DOI:10.5937/FFR1702123P UDK 664.843.5:635.64:615.35]:542.943'78

Original research paper

THE IMPACT OF DIFFERENT THERMAL PROCESSING OF TOMATO TO ITS ANTIOXIDANT ACTIVITY, VITAMIN E, DRY MATTER AND SUGAR CONTENT

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ABSTRACT: The objective of this study was the determination of total antioxidant activity, contents of vitamin E, sugar and total dry matter in fresh and thermally processed (dried and juiced) tomato fruits of different selected tomato lines with the aim to establish the nutritive profile and distinguish superior genotypes in order to obtain high-quality final product with more benefit to human health. Content of vitamin E, total antioxidant activity, dry matter and total sugars, in fresh and dried fruits (dried in parallel hot air dryer at 60 °C, until the final product reached the moisture lower than 10% and in tomato juice pasteurized at 100 °C, for 7 minutes) was studied. Comparative trial with 7 genotypes: one commercial variety (SP-109) and 6 selected high inbreeding generation lines (SPP, SPSM, SPRZ, SPRM-20, S-60 and SPO), was set up. Genotype SPRZ had the highest vitamin E content and total antioxidant capacity, both in fresh fruit and after the treatments. Thermal processing by drying at 60°C and pasteurization of tomato changed the level of total sugar and dry matter content. Total antioxidant activity decreased by drying, comparing to fresh fruit while the level of vitamin E decreased in juice pasteurized at high temperature (100 °C).

Key words: *tomato, fresh fruit, drying, pasteurization, antioxidants*

INTRODUCTION

Tomato is an important food resource to the population of the entire world. This fact is confirmed by its world production, which is estimated to be about 159 million tons. Consumption per capita in Europe is 18 kg, while in the US is somewhat lower, 8 kg per capita (USDA, 2008).

According to some researches, the consumption of fresh and processed tomatoes is constantly increasing. The most common tomato products are different sauces, canned tomatoes, juice, ketchup, puree etc. Apart from being an important part of the diet, tomato fruits are very important source of vitamins, minerals and antioxidants that have a positive impact on health (Frusciante et al., 2007).

Chemical composition of tomatoes is exposed to the influence of numerous factors such as genetic (variety), environmental (light, temperature, mineral nutrition) and cultural practices (ripening stage at har-

vest, irrigation) (Garcia-Valverde et al., 2013).

Antioxidant capacity of tomato lies in the large number of present phytochemical compounds, as well as in their interaction. Due to the composition of phytochemical compounds, tomato has high antioxidant capacity both fresh and processed. This is the reason why tomato is often considered to be good for prevention of cancer and cardiovascular diseases. Total antioxidant capacity of tomato is influenced by many factors that take place before and after harvest. There are some contradictory results regarding the influence of processing on total antioxidant capacity. These changes of antioxidant activity in tomato products can be explained by complex and wide spectrum of biochemical components that can be changed during various kinds of processing. Total antioxidant activity of tomato consists of 83% of hydrophilic and 17% of lipophilic component (Kotíková et al., 2011, Garcia-Valverde et al*.*, 2013).

There are several steps during thermal and non-thermal industrial processing of tomato. Each of these steps was studied in detail regarding its impact to total antioxidant potential, in order to precisely determine quality factors of final product. Parallel with this study it was very important to conduct a research of identification of genotypes with high nutritive values, that breeders will suggest for commercial use and selection of healthy tomato lines (Frusciante et al., 2007).

Vitamin E is highly appreciated vitamin due to its cancer prevention properties (Dorais et al., 2007). Vitamin E belongs to lipophilic antioxidant fraction of tomato fruit. It is present in tomato fruit in two forms (α-tocopherol and γ-tocopherol) (Abushita et al., 1997). Vitamin E enables normal level of photosynthesis when tomato plant is highly stressed. Some studies imply high level of vitamin E in raw tomato (Pék et al., 2014, Abushita et al., 2000, Seybold et al., 2004).

Tomato flavor is a complex interaction of taste and odor. One of the components defining fruit taste is the sugar content. Besides that, phenolic acids and minerals in fruit impact the total flavor (Kader, 2008). Sugar content in tomato fruits is a result of physiological, metabolic and genetic processes that control the plant growth (Baldet et al., 2006, Mounet et al., 2009, Wang et al., 2009). Its accumulation in fruit is important both for nutritive value and for taste. Consumers appreciate the sweet taste of tomato fruits and the ratio of accumulated sugar and total acids determines the intensity of taste. However, the sweet taste is rarely the important criteria for selection process, while other criteria such as resistance to biotic and abiotic stress, firmness, etc. are imposed by producers (Shewfelt, 2000). In contemporary tomato selection, during last decades of 20^{th} century, much has been lost regarding the taste of tomato by introducing LSL gene in selected varieties for fresh consumption and industrial processing (Zdravković et al., 2010).

Recently, tomato selection goes toward improvement of bioactive components of tomato, which puts it among vegetables with high nutritive, even medicinal traits. Criteria for industrial tomato are different: dry matter, sugar content, total acids (Bruhn, 2002) for producing high-quality raw material for processing with minimum energy usage and preservation of biologically valuable components.

Tomato is the most common vegetable in industrial processing. High level of dry matter in tomato fruits is a desirable characteristic and one of the most important criteria in processing industry due to low energy usage, which impacts the price of the final product (Frusciante et al., 2007, Turhan and Veniz, 2009). Content of dry matter in tomato is influenced by numerous factors such as characteristics of soil, irrigation (Turhan and Veniz, 2009), organic and mineral fertilization and especially important intake of micronutrients, of which potassium is the most important.

The object of research in this study was determination of total antioxidant activity, content of vitamin E, sugar content and total dry matter in fresh and thermally processed (dried and juice) fruits of different tomato genotypes in order to study nutritive quality and select superior genotypes. Processing of these genotypes

would obtain more quality final product with high benefit to human health.

MATERIAL AND METHOD

Plant material

Comparative trial was set up with 7 genotypes, one commercial variety (SP-109) and 6 selected lines (SPP, SPSM, SPRZ, SPRM-20, S-60 and SPO) of high inbreeding generation. The origin of clean lines was from different tomato selection programs for industrial processing. The trial was set up with standard procedure for growing industrial tomato, in random block system with three replications. Mature fruits were picked 45 days from fertilization when they were fully ripe.

The content of vitamin E, total antioxidant activity, dry matter weight and total sugar content, in both fresh and dried fruits (dried in parallel hot air dryer at 60 °C, until the final product obtains moisture less than 10%, (Correia, et al., 2015)) and in tomato juice (pasteurization at 100 °C, for 7 minutes).

Vitamin E

Vitamin E content was determined by photometric method according to Emmerie-Engel, with $FeCl_3$ and α,α'-dipyridyl, which is based on the ability of tocopherol to reduce Fe^{3+} in Fe^{2+} which makes intensively red colored complex with α,α'-dipyridyl *(*Trajković et al*.,* 1983). The intensity of color was determined spectrophotometrically at 520-525 nm. 100 g of samples were measured and volume was made up to 100 cm^3 by absolute ethanol in a volumetric flask. 5 cm^3 of this solution was transferred to a volumetric flask and made up to 100 cm^3 by absolute ethanol. 0.5 cm^3, 1.0 cm^3, 1.5 cm^3, 2.0 cm^3, 2.5 cm^3, and 3.0 cm^3 were taken from the diluted sample by pipette. 0.25 cm^3 of α,α'-dipyridyl solution and 0.25 cm^3 of $FeCl_3$ solution were added to each sample. 1 cm^3 of each solution were transferred after 2 minutes to the test tube, and the extinction at 520 nm was measured, using UV/VIS spectrophotometer.

A mixture of the reagents used in the specified amounts was used in blank experiment. The standard curve was obtained from the values of extinction and concentration.

Total antioxidant activity

Determination of total antioxidant activity by DPPH method was done spectrophotometrically (Xu et al., 2010). 8 mg of DPPH (2,2-diphenyl-1-picrylhydrazyl) were dissolved in methanol (100 mL) to give a concentration of 80 g/mL. Serial dilutions were made from the stock solution (1 mg/ml) of extract. Solutions (2 ml each) were then mixed with DPPH (2 mL) and allowed to stand for 30 minutes to any reaction occurred, and the absorption was measured at 517 nm. Ascorbic acid was used as the reference standard and dissolved in methanol to make a stock solution with the same concentration of 1 mg/ml. The control sample was prepared to contain the same volume, but without the test compound or reference antioxidants. 95% percent methanol was used as a blank. Three measurements were made.

Dry matter weight

The percentage of dry matter was determined by drying at 105 °C, until constant mass was reached. After cooling in the desiccator, percentage of dry matter was calculated from the mass difference before and after drying and the known sample mass. The weight of the sample before drying was 5.00 g. Three measurements were performed. (Cvijović and Aćamović, 2005).

Total sugar content

Total sugar content was determined by applying Bertrand method, which is used for the determination of all carbohydrates with free hemiacetal groups that can reduce Cu^{2+} metal ions to Cu^{+} from Bertrand I reagent ($CuSO_4 \cdot 5H_2O$), according to Cvijović and Aćamović (2005). The quantity of copper (I) oxide represents an equivalent amount of sugar. Bertrand solution II ($Fe_2 (SO_4)_3$) is than added, and the resulting precipitate of copper (I) oxide is re-transferred to the copper (II) and iron (III) is reduced to iron (II). In a more acidic environment, iron (II) ions are oxidized with $KMnO_4$ to an equivalent amount of iron (III), and manganese (VII) is reduced to manganese (II). Based on the amount

of spent of $KMnO_4$, corresponding amount of sugar was read from the table.

Data analysis

Genotype differences have been determined 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 calculated using the Tukey's test. To test the mutual dependency of drying and pasteurization in relation to fresh fruit, model of linear trend (Njegić et al., 1991) was applied:

$\hat{y}=a+bx$

$a= \bar{y} - \dot{x} \cdot b$

$b= \sum x_t y_t - n \cdot \dot{x} \cdot \bar{y} / \sum x_t^2 - n \cdot \dot{x}^2$

where:

$\hat{y}$ = estimated value of dependent variable

a = regression constant, or Y intercept

b = regression coefficient, or slope

x = given value of independent variable

RESULTS AND DISCUSSION

Total antioxidant activity (TAA)

Total antioxidant activity of fresh fruits of seven chemically analyzed genotypes ranged from 11.04±0.09 mg AA/100g (genotype S-60) to 15.05±0.07 mg AA/100g (genotype SPRZ) (Table 1). Statistically significant difference for total antioxidant activity was calculated (*LSD* test, $p < 0.001$) in fresh and thermally processed tomato fruits (dried sample and juice) among analyzed genotypes in this experiment. The influence of genotype on TAA was also found by Sahlin et al. (2004), Gonzalez-Cebrino et al. (2011), Garcia-Valverde et al. (2013). Besides the influence of genes on TAA, there are other factors, such as environmental, ripening stages, growing technology, UV-C treatment, etc. (Gonzalez-Cebrino et al., 2011, Garcia-Valverde et al., 2013).

The content of TAA during thermal processing (drying and juicing) slightly decreased compared to its content in fresh fruits of analyzed genotypes. Content of TAA in dried fruits ranged from 10.05±0.10 mg AA/100g and 10.05±0.50 mg AA/100g (genotype SPO and SPRM-20) to 12.20±0.20 mg AA/100g (genotype SPRZ). There was a statistically significant difference among the content of TAA in fresh and dried fruits (Tukey's test, $p < 0.005$, Table 1). On the other hand, there was no statistically significant difference in its level among fresh fruits and juice, as well as among dried fruits and juice. TAA in sample juice ranged from 10.85±0.15 mg AA/100g (genotype SPP) to 14.97±0.03 mg AA/100g (genotype SPRM-20) (Table 3).

Our results are in accordance with Sahlin et al. (2004) who concluded that cooking and baking had relatively small impact to TAA in tomato, while Dewanto et al. (2002) found that during thermal processsing of tomato at 88 °C the TAA increased. Powell and Bennett, (2002) suggest that during processing of tomato, less invasive methods should be applied in order to prevent the change of its antioxidant capacity in an undesirable direction (loss).

Vitamin E (Tocopherol*)*

The content of vitamin E in analyzed tomato genotypes was from 0.21 mg/100g FW (genotype S-60) to 0.63 mg/100g FW (genotype SPRZ). There was a statistically significant difference (*LSD* test, $p < 0.001$) in vitamin E content in fresh and thermally processed fruits among the analyzed genotypes.

Frusciante et al. (2007) found that the level of vitamin E in tomato fruits was between 0.17-0.62 mg/100g FW, which is almost in accordance with values obtainedin this research. Variation of vitamin E depending on genotype was found by Seybold et al. (2004), Lenucci et al. (2006), Maršić et al. (2010), and Zanfini et al. (2010).

Besides the impact of genes, the content of vitamin E in tomato fruits is under influence of environmental conditions, light, ripening stage, stress intensity, irrigation and cultivation practice (Abushita et al., 2000, Seybold et al., 2004, Pék et al., 2014).

During thermal processing of fruits (drying and pasteurization) vitamin E was lost. Its level in dried sample ranged from 0.14 mg/100g FW (genotype S-60) to 0.50 mg/100g FW (genotype SPRZ). Statistically significant difference (Tukey's test, $p < 0.005$) was determined in its loss only between the fresh fruits and juice. Vitamin E content in juice spanned from 0.08 mg/100g FW (genotype S-60) to 0.33 mg/100g FW (genotype SPRZ) (Table 2). Loss of vitamin E during thermal processing was also reported by Abushita et al. (2000). Wang et al. (2009) found that temperatures and duration of thermal processing can increase the level of tocopherol (160 °C, 20 minutes). The authors explained that there are temperatures that destroy cell walls causing a better release of tocopherol from tomato fruits.

Traits of vitamin E during thermal processing were studied by Seybold et al (2004). They concluded that during short, high temperature treatments, the level of vitamin E increased in juice. On the other hand, during long lasting treatments with high temperatures, the level of vitamin E decreased in the product. Lavelli et al. (2013) found that the level of tocopherol depends on level of drying and water content in dried product. The general conclusion was that hydrophilic antioxidants were stable for samples in the glassy state, but were unstable for samples in the rubbery state. In contrast, the lipophilic antioxidants (lycopene and tocopherol) were mostly unstable for samples in the glassy state. In our research, the level of vitamin E slightly decreased in dried sample in comparison to fresh fruits, but not significantly. If the level of drying was determined according to Lavelli et al. (2013) than it would be a glassy drying phase (Table 2).

Dry matter weight

Seven analyzed genotypes of industrial tomato in this study showed that the dry matter weight in fresh fruits ranged from 4.25% (genotype SPP) to 5.20% (genotype SPSM). Among the analyzed genotypes there was a statistically significant difference in dry matter content both in fresh fruits and in final products (dry sample and juice) (*LSD* test, $p < 0.001$) (Table 3). Differences in dry matter content in different genotypes were reported by Turhan and Seniz (2009). In their study, dry matter in fresh tomato fruits ranged from 3.83% to 7.00%, which is similar to the findings from this study. Similar results were also found by Majkowska et al. (2008).

After thermal processing of fresh fruits, statistically significant difference of dry matter content was determined between fresh and dried fruits and juice, while there was no difference between juice and fresh fruits (Tukey's test, $p < 0.005$). This difference was high for dried samples and ranged from 16.25% (genotypes S-60, SPRZ) to 19.05% (genotype SPSM). Koh et al. (2010) found no statistical difference between fresh tomato and juice processed at 100 °C for 5 min, there was no statistically significant difference, which was in accordance with results of Sahlin et al. (2004). They studied different ways of thermal processing of tomato and found that they did not impact the content of total dry matter weight.

Total sugar content

Total sugar content in fresh fruits of the analyzed genotypes ranged from 3.45% (genotype SPSM) to 4.25% (genotype SPRM-20). Among the analyzed genotypes there was a statistically significant difference in total sugar content between fresh and processed (dried and juiced) tomato fruits (*LSD* test, $p < 0.001$). Thermal processing (drying, juicing) of tomato genotypes in this study showed statistically significant difference (Tukey's test, $p < 0.005$) among total sugar content in fresh and dried fruits and also tomato juice (Table 4).

Ganeva and Pevicharova (2015) in their research found that the sugar level ranged from 3.01% to 4.73%, depending on genotype, which coincides with the results of this study. Turhan and Seniz (2009) studied variability of sugar content in different genotypes and found lower values, spanning over 1.67%-3.73%. Dependence of sugar levels in tomato fruits on genotype was reported by Turhan and Seniz (2009) and Gautier et al. (2010). However, sugar content is a complex multigene trait,

under the influence of physiological, metabolic and genetic processes (Ho and Hewitt, 1986; Baldet et al., 2006; Mounet et al., 2009; Wang et al., 2009) and also under the environmental influence (Hartl, 2011). Some genotypes have great gene potential for sugars, however its realization depends on pre- and postharvest factors. The pre-harvest environment factors are day length, temperature, irrigation, fertilization etc. (Dorais et al., 2008). Postharvest practices such as harvest time and storage conditions impact the sugar profile in fruits (Kader, 1986). Crucial condition for fruits for industrial processing is a proper harvest time (Reid, 2002). Sugar content in fruits is increased in late phases of ripening (Carrari et al., 2006), while the harvest of non-mature fruits limits the sugar content and causes postharvest degradation of starch as a main source of carbohydrates (Balibrea et al., 2006). Besides higher accumulation of sugars, harvest in later ripening phases is not practical since fruits are usually damaged and have short shelf life (Reid, 2002; Watkins, 2006; Toivonen, 2007), whereby the question of economic viability and quality of raw material that will be used forrefining processes arises. It is a known fact that the tomato is a plant with fruits that have a climacteric peak in maturation process. Therefore the fruits are still continuing with the accumulation of sugar after harvesting (Kays and Paull, 2004). Mutual relations in the loss of the tested antioxidant complex, vitamin E and total sugars in all genotypes after thermal processing were evaluated and conclusions were drawn.

Antioxidant complex was lost with thermal processing linearly, with the coefficient of determination R^2=0.8613 (dried-juiced-fresh fruits). The value of the coefficient R^2 proved the adequacy of linear tendency. It was different with the loss of vitamin E during processing.

Table 1.
Total antioxidant activity (TAA) of various tomato genotypes in fresh, dried and juice sample expressed as mg AA/100g

Tomato sample	TAA (mg AA/100g)			Tukey's test	Ratio FW:D:J	Significant P < 0.01; 0.05
	Fresh (FW)	Dried (D)	Juice (J)			
SP-109	13.05±0.17	10.27±0.25	12.75+0.20	2.061	FW:D	*
SPP	11.05±0.23	10.34±0.25	10.85±0.15	0.3143	FW:J	ns
SPSM	14.15±0.17	12.05±0.20	14.00±0.05	-1.747	D:J	ns
SPRZ	15.05±0.07	12.20±0.20	14.97±0.03			
SPRM-20	13.25±0.03	10.05±0.50	12.05±0.05			
S-60	11.04±0.09	10.20±0.20	11.00±0.05			
SPO	12.00±0.15	10.05±0.10	11.77±0.10			
$LSD_{0.05}$	0.447	0.512	0.717			
$LSD_{0.01}$	0.627	0.717	1.005			

Table 2.
Vitamin E (Tocopherol) content expressed in mg/100g FW of various tomato genotypes in fresh, dried and juice sample

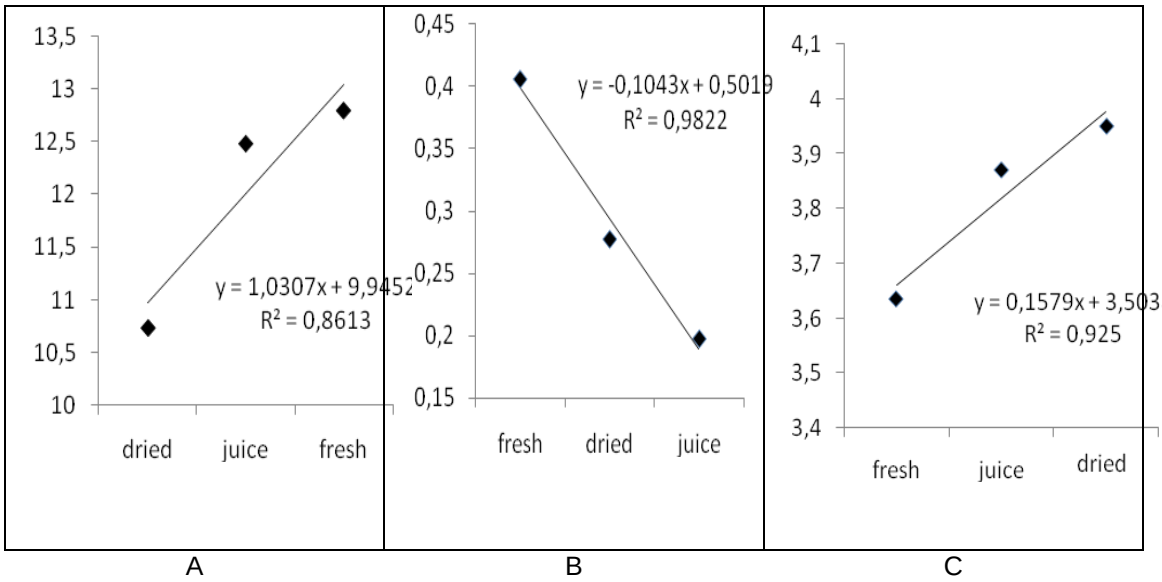
Tomato sample	Vitamin E (mg/100g FW)			Tukey's test	Ratio FW:D:J	Significant P < 0.01; 0.05
	Fresh (FW)	Dried (D)	Juice (J)			
SP-109	0.44±0.03	0.31±0.02	0.22±0.03	0.1286	FW:D	ns
SPP	0.25±0.01	0.15±0.05	0.09±0.06	0.2086	FW:J	*
SPSM	0.52±0.06	0.35±0.06	0.28±0.05	0.08	D:J	ns
SPRZ	0.63±0.05	0.50±0.01	0.33±0.09			
SPRM-20	0.47±0.03	0.28±0.08	0.24±0.01			
S-60	0.21±0.02	0.14±0.02	0.08±0.07			
SPO	0.32±0.01	0.21±0.01	0.14±0.06			
$LSD_{0.05}$	0.042	0.034	0.041			
$LSD_{0.01}$	0.058	0.048	0.057			

Table 3.
Dry matter weight (%) of various tomato genotypes in fresh, dried and juice sample

Tomato sample	Total solid content (%)			Tukey's test	Ratio FW:D:J	Significant P < 0.01; 0.05
	Fresh (FW)	Dried (D)	Juice (J)			
SP-109	4.70±0.02	18.25±0.04	3.70±0.05	-12.82	FW:D	**
SPP	4.25±0.09	18.05±0.05	3.78±0.04	0.3286	FW:J	ns
SPSM	5.20±0.07	19.05±0.07	4.98±0.08	13.15	D:J	**
SPRZ	4.55±0.03	16.25±0.04	4.20±0.09			
SPRM-20	4.78±0.05	18.05±0.02	4.64±0.05			
S-60	4.95±0.05	16.25±0.07	4.88±0.03			
SPO	4.75±0.01	17.00±0.01	4.70±0.02			
$LSD_{0.05}$	0.034	0.740	0.220			
$LSD_{0.01}$	0.06	1.037	0.308			

Table 4.
Total sugar content (%) of various tomato genotypes in fresh, dried and juice sample

Tomato sample	Total sugar content (%)			Tukey's test	Ratio FW:D:J	Significant P < 0.01;0.05
	Fresh (FW)	Dried (D)	Juice (J)			
SP-109	3.89±0.01	10.01±0.04	3.80±0.08	-5.829	FW:D	**
SPP	4.05±0.03	10.60±0.01	4.00±0.06	0.08	FW:J	ns
SPSM	3.45±0.09	8.66±0.06	3.35±0.02	5.909	D:J	**
SPRZ	4.05±0.07	10.38±0.03	4.00±0.02			
SPRM-20	4.25±0.03	8.74±0.02	4.25±0.09			
S-60	4.05±0.01	9.63±0.01	4.00±0.08			
SPO	3.92±0.07	10.44±0.05	3.70±0.01			
$LSD_{0.05}$	0.582	1.570	0.093			
$LSD_{0.01}$	0.816	2.202	0.131			



A B C

Figure 1. Mutual impact of drying and juicing with pasteurization on the changes of antioxidant complex (A), vitamin E (B) and total sugar (C)

CONCLUSION

Obtaining quality in the final product is closely linked with the quality of raw material, i.e. fresh fruits. This study indicated that the total antioxidant activity, vitamin E, sugar and total dry matter content depended on the selected varieties. Thermal proces-

sing of tomato fruits by drying at 60 °C and juicing followed by pasteurization influenced the total sugar and total dry matter content. The total antioxidant activity decreased during drying in comparison to fresh fruits and the content of vitamin E was reduced by juicing at higher temperatures (100 °C). Genotype SPRZ had the highest vitamin E content and total antioxidant capacity, both in fresh sample and after the thermal treatments. Selection of superior genotypes and accumulation of nutrients through breeding programs can improve the quality of the final product and contribute to its greater "prohealth" potential and impact.

ACKNOWLEDGEMENTS

This study was supported by the Serbian Ministry of Education, Science and Technological Development: Project No. TR31059 (Integrating Biotechnology Approach in Breeding Vegetable Crops for Sustainable Agricultural Systems).

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УТИЦАЈ ТЕРМИЧКЕ ОБРАДЕ ПЛОДОВА ПАРАДАЈЗА НА АНТИОКСИДАТИВНУ АКТИВНОСТ, САДРЖАЈ ВИТАМИНА Е, СУВЕ МАТЕРИЈЕ И УКУПНИХ ШЕЋЕРА

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Сажетак: Циљ истраживања је одређивање укупне антиоксидативне активности, садржаја витамина Е, садржаја шећера и укупне суве материје у свежим и термички обрађеним (сушени плодови и сок) плодовима различитих селекционих линија парадајза, са циљем утврђивања нутритивног квалитета и издвајања супериорних генотипова, чијом прерадом би се добио квалитетнији крајњи производ са позитивним дејством на људско здравље. Испитивани су садржај витамина Е, укупна антиоксидативна активност, сува материја, и укупни садржај шећера, код свежих плодова, сушених плодова (сушење топлим ваздухом на 60 °C, до коначне влаге узорка мање од 10%) и сока парадајза (пастеризацијом на 100 °C, у трајању од 7 минута). Изведен је компаративни оглед са 7 генотипова, једна комерцијална сорта (СП-109) и 6 селекционисаних линија (СПП, СПСМ, СПРЗ, СПРМ-20, С-60 И СПО) високих генерација инбридинга. Термичка обрада плодова парадајза (сушењем на 60 °C) и прављењем сока доводи до промене укупног садржаја шећера и садржаја укупне суве материје. Испитивањем укупне антиоксидативне активности утврђено је да се она губи сушењем у односу на свеж плод, а садржај витамина Е се смањио у соку који је добијен обрадом на вишим температурама (100 °C). Генотип SPRZ имао је највише вредности за садржај витамина Е и укупан антиоксидативни капацитет како у свежем стању тако и након примењене обраде. Избором супериорних генотипова и акумулацијом нутријената кроз оплемењивачке програме, може се побољшати квалитет крајњег производа и постићи добијање прерађевина са већим позитивним утицајем на здравље људи.

Кључне речи: *парадајз, свеж плод, сушење, пастеризација, антиоксиданси*

Received: 13. March 2017

Accepted: 19 September 2017