QUALITY OF DIFFERENT COLOURED TOMATOES DEPENDING ON THE GROWING SEASON

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Tomatoes have been widely used in nutrition, as well as in nutritional medicine. Red tomatoes are used for the treatment of anaemia, they contain the antioxidant lycopene, and the high concentration of organic acids promotes digestion. Yellow tomatoes have valuable amounts of β -carotene, the pigment that gives orange and yellow tomatoes their colour, and helps to neutralise free radicals that may damage cells. The size of brown tomatoes is smaller than an average tomato, but they are sweeter, due to higher concentration of fructose. Cherry tomatoes are among the smallest tomatoes commercially available, but they are known for being rich in carotenoids, lycopene and phenolic compounds. The aim of the study was to evaluate how the concentration of biologically active substances differs depending on the tomato growing season. The study examined four varieties of tomatoes (Bolzano F1 — yellow, Chocomate F1— brown, Encore F1 — red, Strabena F1— red cherry) grown in an industrial greenhouse “Mežvidi” (Latvia) using additional light. The concentration of biologically active substances (lycopene, β -carotene, total phenolic compounds, and soluble solids) was determined in two vegetation periods — autumn (November) and spring (March). The obtained results showed that tomatoes harvested in autumn contained more biologically active substances than in spring, as many biological processes in plants occur more rapidly at the beginning rather than in the middle or at the end of the vegetation season. Therefore, the concentration of secondary metabolites in tomatoes is higher at the end of the season. In autumn, cherry tomatoes Strabena contained the highest amount of pigments, total phenols, and soluble solids, and therefore the taste index of this variety also was the highest. In spring, pigment concentration was significantly lower (on average by 20–30%), and phenols and soluble solids concentration ($^{\circ}$ Brix) was not significantly lower — on average by 2–4%. Of the large-fruit tomatoes, at the beginning of vegetation season (autumn), the highest amounts of pigments were in red tomatoes (Encore) — lycopene concentration $4.63 \pm 0.04 \text{ mg} \cdot 100 \text{ g}^{-1}$; yellow tomatoes Bolzano were rich in phenolic compounds — $128.46 \pm 3.25 \text{ GAE mg} \cdot 100^{-1}$, and brown tomatoes Chocomate had the highest soluble solids concentration — $4.48 \pm 0.05 \text{ }^{\circ}\text{Brix}$. In spring, the concentration of biologically active substances was lower on average by 10–15%, regardless of the colour and variety of the tomato.

Keywords: biologically active substances, lycopene, β -carotene, vegetation period.

INTRODUCTION

Tomatoes are the second most widely produced vegetable crop in the world, with an estimated total production of 164 million tons worldwide (Rodríguez-Ortega *et al.*, 2019).

Tomato (*Solanum lycopersicum* L.) belongs to the family *Solanaceae* and is related to other commercially important vegetables such as potato, eggplant, pepper, and tobacco. It

is native to South America and was introduced to Europe in the 16th century by Spanish sailors (Garcia *et al.*, 2017). Tomatoes are self-pollinating herbaceous perennials, but commercially they are mostly grown as annuals (Singh *et al.*, 2016). Although considered a vegetable, botanically tomato is a fruit — a fleshy berry that consists of an epidermis, a thick pericarp and placental tissue surrounding the seeds (Omotayo and Adedeji, 2015).

Tomatoes are consumed in a lot of different ways: fresh or processed in products like ketchup, juice, paste, puree, pasta sauces and canned tomatoes (Li *et al.*, 2018). Fresh and processed tomato products are popular dietary components thanks to their large availability to consumers and ability to meet consumer demands on cost and taste (Burton-Freeman and Reimers, 2011). The quality of tomato fruits can be determined by measuring amounts of bioactive compounds like carotenoids, phenolics, sugars, mineral elements, and vitamins.

Two of the most important tomato carotenoids, due to the health benefits associated with their consumption, are fat-soluble lycopene and β -carotene. Lycopene is a red carotenoid pigment that is also present at lower concentrations in other red/pink fruits such as watermelons, pink grapefruits and papayas (Peixoto *et al.*, 2017). β -carotene is a pigment that is associated with the yellow/orange colour of tomato fruits (Kondratieva and Golubkina, 2016). Both of these pigments are considered to be antioxidants (Mueller and Boehm, 2011; Sen, 2019). However, lycopene has the highest antioxidant activity of all approximately 600 naturally occurring carotenoids, because of two unconjugated double bonds in its chemical structure, which can easily be attacked by electrophilic reagents, resulting in extreme reactivity toward oxygen and free radicals (Kelkel *et al.*, 2011). Since oxidant stress in the cardiovascular system is linked to cardiovascular diseases (Leopold, 2015), consumption of lycopene- and β -carotene-rich products may reduce the risks of those diseases. In fact, there is evidence from animal studies that lycopene intake has a positive correlation with cardiovascular disease reduction (Hasan and Sultana, 2017). β -carotene also has provitamin A activity in humans because of an unsubstituted β -ring with an 11-carbon polyene chain (Kotiková *et al.*, 2011).

Phenolic compounds are another group of bioactive compounds found in tomatoes, which are associated with positive effects on health. The main phenolic compounds found in tomatoes are flavanones (naringenin glycosylated derivatives) and flavonols, like quercetin, rutin and kaempferol glycosylated derivatives (Vallverdú-Queralt *et al.*, 2012). Phenolic compounds have antioxidative, antimicrobial, antiviral and anti-inflammatory properties (Wang *et al.*, 2015). Tomato phenolic compounds are linked to lower rates of cancer and blood serum cholesterol level (Antonious *et al.*, 2019).

Soluble sugars in tomatoes are mainly glucose and fructose and their concentration in tomato fruits ranges from 4%–9% (Helyes *et al.*, 2008). Although there are many components that determine the quality and taste of tomatoes, as described before, the sugar concentration is the main determining factor of taste (Beckles, 2012). A higher sugar to organic acid ratio makes the tomato fruit sweeter and tastier (Barickman *et al.*, 2017).

Factors determining concentrations of bioactive compounds found in tomatoes are on the one hand genetically determined and on the other environmentally (Carli *et al.*, 2011).

For example, one of the main factors affecting lycopene concentration in tomatoes is linked to the ripening of red tomato fruits. Riper red fruit has higher concentration of lycopene. Other factors influencing lycopene concentration can be the time of harvest (Górecka *et al.*, 2020) and the water supply during the growth of the tomato (lower water supply resulting in higher lycopene concentration) (Takács *et al.*, 2020). Since phenolic compounds are plant secondary-metabolism products, they are mostly produced in direct response to environmental conditions (Sánchez-Rodríguez *et al.*, 2012). Higher phenolic compound concentration can be found in cultivars with smaller fruits, such as cherry tomatoes, because of higher skin to volume ratio, since these compounds occur in the skin of fruit (Kacjan Maršić *et al.*, 2011). Sugar content increases during ripening and is also affected by environmental factors such as light, temperature and moisture (Iglesias *et al.*, 2015).

The aim of the study was to determine the changes in tomato chemical concentration depending on the plant growth season.

MATERIALS AND METHODS

The study examined four tomato varieties: Bolzano F1 (yellow, mean weight 100–120 g), Chocomate F1 (brown, mean weight 80–110 g), Encore F1 (red, mean weight 90–100 g) Strabena F1 (red cherry, mean weight 18–26 g). The plants were grown in an industrial greenhouse “Mežvidi” in a conventional way, using additional light. Tomato plants were grown and analysed from September 2018 to June 2019.

Tomato sampling. All fruits for analysis were harvested at fully ripening stage in two vegetation periods — autumn (November) and spring (March). For each variety, 30 fruits were sampled per replication. Seven tomato fruits having similar size and colour of each variety were randomly selected for analysis, weighed, hand-rinsed with pure water, blotted with a paper towel, homogenised and immediately analysed. Puree samples were obtained and triplicate samples were taken to measure the content of lycopene, β -carotene, total phenolic compounds, and soluble solids.

Chemicals and measurements. All the reagents used were analytical grade from Sigma Aldrich, Germany. An UV spectrophotometer UV-1800 (Shimadzu Corporation, Japan) was used for absorbance measurements, and content of total soluble solids was measured refractometrically (Digital handheld refractometer DR301-95, A.KRÜSS Optronic).

Analytical methods. Determination of total phenolic compounds. The homogenised tomatoes samples (1.0 ± 0.001 g) were extracted with a 10 ml methanol/ distilled water/hydrochloric acid (79/20/1 v/v/v) solution for 30 min with occasional shaking at room temperature. The extracts were then centrifuged in a centrifuge Hermle Z383 at 5000 min^{-1} for five minutes. Residues were re-extracted using the same procedure. The extraction process was performed in triplicate. The total phenolic content (TFC) of the tomatoes ex-

tracts was determined according to the Folin-Ciocalteu method (Singleton *et al.*, 1999). To 0.5 ml of extract, 2.5 ml of Folin-Ciocalteu reagent (diluted ten times with water) was added and after three minutes, 2 ml of sodium carbonate water solution Na_2CO_3 ($75 \text{ g} \cdot \text{l}^{-1}$) was added. The sample was mixed. After 30 minutes of incubation at room temperature, the absorbance was measured at 765 nm. Total phenol content was expressed as gallic acid equivalents (GAE) 100 g^{-1} fresh weight (FW) of the sample.

Determination of β -carotene. For extraction a representative portion of a tomato sample ($0.5 \pm 0.0001 \text{ g}$) was accurately weighed in a glass test tube. Then 10 ml of solvent (ethanol, 97%) was added and the test tubes were held for 30 min with occasional shaking at room temperature and finally centrifuged for 5 min at 5000 min^{-1} . Residues were re-extracted using the same procedure. The extraction process was performed in triplicate. The absorbance of supernatant was analysed spectrophotometrically by absorption measurements at 350 to 700 nm and calculated in accordance with Nagata and Yamashita (1992).

Determination of lycopene content. For extraction, $1.0 \pm 0.001 \text{ g}$ of tomatoes puree was accurately weighed in a glass test tube. Then 10 ml of solvent tetrahydrofuran (THF) was added and the test tubes were held for 30 min with occasional shaking at room temperature and finally centrifuged for 5 min at 5000 min^{-1} . Residues were re-extracted using the same procedure. The extraction process was performed in triplicate. The absorbance of supernatants was analysed spectrophotometrically by absorption measurements at 350 to 700 nm and calculated in accordance with Nagata and Yamashita (1992).

Determination of titratable acidity. Titratable acidity (TA) was determined titrimetrically. For determination, $2 \pm 0.001 \text{ g}$ of tomato puree was quantitatively transferred in 50 ml tubes, 20 ml of distilled water was added, mixed thoroughly and occasionally shaken at room temperature. After 30 minutes, the solutions were centrifuged for 10 min at 5000 rpm. For determination, 5 ml of the supernatant was titrated with 0.1 M NaOH in presence of indicator phenolphthalein and the results expressed as g of citric acid 100 g^{-1} tomato sample (FW).

Determination of total soluble solids. The total soluble solids concentration ($^{\circ}\text{Brix}$) was measured directly with a refractometer (A.KRÜSS Optronic Digital Handheld

Refractometer Dr301-95), calibrated at 20°C with distilled water.

The Taste Index (TI) was calculated using the equation proposed by Narvez *et al.* (1999) and Nielsen (2003)

$$TI = \frac{^{\circ}\text{Brix}}{TA} + TA$$

Statistical analysis. Experimental results were means of three replications and were analysed using Microsoft Excel 2010. Analysis of variance (ANOVA) and the Turkey's test were used to determine differences among samples. Differences were considered as significant at $p < 0.05$.

RESULTS

Red and brown tomatoes may be interesting for consumers as rich sources of the antioxidant lycopene, but the content of biologically active substances changes depending on the tomato growth season. The obtained results showed that tomatoes harvested in autumn (at the beginning of the plant vegetation season in greenhouses) contain more pigments (lycopene and β -carotene) than in spring (in the middle or end of the vegetation season in greenhouses). In autumn, the content of lycopene changes from $0.23 \pm 0.07 \text{ mg} \cdot 100 \text{ g}^{-1}$ FW in yellow tomatoes (cv. Bolzano) to $6.46 \pm 0.28 \text{ mg} \cdot 100 \text{ g}^{-1}$ FW in red cherry tomatoes (cv. Strabena) (Table 1). A significant ($p < 0.05$) difference also was observed in lycopene concentration of tomato varieties growing in spring, but the content of this pigment was lower than in autumn on average by 6% (brown and cherry tomatoes) to 50% (yellow tomatoes).

The concentration of β -carotene depends on tomato colour and size, as well as on growing season. In both growing seasons the level of the provitamin A carotenoid β -carotene varied according to the sequence red cherry red big yellow brown. In autumn, cherry tomatoes Strabena contained the highest concentration of β -carotene ($8.84 \pm 0.13 \text{ mg} \cdot 100 \text{ g}^{-1}$ FW), and in spring the pigment concentration was significantly ($p < 0.05$) lower ($6.25 \pm 0.18 \text{ mg} \cdot 100 \text{ g}^{-1}$ FW). Of the large-fruited tomatoes, at the beginning of vegetation season (autumn), the highest concentration of β -carotene was found in red tomatoes (var. Encore) — $6.19 \pm 0.11 \text{ mg} \cdot 100 \text{ g}^{-1}$ FW, but a significant lower concentration oc-

Table 1. Concentration of β -carotene and lycopene depending on growing season

Tomatoes variety	β -carotene $\text{mg} \cdot 100 \text{ g}^{-1}$ FW		Lycopene $\text{mg} \cdot 100 \text{ g}^{-1}$ FW	
	Autumn	Spring	Autumn	Spring
Bolzano F1	5.82 ± 0.11	5.36 ± 0.10	0.23 ± 0.08	0.10 ± 0.02
Chocomate F1	4.49 ± 0.13	4.21 ± 0.11	3.26 ± 0.09	3.07 ± 0.09
Encore F1	6.19 ± 0.15	5.87 ± 0.10	4.63 ± 0.12	4.27 ± 0.13
Strabena F1	8.84 ± 0.12	6.25 ± 0.11	6.46 ± 0.12	5.25 ± 0.08
FW, fresh weight				

curred in spring (in all large fruited tomatoes by 5 to 10%). Unfortunately, the consumer's favourite brown and yellow tomatoes contained on average 1.5 to 2 times less beta carotene, regardless the growing season.

Growing season significantly affected the total phenolic concentration (TPC) of all tested tomato varieties. The highest TPC was observed for cherry tomatoes (36.35 ± 1.25 mg GAE·100 g⁻¹FW) in autumn, and was lower by ~5% in spring (Fig. 1). The large-fruited tomatoes contained less phenolic compounds, but they are more stable regarding change in concentration across seasons — TPC concentration 19.66 ± 1.31 mg GAE·100 g⁻¹ FW and 18.85 ± 1.31 mg GAE·100 g⁻¹ FW in autumn and spring, respectively. In comparison, TPC in yellow and brown tomatoes decreases by 12–15%, comparing autumn and spring seasons.

The content of soluble solids expressed as °Brix were variable and tomato variety and growing season had significant ($p < 0.05$) effect. Concentration soluble solids had the following sequence in both seasons: red cherry brown yellow red. The concentration of soluble solids varied from 3.98 ± 0.25 °Brix (red tomatoes var. Encore) to 6.12 ± 0.25 °Brix (cherry tomatoes cv. Strabena) in autumn and from 3.37 ± 0.31 Brix (red tomatoes var. Encore) to 6.05 ± 0.14 °Brix (cherry tomatoes cv. Strabena) in spring.

The taste index was calculated using the values of the °Brix degree (Fig. 2) and titratable acidity (Table 2) following the equation suggested by Navez *et al.* (1999), which calculates the ratio between total soluble solid (TSS) concentration and titratable acidity (TA). Tomato fruits growing in autumn had a greater TSS/TA ratio than those harvested in spring. The cherry tomatoes had a taste index mean value of 1.11–1.10 (in autumn and spring, respectively). This was significantly higher ($p < 0.05$) than the values for the large size tomatoes. The lowest taste index was found for red large size tomatoes and ranged from 0.89–0.82 (in autumn and spring, respectively) (Fig. 3).

In general, all average parameters for the cherry type tomatoes were noticeably higher than for large types/varieties.

Fig. 1. Concentration of total phenols depending on variety and growing season.

Fig. 2. Concentration of soluble solids depending on variety and growing season.

Table 2. Titratable acidity of tomatoes depending on growing season

Tomatoes variety	Autumn TA as g of citric acid 100 g ⁻¹ tomato sample (FW)	Spring TA as g of citric acid 100 g ⁻¹ tomato sample (FW)
Bolzano F1	0.474 ± 0.069	0.368 ± 0.081
Chocomate F1	0.546 ± 0.072	0.377 ± 0.038
Encore F1	0.471 ± 0.047	0.398 ± 0.063
Strabena F1	0.545 ± 0.0261	0.512 ± 0.098

FW, fresh weight

Fig. 3. Tomatoes taste index depending on variety and growing season.

DISCUSSION

The range of available tomato varieties and colours gives consumers a wide variety of choices and, taking into account modern technologies and capabilities, it is possible to buy and use tomatoes all year round. Tomatoes are source of lipophilic antioxidants, such as lycopene and β-carotene, as well as hydrophilic antioxidants (phenolics and flavonoids). The most popular among consumers are smaller (cherry type) tomatoes available in different colours.

Lycopene, the red coloured carotenoid in tomatoes, has various health benefits for humans due to its capability of scavenging free radicals. It is one of the strongest natural antioxidants known and the main carotene in ripe tomato (Xie *et al.*, 2019). Therefore, tomatoes are recommended by health specialists.

Consumers consume tomatoes all year round and it is important for them to know how the biological value of these products changes depending on the growth season. In industrial greenhouses, the tomato growth season usually begins in autumn (August and September) and the first fruits are harvested around November. Then, using additional lighting, the growth season continues until spring, summer. Of course, the length of vegetation season affects the concentration of phytonutrients.

In our study, the concentration of lycopene in cherry tomatoes was considerably higher than that detected in big size tomatoes, regardless of tomato colour, but lower concentration was determined for yellow tomatoes. The results reported here are in line with previous studies (Markovic *et al.*, 2006; Bojarska *et al.*, 2020) in which lycopene concentration in fresh tomatoes ranged from 1.82 to 11.19 mg·100 g⁻¹ wet weight; similar also to values reported by Asensio *et al.* (2019) and Coyago-Cruz *et al.* (2019) as well to our previous results (Dūma *et al.*, 2018), but lower than those reported by Marti *et al.* (2016). The lycopene concentration was on average 30% higher in red tomatoes than in brown tomatoes. A significantly ($p < 0.05$) lower lycopene concentration (by 6% to 50%) of tomato varieties was observed in spring.

The second main coloured carotenoid present in tomato is β -carotene, one of the lipophilic antioxidants. In general, the forming and accumulation of biological active compounds in fresh biological systems are significantly influenced by different factors including genotype (Coyago-Cruz *et al.*, 2017; Flores *et al.*, 2017), growing conditions (Anton *et al.*, 2017), and the stage of fruit maturity, which is one of the most important factors that determines the levels of phytonutrients in tomatoes (Nour *et al.*, 2015). The obtained results showed that the concentration of β -carotene significantly ($p < 0.05$) depended on tomatoes colour and size, as well as on growing season. In both growing seasons, the highest level of β -carotene was found in red cherry tomatoes. According to Bojarska *et al.*, 2020, small-fruited tomatoes show significantly higher carotenoid concentration than large-fruited varieties. However, a previous study (Garande and Patil 2014) reported that yellow tomatoes contain more β -carotene than red tomatoes. The obtained results are similar to findings of Coyago-Cruz *et al.* (2019), but were lower than those reported in other studies on tomatoes of this class (Asensio *et al.*, 2019). Cortés-Olmos *et al.* (2014), explains the difference by the fact that the analysed tomatoes were not of the same maturity.

Our study showed that cherry tomatoes contained on average 1.5–2 times more β -carotene, but among varieties they

showed the largest difference in β -carotene concentration between autumn and spring growth seasons. The concentration β -carotene in red tomatoes differed on average by 8%, in brown tomatoes by 6%, in yellow tomatoes by 8%, and in cherry tomatoes by 29%, comparing autumn and spring seasons. This means that cherry tomatoes are more useful as a source of beta carotene at the beginning of the plant vegetation season, while large fruited tomatoes are considered to be a source of this lipophilic antioxidant regardless of the time of harvest and the duration of cultivation.

Fruit and vegetables are rich sources of different classes of plant secondary metabolites that have a polyphenolic structure (Alenazi *et al.*, 2020). Phenolic compounds are well known natural antioxidants in food and their antioxidant activities are well established. They inhibit autoxidation of lipids, and due to their high antioxidant properties, consumption of food containing phenolic compounds will remain an area of great interest (Alenazi *et al.*, 2020).

The varieties of tested tomato samples in two vegetation periods differed in total phenolic concentration and the average values of TPC differed significantly. It was concluded that small-fruited tomatoes have the highest concentration of phenolic compounds, especially in autumn, and the concentration is lower by ~5% in spring. The results reported here are in line with the data presented by Asensio *et al.* (2019) and Alenazi *et al.* (2020), and slightly lower than in other reports (Dūma *et al.*, 2018; Bojarska *et al.*, 2020). However, it should be noted that the comparison is often difficult due to the great influence of agronomic factors such as varieties, growing conditions and harvesting time.

Cherry type tomatoes very often have high concentration of soluble solids compared with large-fruited tomatoes. Our study showed that SSC values for cv. Strabena differed from 6.12 ± 0.11 in autumn to 6.05 ± 0.09 °Brix in spring. This means that these tomatoes have high quality regardless of the harvesting season, as the range of 4.8–8.8 the °Brix indicates the highest quality of tomato. According to Manzo *et al.* (2018), the TSS in cherry type tomatoes can range from 6.3–8.5 °Brix. The highest concentration of soluble solids in large fruited samples in autumn was found for brown tomatoes (6.48 ± 0.05 °Brix), but the lowest in red fruits (3.98 ± 0.07 °Brix). Another study found that SSC in large-fruited tomatoes can range from 4 to 6 °Brix (Ajdanian *et al.*, 2020). Compared to the autumn, in spring, TCC was lower by 6% (yellow tomatoes) to 15% (red tomatoes).

Taste index, which is the ratio between TSS and titratable acidity, is an important parameter for characterising tomato flavour. The highest taste value was found for cherry type tomatoes, and the lowest for red tomatoes, regardless of the harvesting season. The sugar-acid ratio is mainly associated with fruit maturity. With maturity, organic acid concentration decreases while sugar concentration tends to increase. Therefore, the ratio is higher in mature fruits.

CONCLUSIONS

The chemical composition of tomato depends on the variety as well as on growing season. Based on our results, we can conclude that tomatoes harvested in autumn contain more biologically active substances than in spring, which can be explained by the fact that many biological processes in plants occur more rapidly at the beginning of the vegetation season than in the middle or end of the vegetation season. Therefore, the concentration of secondary metabolites in tomatoes increases. The overall results of the present work study showed that cherry type tomatoes had the highest concentration of biologically active compounds.

In autumn, cherry tomatoes Strabena contained the highest concentration of pigments, total phenols and soluble solids, and the taste index of this variety is also the highest. In the spring season, pigment concentration was significantly lower ($p < 0.05$), but the decrease of phenols and soluble solids concentration was not significant. Of the large-fruited tomatoes, at the beginning of the vegetation season, red tomatoes (cv. Encore) had the highest amounts of pigments, but yellow tomatoes cv. Bolzano were rich in phenolic compounds. The consumer favourite brown tomatoes cv. Chocomate had the highest soluble solids concentration and second highest taste index. Comparing the obtained results in the tomatoes harvested in spring, the concentration of biologically active substances was lower on average by 5–30%, regardless of the colour, size and variety of tomatoes.

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DAŽĀDU KRĀSU TOMĀTU KVALITĀTE ATKARĪBĀ NO AUDZĒŠANAS SEZONAS

Tomāti ir labi zināmi dārzeņi, kas plaši tiek izmantoti uzturā visa gada garumā. Sarkanie tomāti satur antioksidantu likopēnu, bet dzeltenajos tomātos ir atrodams β -karotīns. Brūno tomātu izmēri ir mazāki par vidējo, taču tie ir saldāki, jo satur vairāk fruktozes. Lai gan ķiršu tomāti ir vieni no mazākajiem komerciāli pieejamajiem tomātiem, tiem raksturīgs liels karotinoīdu, likopēna un fenola savienojumu saturs, kā arī tiem ir izteikti salda garša. Pētījuma mērķis bija novērtēt, kā mainās bioloģiski aktīvo vielu saturs dažādu krāsu tomātos atkarībā no tomātu veģetācijas perioda — rudens sezonā (novembrī) un pavasara sezonā (martā). Iegūtie rezultāti parādīja, ka rudens sezonā novāktajos tomātos ir vairāk bioloģiski aktīvo vielu nekā pavasara sezonā, kas izskaidrojams ar to, ka daudzi bioloģiskie procesi augos veģetācijas sākumā notiek straujāk. Rudens sezonā ķiršu tomāti Strabena satur visvairāk pigmentu, kopējo fenolu un šķīstošo vielu daudzumu, tāpēc arī šīs šķirnes garšas indekss ir visaugstākais. Pavasara sezonā pigmentu saturs ir ievērojami mazāks (vidēji par 20–30%), bet fenolu un šķīstošo vielu samazinājums nav tik ievērojams — vidēji 2–4%. No lielaugļu tomātiem veģetācijas sākumā (rudens sezonā) visvairāk pigmentu satur sarkanie tomāti (Encore) — likopēna saturs $4,63 \pm 0,04 \text{ mg} \cdot 100 \text{ g}^{-1}$; dzeltenie tomāti Bolzano ir bagāti ar fenola savienojumiem — $128,46 \pm 3,25 \text{ GAE mg} \cdot 100^{-1}$, bet brūnajiem tomātiem Chocomate bija vislielākais šķīstošo vielu saturs — $4,48 \pm 0,05 \text{ Brix}^\circ$. Salīdzinot iegūtos rezultātus, pavasara sezonā novāktajos tomātos bioloģiski aktīvo vielu saturs samazinājās vidēji par 10–15% neatkarīgi no tomātu krāsas un šķirnes.