable crop in the world with total production about 1.26 millions of metric tons per year including China and the USA as a leading producers [www.faostat.org]. Tomato (*Lycopersicon esculentum* Mill.) is a vegetable that can be used in many ways – fresh as a salad, proceeded, dried or as salsa, pasta dressings, sauces, soups and juices. Dishes with tomato are inbuilt in traditional food prepare and are involved in culture of many people. There is a great number of tomato varieties for different purposes which explains the global usage in preparation of many dishes [Beckles 2012]. Tomato fruits can be use in wide range. Industrial processing usually includes thermal proceeding and/or homogenization and both ways of processing disrupt the cell matrix of tomato fruit [Van het Hof et al. 2000a, b]. The range of "remembering" of cell matrix determines the bio-availability of different nutrients. Tomato fruits are a part of the human diet and an important source of substances with positive effects to health, including vitamins, minerals and antioxidants [Frusciante et al. 2007]. Ascorbic acid (vitamin C) plays important role in the human diet and it is in positive correlation with decreased risk of

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different illnesses [Schlueter and Johnston 2011]. It also has a fundamental importance in plants with antioxidant impact against wide range of biotic and abiotic stresses [Gallie 2013]. The content of the ascorbic acid in tomato fruit goes from 10 to 88 mg/100 g of fresh weight (FW). This range is the effect of the tomato breeding and the growing method significantly influences the content of ascorbic acid [Locato et al. 2013]. It is well known that the vitamin C belongs to the group of thermo-labile compound and its degradation starts at 70°C. Significant losses can also happen during processing, partly due to oxidation and partly due to high temperatures during cooking [Davey et al. 2000]. Cold treatment and low temperature have a better effect to preservation of vitamin C. All this should be considered when processing tomato, having in mind that the increase of nutritive quality of tomato includes the high level of ascorbic acid [Ruggieri et al. 2016].

Carotenoids are wide group of bio-active components and represent the pigments soluble in oil, so they belong to most important micro-nutrients in human diet. Yellow-orange fruits are especially rich in carotenoids. There are different literature sources that say that different biosynthesis of carotenoids and its accumulation in plants depends on genetic and ecological factors. Carotenoids have more important role in biological activities in human body. The most studied and explained is the nutritive role of carotenoids through activity of provitamin A [Maiani et al. 2009]. Carotenoids have potentially important role in human health acting as a biological antioxidant. Lycopene is a carotenoid which gives a red colour to the tomato and is especially efficient of quenching destructive potential of singlet oxygen [Di Mascio et al. 1989]. Out of more than 700 natural carotenoids identified by now, 50 are present in human diet and can be absorbed and metabolized in human body [Khachik et al. 1997]; however, only six of them (β-carotene, β-cryptoxanthin, α-carotene, lycopene, lutein and zeaxanthin) represent more than 95% of total carotenoid of the blood [Maiani et al. 2009]. During processing, biological value of carotenoid content in products can be improved, which potentially depends from technology of fruit processing. When drying with the hot air of whole or cut tomato fruits, generally, temperatures should not exceed 80°C. Among the bioactive parts present in tomato, carotenoid and lycopene content represent a factor than can be used for the increase of commercial value of tomato fruits [Frusciante et al. 2007].

Tomato contains phenolic compounds with strong antioxidative activity [Raiola et al. 2014]. Over 8000 of phenolic compounds have been identified in plant material [Luthria et al. 2006]. Phenolics are ubiquitous secondary metabolites in plants. According to the number of phenolic subunit in contemporary classification there are two basic phenol groups: single phenols and polyphenols [Marinova et al. 2005]. Polyphenol compounds are connected to therapeutic mechanisms during illness, including: inflammations, cardiovascular diseases, obesity and type II diabetes, neurodegenerative diseases, cancer and aging [Raiola et al. 2014]. Tomato polyphenol, mostly phenol acids are present in free solutions or undiluted, attached to fiber [Frusciante et al. 2007]. Quantity and composition of phenol compound in fruits depend on genotype, conditions of storage [Asami et al. 2003], extraction process [Mukhopadhyay et al. 2006] and external conditions [Luthria et al. 2006]. Besides that, tomato contains flavonoids rutin (glycoside containing flavonol quercetin and the disaccharide rutinose) and naringenin. These are the promoters of the carbohydrate metabolism and the modulator of immune system. Flavonoids are the largest group of the natural phenols in tomato and contribute to aroma, smell and the colour [D'Introno et al. 2009]. Many authors emphasize the role of the tomato flavonoids, due to its high antioxidative power and significant biological activities, as well as the possibility to have important role in health benefit [Bourne and Rice-Evans 1998, Frusciante et al. 2007].

The aim of this study was to estimate the effect of the thermal treatment (high temperatures – cooking and low temperatures – drying) on nutritive quality of different selected genotypes of industrial tomato, through comparative analysis of total content of vitamin C, β-carotene, lycopene, phenols and flavonoids in fresh and dried fruits and in tomato juice. Genotypes with the highest level of bioactive components will be used for further selection in order to improve quality of processed tomato.

MATERIAL AND METHOD

Comparative trial with 7 genotypes, one commercial variety (SP-109) and 6 selected lines (SPP, SPSM, SPRZ, SPRM-20, S-60 and SPO) and high generations of inbreeding was set up in a random block system with three replications according to standard method of growing industrial tomato. The clear lines originate from different industrial tomato selection programs. Mature fruits were picked at the stage of full color of the fruits (45 days from fertilization).

The level of lycopene, vitamin C, β-carotene, phenols and flavonoids in the fresh and dried fruits (drying with parallel hot air at 60°C, in driers of Cer, RS type) and in tomato juice (pasteurisation at 100°C, for 7 minutes) was studied.

Determination of vitamin C (ascorbic acid – method by Tillmans)

By pressing tomato 100 cm^3 of pale tomato juice was obtained. The juice was than homogenized and mixed with equal quantity of 100 cm^3 solution of mixture of HPO_3 and glacial acid CH_3COOH (15 g HPO_3 in 40 cm^3 CH_3COOH and 200 cm^3 H_2O). Then, the mixture was filtrated through creased filter paper. The first 5–10 cm^3 filtrated mixture was thrown away and the aliquot part was taken from the rest of the mixture for the further investigation. If necessary, the researched sample was diluted with cooked, cooled distilled water, so the aliquot part contains about 2 mg of ascorbic acid. Process of determining ascorbic acid in the sample: 10 cm^{-3} of filtrated sample (containing 5 cm^3 of juice and 5 cm^3 HPO_3 and glacial acid CH_3COOH) was applied to three Erlenmeyer dishes using pipette. Each sample was titrated with Tilmans reagent (TR) solution until pale pink, for about 5 seconds. At the same time, solution of TR was titrated and blind tested until pale pink [Cvijović and Aćamović 2005].

$$\text{The content of ascorbic acid (mg}\cdot 100\ cm^{-3}) = \frac{(V - V1)\times T \times 100}{g}$$

V – cm^3 of TR solution used for titration in trial testing,
V1 – cm^3 of TR solution used in blind testing,
T – titer solution TR (mg $C_6H_8O_6 \cdot 1\ cm^{-3}$ TR solution),
g – juice volume in cm^3 in aliquot part of sample.

Lycopene content

For determining lycopene content 20 g of tomato was taken and extracted in 100 cm^3 96% C_2H_5OH. After 24 h of extraction (maceration), the sample was filtrated. The extract was evaporated to dryness. The dry extract was dissolved in 10 cm^3 of mixture of acetone-hexane (ratio 4 : 6) and filtrated on Whatman No. 4 paper. The obtained extract was dissolved 10 times and the absorbance was measured on wavelength 453, 505, 645 and 663 nm [Nagata and Yamashita 1992]. Spectrophotometric measurements of samples have been performed by using UV-VIS spectrophotometer MA9523-SPEKOL 211 (Iskra, Horjul, Slovenia). The content of lycopene (mg lycopene/ 100 cm^3 of extract) was calculated according to the equation:

$$\text{Lycopene} = -0.0458 \times A663 + 0.204 \times A645 + 0.372 \times A505 - 0.0806 \times A453$$

β-carotene content

β-carotene was determined according to the method of [Nagata and Yamashita 1992]. The dried ethanol extract (100 mg) was vigorously shaken with 10 cm^3 of acetone-hexane mixture (4 : 6) for 1 min and filtered through Whatman No. 4 filter paper. The absorbance of the filtrate was measured at 453, 505, 645 and 663 nm. β-carotene content was calculated according to the following equation:

$$\beta\text{-carotene (mg}\cdot 100\ cm^{-3}\text{ of extract)} = 0.216A_{663} - 1.22A_{645} - 0.304A_{505} + 0.452A_{453}$$

Total phenols content

Total phenols in the tomato ethanol extracts were estimated according to the Folin–Ciocalteu method [Singleton et al 1999]. The extract was diluted to the concentration of 1 mg·100 cm^{-3}, and aliquots of 0.5 cm^3 were mixed with 2.5 cm^3 of Folin–Ciocalteu reagent (previously diluted 10-fold with distilled water) and 2 cm^3 of $NaHCO_3$ (7.5%). Aliquots were left for 15 minutes at 45°C, and then the absorbance was measured at 765 nm with a spectrophotometer against a blank sample. Gallic acid (GA) was used to calculate the standard curve. The assays were carried out in triplicate; the results

were the mean values ± standard deviations and expressed as mg of gallic acid equivalents per gram of dry extract (mg of GA·g^{-1}).

Total flavonoids content

The aluminium chloride colorimetric method Brighente et al. [2007] was used to measure the flavonoids content of the tomato extracts. Two percent aluminium chloride (0.5 cm^3) in methanol was mixed with the same volume of methanol solution of plant extract. After 1 hour-incubation at room temperature, the absorbance of the mixtures was measured at 415 nm using UV/VIS spectrophotometer. Rutin was used as standard for the calibration curve. Estimation of the total flavonoids was carried out in triplicate. The results were mean values ± standard deviations and expressed as rutin equivalents (mg of RU·g^{-1} of dry extract).

Data analysis

Genotype differences have been determinate according to ANOVA model for random block system, and the significant difference was expressed by LSD test. Differences among level of bioactive components in fresh fruits and products, ratio fresh (FW) : dried (D), fresh (FW) : juice (J) and dried (D) : juice (J) have been shown according to significant differences according to Tukey's test.

RESULTS AND DISCUSSION

Ascorbic acid (vitamin C)

In analysed genotypes of industrial tomato in this research the content of ascorbic acid was from 5.71 (genotype SPP) to 10.86 (genotype SPO) mg·100 g^{-1} FW. There was a statistically significant difference (LSD test, $P < 0.001$) among them (tab. 1). Frusciante et al. [2007] reported vitamin C content between 8.0 and 16.3 mg·100 g^{-1} FW. Results in this research were in accordance with the results of Frusciante et al. [2007], Zdravković et al. [2012], García-Valverde et al. [2013], Ganeva and Pevicharova [2015].

Thermal treatment significantly decreases the vitamin C content. Statistical analysis and Tukey's test proved statistically significant difference ($p < 0.001$) in vitamin C content among fresh and dried fruits and fresh juice. Among dried tomato and juice, no significant differences have been found regarding vitamin C content is generally accepted that contains vitamin C essentially depends on the thermal treatment, while it is mostly present in fresh tomato fruits [Dewanto et al. 2002, Chang et al. 2006, George et al. 2011]. The degree of loss of ascorbic acid is closely correlated to the drying temperature used for the production of the end product [Capanoglu et al. 2010]. However, processing at low temperatures can preserve vitamin C with minimal losses [Norshahida et al. 2011].

Table 1. Vitamin C (mg·100 g^{-1}) in various tomato genotypes in fresh dried and juice sample

Tomato sample	Vitamin C			Tukey's test	Columns FW : D : J	Significant
	fresh (FW)	dried (D)	juice (J)			
SP-109	7.79	4.21	3.80	2.486	FW : D	**
SPP	5.71	4.10	2.69	3.897	FW : J	**
SPSM	6.78	5.20	3.25	1.411	D : J	ns
SPRZ	8.05	6.53	3.62			
SPRM-20	7.20	5.54	3.52			
S-60	5.89	4.25	2.75			
SPO	1.,86	5.05	5.37			
$LSD_{0.05}$	0.536	0.119	0.225			
$LSD_{0.01}$	0.751	0.167	0.316			

* $P < 0.01$, ** $P < 0.05$

Table 2. β-carotene mg·100 g^{-1} of various tomato genotypes in fresh, dried and juice sample

Tomato sample	β-carotene mg·100 g^{-1}			Tukey's test	Columns FW : D : J	Significant
	fresh (FW)	dried (D)	juice (J)			
SP-109	0.43	0.35	0.43	0.2286	FW : D	*
SPP	0.40	0.27	0.40	0.04571	FW : J	ns
SPSM	0.56	0.29	0.55	–0.1829	D : J	ns
SPRZ	0.75	0.42	0.70			
SPRM-20	0.35	0.25	0.30			
S-60	0.53	0.39	0.49			
SPO	0.85	0.30	0.68			
$LSD_{0.05}$	0.130	0.096	0.079			
$LSD_{0.01}$	0.182	0.134	0.110			

* $P < 0.01$, ** $P < 0.05$

β-carotenoids content

Level of β-carotene in 7 genotypes of industrial tomato was ranged from 0.35 (genotype SPRM-20) to 0.85 mg·100 g^{-1} FW (SPO). Among analysed genotypes there was a statistically significant difference for the level of β-carotene (LSD test, $P < 0.001$), (tab. 2). Some authors found that totally determinate level of β-carotene in tomato grown in the open field ranges from 0.28 to 1 mg·100 g^{-1} FW [Scalzo et al. 2005, Frusciante et al. 2007], which is in accordance with the results in this research. The influence of genotypes on variation of carotene in tomato fruits was studied by Abushita et al. [2000], Binoy et al. [2004], Frusciante et al. [2007], García-Valverde et al. [2013]. Data regarding the analyzed genotypes in this study confirm that the concentration of β-carotene can be very different in different tomato genotypes (tab. 2). Besides the genotype, the other factors have big influence, such as environmental condition, irrigation [Pek et al. 2014]. Content of β-carotene in fresh tomato fruits varied significantly, statistically (Tukey's test, $P < 0.005$) comparing to samples of dried fruits. During the drying process β-carotene decreased statistically significantly and its content was ranged from 0.25 (SPRM-20) to 0.42 (SPRZ) mg·100 g^{-1} per sample. George at al. [2011] also found in their study that the level of β-carotene significantly decreases in lyophilised tomato sample comparing to fresh. This study shows that the difference in β-carotene content in tomato juice was lower than in thermally dried fruits in favour of fresh fruits and it was not statistically significant (tab. 2). Reduction of β-carotene in thermally treated samples comparing to fresh [Shofian et al. 2011, D'Evoli et al. 2013] some authors explain with local presence of carotene in cell and it is situated in lipid membranes or in vacuole plasm [Mangels et al. 1993], so, degradation of phenol compounds is followed by β-carotene degradation. However, Odriozola-Serrano et al. [2009] found that some specific processing (high intensity pulsed electric fields) improves the content of some carotenoids (lycopene, β-carotene and phytofluene) and red colour in the juice.

Lycopene content

Lycopene is a phytonutrient and antioxidant, pigment responsible for characteristically red colour of tomato fruits and its products [Ibitoye et al. 2009]. In this study the content of lycopene in fresh tomato fruits of seven genotypes for industrial proceeding, has been analysed and ranged from 5.00 (genotype SPO) to 6.98 (genotype SPRZ) mg·100 g^{-1} FW. There was a statistically significant difference among them for lycopene content (LSD test, $P < 0.001$), (tab. 3). Martínez-Valverde et al. [2002], Ibitoye et al. [2009], Ganeva and Pevicharova [2015] proved in their studies the impact of genotype to a total level of lycopene in fresh tomato fruits.

In this study, analysis among products obtained by thermal processing of tomato (drying and juice) no statistically significant differences in total lycopene content was found comparing to its content in fresh fruits, which proves its high thermal stability (tab. 3). These results are in accordance with other authors [Anguelova and Warthesen 2000, George et al. 2001, Sanchez-Moreno et al. 2006, Demiray et al. 2013], but not in accordance with Mayeaux al. [2006] Martínez-Hernandez et al. [2016] who found that lycopene has a decreasing stability in increased temperatures and long storage periods (degraded at 100°C after 60 min, 125°C after 20 min, and 150°C after less than 10 min). In dried tomato sample its content was ranged from 4.16 (genotype SPRM-20) to 6.06 (SPRZ) mg·100 g^{-1} sample. In tomato juice its content was ranged from 4.90 (SPO) to 6.85 (SPP) mg·100 g^{-1} sample (tab. 3). The results obtained in this study were compatible with the results obtained by Perez-Conesa et al. [2009] and George et al. [2011]. Analysing the impact of the length of cooking of tomato juice, Thompson et al. [2000] found that there was no significant difference in content comparing fresh tomato and 4 minute cooking, which is in accordance with the results in this study. Some authors found that tomato has higher bio-accessible lycopene when longer cooked, due to the increased lycopene emission from cell matrix. Most of the lycopene is found in the outside part of the pericarp attached to non-soluble part of tomato fibers. Thermal treatment breaks cell membrane and walls and releases the lycopene for the non-soluble part of the fruit, which increases the total content of bio-accessible lycopene and improves its absorption [Shi and Maguer 2000, Dewanto et al. 2002]. D'Evoli et al. [2013] found that preservation of lycopene and its increase during thermal treatment is due to pasteurisation process, which can improve pigment extraction cell matrix. High level of lycopene could come from high ripening stage tomatoes.

Total phenolic compounds

In analysed genotypes of industrial tomato, the level of total phenolic compound TPC was ranged from 48.01 ±0.25 mg of GA·g^{-1} (SPRZ) to 32.65 ±0.05 mg of GA·g^{-1} of fresh tomato weight (FW) for genotype S-60. There was a statistically significant difference among them (LSD test, $P < 0.001$). This experiment shows a significant difference among analysed tomato genotypes in TPC from 15.36 mg of GA·g^{-1} FW (tab. 4). Level of chemical compounds in tomato significantly depends from genotype [Fruscіante et al. 2007, García-Valverde et al. 2013, Raiola et al. 2014].

Table 3. Lycopene content (mg·100 g^{-1}) of various tomato genotypes in fresh, dried and juice sample

Tomato sample	Lycopene mg·100 g^{-1}			Tukey's test	Columns FW : D : J	Significant
	fresh (FW)	dried (D)	juice (J)			
SP-109	6.27	5.33	6.27	0.9671	FW : D	ns
SPP	6.87	5.50	6.85	0.1271	FW : J	ns
SPSM	6.79	5.75	6.79	–0.84	D : J	ns
SPRZ	6.98	6.06	6.75			
SPRM-20	5.69	4.16	5.25			
S-60	6.05	5.58	5.95			
SPO	5.00	4.50	4.90			
$LSD_{0.05}$	0.448	0.395	0.189			
$LSD_{0.01}$	0.628	0.554	0.265			

* $P < 0.01$, ** $P < 0.05$

Table 4. Total phenols (mg of GA·g^{-1}) of various tomato genotype in fresh, dried and juice sample

Tomato sample	Total phenols			Tukey's test	Columns FW : D : J	Significant
	fresh (FW)	dried (D)	juice (J)			
SP-109	37.90 ±0.65	22.45 ±0.55	18.08 ±0.45	8.51	FW : D	**
SPP	33.07 ±0.05	27.97 ±0.35	17.04 ±0.25	19.79	FW : J	**
SPSM	42.08 ±0.15	33.05 ±0.15	21.05 ±0.15	11.28	D : J	**
SPRZ	48.01 ±0.25	32.20 ±0.12	17.65 ±0.23			
SPRM-20	34.05 ±0.25	26.07 ±0.15	17.01 ±0.20			
S-60	32.65 ±0.05	29.45 ±0.04	16.05 ±0.07			
SPO	34.65 ±0.02	31.65 ±0.20	17.02 ±0.20			
$LSD_{0.05}$	2.425	1.647	2.313			
$LSD_{0.01}$	3.400	2.309	3.243			

* $P < 0.01$, ** $P < 0.05$

Results of this research prove significant difference (Tukey test, $P < 0.001$) in TPC depending on treatment. In dried fruits, TPC was ranged from 22.45 ±0.55 (SP-109) to 33.05 ±0.15 (SPSM) mg of GA·g^{-1} per sample. TPC content in juices in this research was ranged from 16.05 ±0.07 (S-60) to 21.05 ±0.15 (SPSM) mg of GA·g^{-1} per sample (tab. 4). Both treatments significantly decrease the TPC content, comparing to fresh fruits.

Total flavonoids content

Generally, tomato is considered to be a food with medium level of flavonoids, with average value < 50 mg kg^{-1} [Hollman et al. 1996]. They can, usually be found in skin and only in small parts in other parts of fruits [Raiola et al. 2014]. In this research, the analysis of total flavonoids in 7 genotypes of industrial tomato was ranged from 12.98 ±0.22 (S-60) to 18.25 ±0.20 (SPRZ) mg RU·g^{-1} FW. There was a statistically significant difference among them (LSD test, $P < 0.001$), (tab. 5). Slimestad et al. [2008] found that total flavonoid content in tomato fruits was from 2.6 to 25.6 mg/g FW, which is in accordance with the results in this research.

The results of the research show that there is a decrease of total flavonoids content during thermal treatments (drying and cooking). In dried fruits total flavonoids content ranged from 11.06 ±0.50 (genotype SP-109) to 16.75 ±0.15 (genotype SPSM) mg RU·g^{-1} sample. Total flavonoids content in tomato juices was ranged from 5.25 ±0.20 (genotype SPRZ) to 8.45 ±0.15 (genotype SPSM) mg RU·g^{-1}. It is clear that the drying of fruits leads to a slightly decrease of total flavonoids content and there was no statistical significance (Tukey test). On the other hand, cooking decreases flavonoids significantly comparing to the fresh fruits (Tukey test, $P < 0.001$), (tab. 5). The difference in flavonoid content in dried sample and tomato juice in this research can be in connection with thermal treatment. Variation of total flavonoids mostly depends on thermal treatment [Dewanto et al. 2002] and on storage and packaging [Pérez-Gregorio et al. 2011a, b].

Analysing summary results of all researched genotypes in fresh and dried and in cooked tomato juice, best genotypes for processing industry are SPRZ for drying and fresh consumption, while SPSM is the best genotype for tomato juice. These conclusions regard the preservation of bioactive components during thermal treatment. Genotype SPSM can be used for drying (II in the range, after SPRZ line).

Table 5. Total flavonoids (mg RU·g^{-1}) of various tomato genotype in fresh, dried and juice sample

Tomato sample	Flavonoids			Tukey's test	Columns FW : D : J	Significant
	fresh (FW)	dried (D)	juice (J)			
SP-109	15.44 ±0.38	11.06 ±0.50	6.07 ±0.35	2.31	FW : D	ns
SPP	13.27 ±0.15	11.25 ±0.25	5.58 ±0.35	8.823	FW : J	**
SPSM	17.04 ±0.15	16.75 ±0.15	8.45 ±0.15	6.513	D : J	**
SPRZ	18.25 ±0.20	15.65 ±0.27	5.25 ±0.20			
SPRM-20	15.45 ±0.20	11.50 ±0.05	5.55 ±0.12			
S-60	12.98 ±0.22	11.76 ±0.20	6.76 ±0.23			
SPO	13.76 ±0.20	12.05 ±0.20	6.77 ±0.20			
$LSD_{0.05}$	1.844	0.961	0.354			
$LSD_{0.01}$	2.586	1.348	0.496			

* $P < 0.01$, ** $P < 0.05$

Conclusion

The key of preservation of high content of nutritive traits during processing of industrial tomato is the quality fresh matter. This study proves that the genotype choice of the industrial tomato is statistically significant on concentration of ascorbic acid, β-carotenoids, lycopene, total phenols and flavonoids and in the end on its antioxidative profile. Generally, processing of tomato decreases the nutritive components comparing to fresh tomato but the concentration of nutrients stays high, so this treatment is justified. Drying of tomato (65°C) preserves some quantities of vitamin C, total phenols and flavonoids. On the other hand cooking preserved β-carotenoids and lycopene. Having in mind the obtained results in this study, industrial tomato processors should know nutritive profile of industrial tomato so the best quality products could be obtained with beneficial effects on human health.

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