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NUTRITIONAL QUALITY PARAMETERS OF THE FRESH RED TOMATO VARIETIES CULTIVATED IN ORGANIC SYSTEM

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Abstract

Production of tomatoes in the organic system is very important because these are not only the most vegetables widely consume (the second after potato) but also are classified as a functional food. Due to the high content in bioactive compounds, especially lycopene, tomatoes provide nutritional properties and also contribute to maintaining health. In this context, the aim of this study is to compare the nutritional quality parameters of two organic red tomato varieties, 'Coeur de Boeuf' and 'Cher Ami' grew under controlled conditions in a hi-tech glass greenhouse. The quality parameters analyzed were the titratable acidity, total soluble solids, dry matter, carotenoid and lycopene content. The highest total soluble solid content, lycopene and carotenoid content were obtained from 'Cher Ami' variety.

Key words*: organic tomato, lycopene, carotene, nutritional, quality.*

INTRODUCTION

The market demand for the high quality organic products increases from year to year and is led to a change in the production strategies of the greenhouse industry in terms of cultivation in larger and more frequent quantities of some species with thermal requirements such as cucumbers, hot peppers, red melon, red melon, green beans, eggplant, etc. (FAO 2013).

Fruits quality is an important factor for market value, transportation, and storage requirements. Tomato is a very important crop, being an integral part of the diet worldwide. The world production of tomatoes has increased in the last five years, from 165,295,864 tons in 2013 to 182,301,395 tons in 2017 (FAOSTAT 2019). Tomatoes availability, good taste, low price, and distinct health benefits are unique features that make it a popular and highly demanded vegetable among adults and children. (Salehi, 2019).

Many scientific studies have shown that tomatoes are an important source of carotenoids (lycopene, neurosporene, phytoene, β-carotene, and lutein). Lycopene is the most beneficial tomato compound with important health effects, having a higher level of antioxidant activity (Singh, 2008; Ilahi, 2011; Basuny, 2012; Abete, 2013; Stice, 2018; Chen, 2019; Yin, 2019; Zeng, 2019).

Palozza et al. (2011), Soares et al. (2017), Mohri et al. (2018) and Navarro-Gonzalez et al. (2018) revealed that lycopene may inhibit cell invasion, angiogenesis, and metastasis and can have an anti-inflammatory and hypocholesterolemic effect.

The consumption of tomatoes can have also the following benefits: radioprotective effects, protection against degenerative diseases including cardiovascular diseases and age-related macular degeneration (Mendelová, 2013, Islamian, 2015, Alam 2018). According to European Commission 2015 and Regulation (EU) 2018/1023, the recommended daily serving of lycopene must not exceed 15mg.

The amount of lycopene and total carotenoids content can vary with the variety, degree of ripeness, climatic conditions and agricultural practices. According to European legislation regarding organic crops, the organic products, compared to the conventional ones, have a higher amount of antioxidant compounds, are

free of heavy metals and pesticides (Rao, 1998; Araujo, 2014; Lahoz, 2016; Bosona, 2018; Ronga, 2019).
This study evaluates the physico-chemical parameters, dry matter, soluble solids, titratable acidity, carotenoids content and lycopene content of two organic tomato varieties. A fast and simple spectrophotometric method for analysis of carotenoids and lycopene was made.

MATERIALS AND METHODS

The organic crop of tomatoes ('Cher Ami' and 'Coeur de Boeuf' varieties) were cultivated in hi-tech glass greenhouse using the PRIVA program for the greenhouses. The planting was started in March 2018. The plants were not grafted and were used only hybrids.

Figure 1. Tomatoes of *'Cher Ami'* variety

The soil was mixed up with manure and cover with white plastic folia. The fertilization was made also with organic liquid fertilizers.
For the protection of the crop *Encarsia* sp., *Macrolophus* sp. and pheromone traps were used.

Bio Culture Cluj / photos
Figure 2. Tomatoes of 'Coeur de Boeuf' variety

The tomatoes of 'Coeur de Boeuf' variety can be harvest until the beginning of October, while the tomatoes of the cherry specialties until the end of November.

'Coeur de Boeuf' variety (Figure 2) it is indigenous to Italy and South of France and have irregular shape, a dense texture, and delicious flavor (Bareham, 2012).
The following tomatoes quality parameters were evaluated for: dry matter, total soluble solids, firmness, titratable acidity, lycopene, and carotenoids content) The experimental work was made in the laboratories of Research Centre for Study of Food and Agricultural Products Quality, USAMV of Bucharest.
Determination of the **dry matter (DM)** and humidity was achieved by drying of the fresh tomatoes and for 24 hours at 105 °C until a constant weight was reached. (European Pharmacopoeia 7.0-2.2.32.).
Soluble solids content (TSS) was determinate using a Kruss Digital Handheld Refractometer. The results were expressed in percentage °Brix (%) according to (UE) No. 974/2014 Regulation.
For determination of the **titratable acidity (TA)** the samples were homogenised with distilled water and titrated with 0.1 N NaOH until reaching of 8.1 pH. The results been calculated using the following formula and expressed as percentages of citric acid content (Saad et al., 2014):

Percent of titratable acidity =
(V x N x 100 x 0.0064)/m,

where N is the normality of NaOH, 0.0064 is the conversion factor for citric acid, V is the volume of NaOH used (mL) and m is the mass of tomato sample used (g).

Maturity index (MI) was calculated with following formula: °Brix of sample/titratable acidity (Mendez, 2011; Fruit juice –Technical guidance, 2016,)

Taste index (TI) was calculated after Mendez, (2011) and Figàs (2018) as follows:

TI=TA+((TSS/(20*TA))

where TA=titratable acidity, TSS= total soluble solids

Tomatoes varieties **firmness** was measured with the fruit penetrometer 53200.

Total carotene and lycopene content

The carotenoids pigments content was quantified after petroleum ether (PE) extraction method as follows: fresh sample was ground

using mortar and a small quantity of sea sand. The sample was washed repetitively with the extraction solvent until the residue was colorless. The absorbance of the etheric extract was measured at 452 and 472 nm against a petroleum ether blank, using Specord 210 Plus UV/VIS spectrophotometer. The total carotenoids content was calculated after Rodriguez-Amaya et al., (2004) and lycopene content after Pelissarii et al., (2016). The results were expressed as mg100 g^{-1} of fresh weight (FW).
The results were analysed using Office Excel ANOVA at the significance level of $p = 0.05$. All values are averages of triplicates assay.

RESULTS AND DISCUSSIONS

Results regarding the physico-chemical parameters of the 'Cher Ami' and 'Coeur de Boeuf' tomato varieties were presented in Table 1. Tomatoes of 'Cher Ami' had the higher TSS (5.35 %%) with 4.71% more than 'Coeur de Boeuf' tomatoes (Table 1). Aoun et al., (2013) also found that TSS range between 2.35 and 4.5%.
Both tomatoes variety, 'Coeur de Boeuf' and 'Cher Ami', showed a similar level of TA of about 0.4% (Table 1). This value of acidity of studied tomatoes is comparable to the results of Vînătorul et al. (2016) who found that TA range between 0.35%- 0.43%.

Table 1. Nutritional parameters of 'Cher Ami' and Coeur du Boeuf tomatoes varieties

Variety	TA (Citric acid %)	Firmness (kgf/cm^2)	DM (%)	TSS (%)	TI	MI
'Cher Ami'	0.41 ±0.00	0.73 ±0.03	6.85 ±0.02	5.35 ±0.11	1.06	13.03
'Coeur de Boeuf'	0.447 ±0.00	1.46 ±0.03	4.87 ±0.01	5.1 ±0.16	1.02	11.40

According to Aoun et al. (2013) and Tigist et al. (2011), higher fruit acidity can lower the development of diseases infections. They also mentioned that sugar/acid ratio could be an indicator for tomatoes flavor and taste quality for consumers' acceptability as well as to distinguish differences between varieties.

'Cher Ami' tomatoes have the higher **maturity index** of 13.03 compared to 'Coeur de Boeuf' tomatoes who was of 11.40 (Table 1). The results obtained are in concordance with Mendez et al. (2011), who obtained values of MI in thirteen tomato accessions ranging between 10.55 and 17.96. Maturity index (TSS/TA) with a higher value gives a smoother flavour of fruits and vegetables, whereas lower values are correlated with acid, so worse flavor (Araujo et al., 2014).
Taste index is another important parameter in determining the flavour quality correlated with MI. 'Cher Ami' and 'Coeur de Boeuf' tomatoes have similar taste index of 1.06 and 1.02 respectively (Table 1). These results are similar with the results found by Figàs et al. (2018) and Mendez et al. (2011).
The results for the **firmness** (Table 1) show that 'Coeur de Boeuf' variety had the highest value of 1.46 Kgf/cm^2, with 50.21% more than 'Cher Ami' variety (0.73 Kgf/cm^2).
Dry matter content was 6.85% for 'Cher Ami' variety and 4.87% for 'Coeur de Boeuf' variety (Table 1).

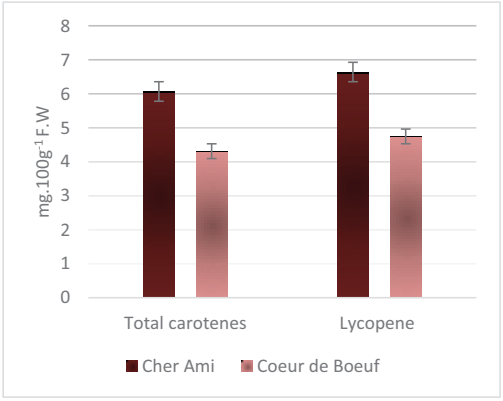

Figure 3. Total carotenes and lycopene content of 'Cher Ami' and Coeur du Boeuf tomato varieties

Lycopene content for 'Cher Ami' variety was of 6.64 mg.100 g^{-1}, while for 'Coeur de Boeuf' variety it was 4.74 mg.100 g^{-1}.
Total carotenoids content follow the same trend as the lycopene content (Figure 3). 'Coeur de Boeuf' variety had lower carotenoids content compared with the 'Cher Ami' variety. The results are in accordance with Astuti et al. (2018) and Palozza et al. (2011), who determined the lycopene content in tomatoes in

the range of 0.9-5 mg.100 g^{-1} FW. Vînătorul et al. (2016) found the lycopene content between 5.00-9.08 mg.100 g^{-1} FW. We can say that lycopene content depending upon variety. Dry matter of the both tomatoes varieties it was found that has a strong positive linear relationship with total carotenes and lycopene. This parameter is very important for tomatoes food products because the highest tomato total solids content amount will lead to less tomato to be used in food processing, according to Aoun et al. (2013).

CONCLUSIONS

The results showed that physicochemical quality of organic tomatoes varieties assessed as dry matter, total soluble solids, firmness, titratable acidity are depending on variety.

Both lycopene content and carotene content were in higher amount both in 'Cher Ami' variety and in 'Coeur de Boeuf'.

Organic tomatoes produced successfully under controlled conditions in a hi-tech glass greenhouse are a good source of nutritional quality parameters, which can be used in food and pharmaceutical industries.

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