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BIOACTIVE COMPOUNDS IN FRESH GARDEN VEGETABLES

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Abstract
Plant-based foods are rich in bioactive compounds such as flavonoids, anthocyanins, tannins, betalains, carotenoids, plant sterols and glucosinolates. These compounds were extensively investigated due to their benefits for human health, and their positive effects as cardioprotector and hepatoprotector as well as theanticarcinogenic effect were widely discussed. Six tomatoes and three pepper types were investigated in this study regrarding their bioactive content. All the methodsapplied were spectrophotometric. The total phenolic content ranges from 29.3 mg GAE/100g in cherry tomatoes to 199.2 mg GAE/100g in kapia pepper. Flavonoids content ranges from 3.1 mg QE/100g in pink tomato to 28.9 mg QE/100g in kapia pepper. The pigment content of the tested vegetables shows, as expected, that green pepper practically is deprived of lycopene and β-carotene. In all other tested samples lycopene is predominant over carotene, much more obvious for tomatoes than for peppers. The highest lycopene content was determined in Sultana tomato TS (234 µg/g) and kapia pepper (201.8 µg/g) and the highest βcarotene content in red pepper (139 µg/g). The tomatoes' vitamin C content ranges from 27.9 mg% to 55.8 mg%and is much higher in all pepper samples, from 94.3 mg% to 98 mg%. The experimental results of the study showed that fresh tomatoes and peppers are a valuable source of bioactive compounds in our diet. Among the tested vegetables, kapia pepper type showed the highest investigated bioactive compounds content.

Key words: tomatoes, peppers, phenolics, vitamin C, lycopene, β-carotene

INTRODUCTION

Given the fact that food quality highly affects human health, the studies regarding their specific composition are conducted on both animal and vegetal foodstuff. The latter are rich in bioactive compounds such areflavonoids, anthocyanins, tannins, betalains, carotenoids, plant sterols and glucosinolates.They are defined as components of food that have an impact on physiological or cellular activities in the humans or animals that consume such compounds(Waliaet al., 2019)

A healthy diet includes the consumption of fruits and freshvegetables, such as tomatoes and peppers. The use of greenhouses enabled the consumption of fresh produceall year long.

Tomatoes (*Lycopersiconesculentum*Mill.) have been cultivated in Europe, in the Mediterranean countries since the 16thcentury,nowadays being the most important garden crop. A large number of tomatoes and pepper cultivars are proposed to consumers and they provide important health benefits due to their rich bioactive components.Regarding tomatoes we can nominatecarotenoids such as βcarotene, a precursor of vitamin A, and mostly lycopene, which is responsible for the red colour. As a matter of fact, tomatoes and tomato-based products account for over 85% of all the dietary sources of lycopene (Pinela et al., 2016).They are rich also in vitamins especially ascorbic acid, tocopherolsand phenolic compounds including hydroxycinnamic acid derivatives and flavonoids. Analytical methods of antioxidants extraction and determination in vegetables were reviewed byGarcia – Salas et al., 2010 and Gomez-Romero et al., 2007.

Peppers can be very diverse in shape, colour ortaste. They belong to the genus *Capsicum. C. annuum, C. frutescens, C. chinense, C. pubescenes and C. baccatum. C. annuum* is the more common as garden or field crop. Peppers provide a large type of phytochemicals as pigments (carotenoids and antocyanins), vitamins, phenolic acids and flavonoids (Abdul-Hamed et al., 2019). Capsaicinoids are responsible for the pungent taste of some bell peppers (Nagy et al., 2015).

The bioactive content can be affected by a lot of factors in both investigated vegetables. We can mention the maturity stage (Duma M et al, 2018),environmental and geneticcultivar or variety factors (Medina-Juárez et al.,2012,Mladenovics et al., 2014), geographicallocation and agricultural practices(Ulrichs et al., 2008) or processing conditions (Devanand et al., 2006,KacjanMaršić et al., 2009,Mirdehghanand Valero, 2016).

A lot of scientific studies reveal the health benefits of the bioactive compounds contained in the above-mentioned horticultural products by direct consumption or throughsingular and combined extracts. Positive effects, such as cardioprotection and hepatoprotection, as well as the anticarcinogenic effectwere under discussion. (Pinela et al., 2016).Nevertheless, the role of bioactive compounds in human health is not completely clarified by scientific studies and further investigations are needed in order to reveal their potential (Walia et al., 2019).

The aim of this study was to determine and to compare the amount of bioactive compounds content in some tomato and peppers genotypes cultivated in the Oradea area.

MATERIAL AND METHOD

Material

The tested materialcomprises six tomato types and three pepper types, codded as follows:

- round cherrytomato (TRC), oblong cherry tomato (TOC), oblong summer tomato (TOS), pink tomato(TP), Sultanatomato (TS), autumn tomato(TA)

- Yellow pepper (PY), red pepper (PR), Kapia pepper (PK)

The vegetableswerecultivated during the summer of 2019 in private gardens from Biharia and Oradea. The experiments were conducted in the food control laboratory of the Food Engineering Department, Environmental Protection Faculty, University of Oradea.

Methods

Ethanol (50%) was used for phenolic extraction in a 1:10 ratio for both Total Phenolic Content(TPC) and flavonoids(FL) determination, after an appropriate dilution. TPCwas determined using Folin-Ciocâlteuspectrophotometric method developed by Singleton and Rossi (1965) and adapted for vegetables by Moigrădeanet al, 2007. The reaction mixture contains the appropriate dilutedextract,Folin-Ciocâlteu reagent and natrium carbonate 7.5%.After 2 hours the absorbance was read at 750nm. Gallic acid, from 0.2 to 1.2 μM/mL was the used standard and results were expressed as mg GAE/100g FW.

FL was determined using the spectrophotometric methodbased on the formation of chelated compounds between flavonons,flavonols andaluminum chloride in methanol. (Kroyer and Molnar, 2011, Bahorun et al, 2004). The absorption of the reaction mixture containing ethanol extract,NaNO 25%, 3 $AlCl_3$ $6H_2O$ 10% and NaOH 1M was read at 510 nm against reagents blank. The used standard was quercetine 0-100 mg/L in methanol and results were expressed as mg QE/100g FW.

The pigments, β-carotene and lycopenewere extracted in a hexane:ethanol:acetone 2:1:1 mixed solvent (Sharma and Le Maguer,1996). The absorbance of the organic layer, dried on anhydrous sodium sulphate,was read at 450 and 502 nm. Calculations were performed by Abdul-Hammed et al., 2012 method, β-caroten = $(1.483 \times A_{450} - A_{502})/1.798 \times 10^5$andlycopene = $A_{502}/1.72 \times 10^5$.

Vitamin C was extracted with metaphosphoric acid and spectrophotometric determinate by Beltran–Orozco et al., 2009, method. Ascorbic acid reacts with 2:6-diclorphenol indophenol (DCPIP) which changes its colour from blue to colourless in acetate buffer (pH4) environment. The reaction product was extracted in xylene and the absorbance read at 520nm. Pure ascorbic acid between 0.1mg/ mL and 1mg/ml concentration was used for the calibration curve.

The results represent the mean of two determinations at each sample for all tested parameters.

RESULTS AND DISCUSSION

Figure 1 presents the TPC and FL content of the tested samples. Regarding phenolic content, the values range from 29.3 to 199.2, the highest being determinate in red colour peppers.The registered values for tomatoes in our study are higher than the ones reported by Moigradean et al., 2007 (16 - 23 mg GAE/100 g) or Duma et al, 2018 (max 12.7 mg GAE/100 g for green house tomatoes).

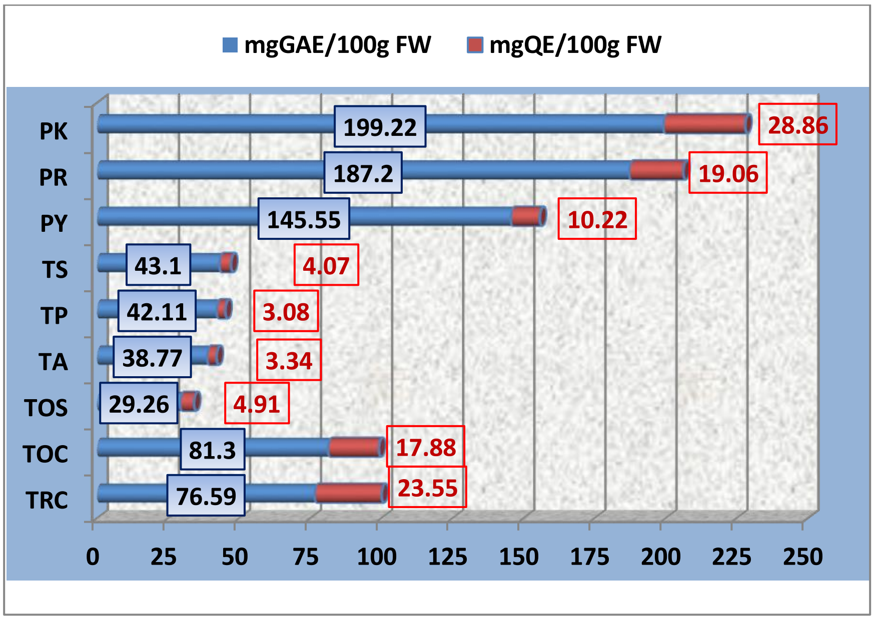

Fig.1 –Total phenolic and flavonoids content

They are in agreement with the ones found by Helyes and Pek, 2006 (33 - 48 mg GAE/100 g), aside from cherry tomatoes, where we determined a double TPH content. In what regards peppers, our experimental values are higher than the ones found by Shotorbani et al 2013 for yellow (30 mg GAE/100 g) and red (90 mg GAE/100 g) peppers and comply to those reported by Zhuang et al, 2012 (107 to 499 mg GAE/100 g).

As for the FL content, it ranges from 3.1 to 28.9 mg QE/100 g FW. Again, red pepper varieties present the highest values, but cherry tomatoes are close (23.5mg QE/100 g). Others tested tomato varieties revealed up to a six times lower FL content, which complies with Shotorbani et al 2013 (2.5 to 7.5 mg QE/100 g FW). However, the comparisons are rather difficult due to the differences of experimental procedures or the results expression.

Figure 2 shows the pigment content of the tested vegetables and, as expected, green pepper practically is deprived of lycopene and β-carotene. In all cases lycopene is predominant over β-carotene, much more obvious for tomatoes than for peppers. The highest lycopene content was determined in tomato TS (234µg/g) and pepper PK (201.8 µg/g) and the highest β-carotene content in PR pepper (139 µg/g).The differences in pigment content among the tested tomatoes types are significant.

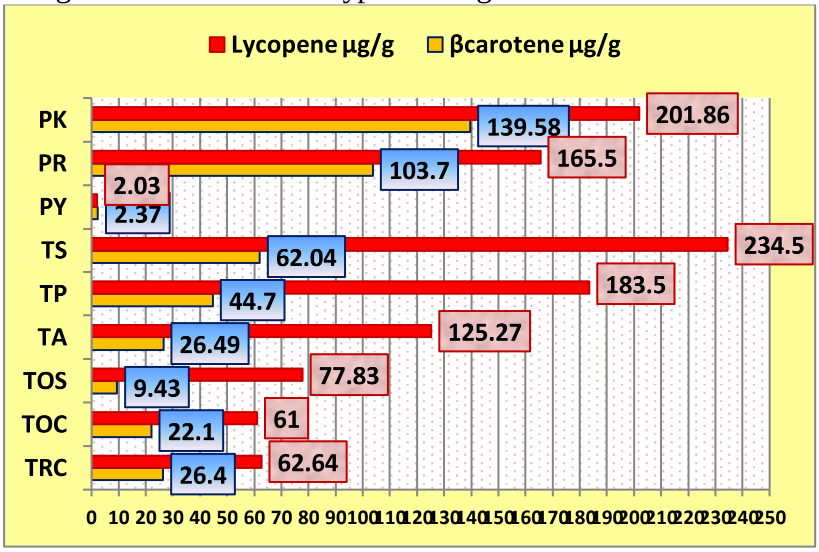

Fig.2 – The pigment content

Therefore the values range from a minimum 61µg/g to a maximum 234 µg/gfor lycopene and for from 9.4 µg/g to 62µg/g for β-carotene. That is not an unusual situation, Duma et al, 2018 reported for red mature tomatoes lycopene content from 31 to 270 µg/g and Mladenovic et al., 2014 reported for β-carotene values from 0.5 to 45 µg/g.

The experimental results presented in figure 3 refer to vitamin C content of the tested vegetables. They show a double amountof vitamin C for all tested peppers than tomatoes, with a maximum of 98 mg% in PR.

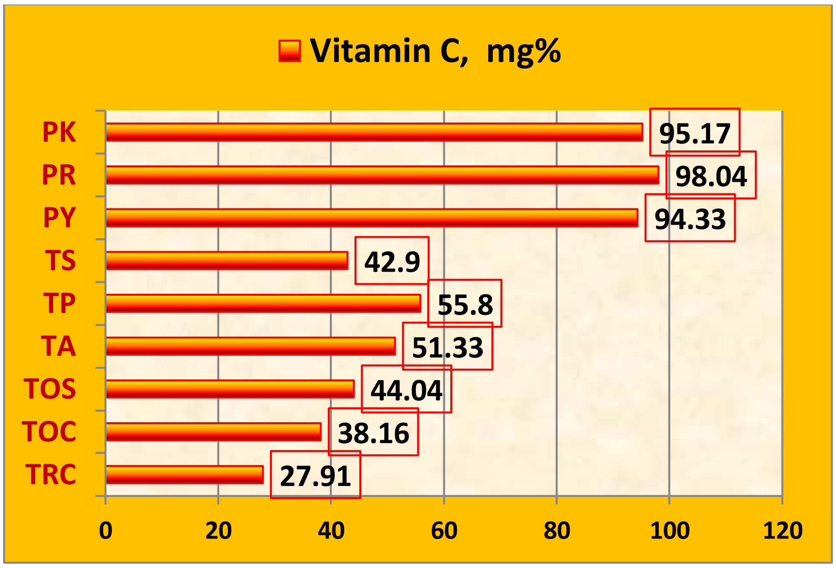

Fig.3 – The vitamin C content

The vitamin C content of tomatoes ranges from 27.9 mg% to 55.8 mg%. The results of our experiment complies with the ones reported by Chavez-Mendoza et al, 2013, for peppers(135 mg/%)and fortomatoes by Valšikova, et al, 2010, (max 34,5 mg%), Duma et al, 2018 (max 22.8mg%) or Mladinovic et al., 2014 (max 37mg%).

CONCLUSIONS

The experimental results of the study lead to some conclusions starting with the fact that fresh tomatoes and peppers are a valuable source of bioactive compounds in our diet. Among the tested vegetables, kapia pepper type showed the highest investigated bioactive compounds content.

Considering total phenolic content, peppers show significant higher content than tomatoes, kapia pepper being the leader as well as for flavonoids content. In the same time, we can observe a great variability among the tested tomatoes types referring to their phenolic content.

Peppers also lead in terms of vitamin C content and there is no significant difference regarding vitamin C between tomatoes tested types.

Besides green pepper, all tested vegetables are an important source of pigments.Peppers are a better source of β-carotene than tomatoes and their lycopene content is at the same level as in some tomato types, which showsignificantly different values for this parameter.

These conclusions emphasise the fact thatthe content of bioactive compounds in tomatoes and pepper is strongly dependant on the variety and, for a balanced diet, the consumption ofa wide variety of vegetables is advisable.

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