

RESEARCH ON THE PHYSICO – CHEMICAL CHARACTERIZATION OF IMPROVED GENOTYPES FOR *LYCOPERSICON ESCULENTUM* MILL. OBTAINED IN THE ECOLOGICAL SYSTEM

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Abstract

Currently, world, horticultural producers and processors are concerned to obtain high quality organic products in conditions of economic profitability. The main aim of the research is to highlight the physico – chemical characteristics of some improved genotypes from the species *Lycopersicon esculentum* Mill. obtained in ecological system in the experimental field within USAMV Iasi in 2019. Thus, the aim was to highlight some qualitative parameters, respectively: titrable acidity, pH value, total dry matter content, soluble dry matter, vitamin c, carotene and lycopene content. The biological material was represented by 37 improved tomato genotypes in order to ensure competitive horticultural techniques. The 37 genotypes of *Lycopersicon esculentum* Mill. showed an average value of the total dry matter content of $7.07 \pm 0.5\%$, showing an oscillating amplitude of the lower delimited values of 4.64% (G223) and 17.9% (G265). The average pH value was 4.4 with limits that fell within the range of variation [4.15 – 4.85]. The content of vitamin C ranged between 14 mg/ 100 g and 29 mg/ 100 g. Other components with antioxidant value that have been shown in important proportions are represented by carotenes (2.36 – 21.22 mg/ 100 g) and lycopene (3.01 – 33.7 mg/ 100 g). This research results strengthens the data in the literature referring to the bioactive compounds of tomatoes emphasizing that the study was conducted for different genotypes grown in organic conditions.

Key words: tomatoes, chemical composition, carotenes, lycopene

Current studies investigate how consumers perceive the attributes of organic horticultural products, which in turn contribute to consumer's attitudes and intentions towards this category of products. The improvement of the assortment of tomato hybrids and cultivars is permanently needed, in order to satisfy the market request (Brezeanu P.M. *et al*, 2019).

Specifically, consumer's perceptions of the nutritional contributions (Robu M. *et al*, 2019), ecological well-being and price of organic products (Brezeanu P.M. *et al*, 2020) have strong effects on the utilitarian and hedonic attitude towards organic farming on the purchase of organic products from the commercial network (Brezeanu P.M. *et al*, 2016). Through the improvement of characteristics of tomatoes regarding the resistance to diseases, pests and unfavorable environmental factors, the possibility of pollution of the obtained food product and the agricultural ecosystem is strongly diminished (Brezeanu P.M. *et al*, 2019).

Some of the core values of consumers are health and welfare (Predescu C.N. *et al*, 2019,

Schiffman and Kanuk, 2010) as evidenced by the growing number of consumer who are concerned about the nutritional (Murariu O.C. *et al*, 2016; 2018) and antioxidant value of the foods they eat (USDA, 2001; 2002), trying to follow a healthy diet, consuming properly preserved foods without toxic residues, that can reduce the risk of obesity and chronic diseases (Miller and Cassady, 2012, Gonciarov M. *et.al*, 2015, Petcu C.D. *et al*, 2014, Petcu C.D. *et al*, 2019). As a result, when consumer decide to buy food, their health – related attributes become important (Petcu CD *et al*, 2020, IFICF, 2020).

This trend may contribute to increased sales of organic products, because organic foods are generally considered to have a higher nutritional content (Lea and Worsley, 2005).

Another reason for the increase in production and demand for organic products would be to prevent negative consequences for the environment. It should be noted that organic products are not grown or processed with conventional pesticides, synthetic fertilizers,

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bioengineering techniques or ionizing radiation (USDA, 2007).

According to national survey conducted by Simmons on consumer awareness of the economic impact, it was concluded that more than a third of consumers indicated that they are willing to pay more for environmental safety or ethical products than for conventional products (Socially Conscious Consumerism, 2007).

Data on some quality indices of organic horticultural products, which could contribute to the formation of an overview of the nutritional and safety properties of these products, appear with a fairly low frequency in the reference literature, especially when the consumer is interested in organic products that could be marked at present in Romania.

Changes in soil microbiota are an early and sensitive indicator of soil pollution being easily to measure accurately across a wide range of soil types and conditions (Ulea E. *et al.*, 2017).

To be successful, growers must produce a high yield of high-quality fruit, while holding production costs as low as possible (Brezeanu P.M., *et al.*, 2019). Therefore, many of the breeding goals focus on characteristics that reduce production costs or ensure reliable production of high yields with high-quality fruits (Yuling and Lindhout, 2007).

Tomatoes occupy one of the main places among the vegetable of horticultural species grown in areas with temperate climates, both in terms of production volume and demand on the markets. These products are foods of plant origin characterized by taste qualities, nutritional value, therapeutic and prophylactic; they can be eaten fresh as well as canned (Murariu O.C. *et al.*, 2014;2015).

The main aim of the present research is to highlight the physico – chemical characteristics of fruits from the species *Lycopersicon esculentum*, obtained in ecological system. The main objectives were to highlighting the acidity of the genotypes (titrable and pH value), water content, total dry matter, vitamin C, sugars and pigments for some improved tomato genotypes organically grown.

MATERIAL AND METHOD

As the research topic includes aspects related to some nutritional, physico – chemical, technological and sensory properties of horticultural products, for obtaining and interpreting scientific data, the research activity was carried out in several laboratories within the University of Agricultural Sciences and Veterinary Medicine of Iași. The practical activities took place between July and September 2019.

The laboratories in which the research was conducted have equipment, glassware, utensils and reagents that have led to conclusive results. The following equipments was used for the physico – chemical analyzed: scale, oven, analytical balance, Zeiss refractometer, hand press, water bath, pH – meter, spectrophotometer UV-1700 and Spokol 1100 spetrophotometer.

The main objective of the research was to monitor the physico – chemical properties of vegetables represented by 37 different genotypes of *Solanaceae* fruits vegetable represented by improved *Lycopersicon esculentum* Mill. tomatoes.

The material studied was cultivated in the experimental fields of USAMV Iași in an ecological system. The genotypes thus cultured were grouped into different experimental categories, coded as follows: G90, G86, G195, G202, G259, G186, G223, G256, G261, G258, G254, G228, G255, G262, G92, G85, G99, G270, G187, G220, G194, G94, G221, G196, G272, G279, samples harvested in august and G84, G184, G198, G200, G222, G263, G264, G265, G267, G271 and blak tomato harvested in September.

The quality of the biological material obtained in the ecological system harvested in August and September by improving some tomato genotypes was evaluated in the research laboratories of the USAMV Iași by determining the main chemical components: total dry matter, soluble dry matter, acidity expressed in predominant acid, pH – value, vitamin C content, β – carotene and lycopene.

The biological material was used for physico – chemical determinations performed in order to argue the nutritional profile rich in antioxidants of improved genotypes grown in ecological conditions.

The soluble dry matter content was determined on the juice extracted from the samples by using the Zeiss refractometer by automatic reading and temperature control at 20°C, pH value and titrable acidity were determined by the filtered acid extract of the samples analyzed. The pH value was determined using *Hanna Instruments* device which was previously calibrated in the range of 4.01 – 7.01 – 4.01. The titratable acidity was determined by titration with a 0.1 N NaOH solution in the presence of color indicators, respectively phenophtalein/ thymophtalein, being expressed in the predominant acid (citric acid%). The total dry matter content was determined by drying in an oven at 70°C for 20 hours.

The total content of L – ascorbic acid (vitamin C) was determined by extraction with 2% oxalic acid and titration with 2.6 – dichlorophenol indophenol.

The pigments represented by β – carotene and lycopene were evaluated spectrophotometrically. These were extracted with petroleum ether and the quantitative dosing was performed spetrophotometrically UV 1700 against

a blank of petroleum ether at wavelengths of 452 nm for carotene and 472 nm for lycopene.

RESULTS AND DISCUSSIONS

In Romania, tomatoes are annual plants, although in their areas of origin they behave like perennials. In greenhouse conditions, tomatoes can vegetate for many years (Brezeanu P.M. *et al*, 2020).

Tomatoes are classified according to several criteria: according to the destination of production (for fresh consumption and for industrialization), according to the shape of the fruit (spherical, ribbed, oblong/ elongated, cherry) and according to the color of the fruit (red, pink, orange, yellow).

The fruit is a fleshy berry of different shapes, colors and sizes, depending on the variety of hybrid grown. The shape of the fruit is given by the shape index ($IS = h/D$, where h = height; D = diameter of the fruit).

If the shape index is equal to or close to 1, the fruits are spherical. If the shape index is less than 1, the fruit is flattened. If the shape index is less than 1, the fruits are elongated.

The color of the fruit can be red, of different shades, orange or yellow, pink. The color of the red and pink fruits is due to the carotenoid pigments contained in the pulp (the lycopene that dominates that β - carotene up to 13 times), over which the epidermis of the fruit, yellow or colorless. When fruits contain more β - carotene than lycopene, they are yellow – orange.

Before ripening, the color of the fruit is light green uniform or green with a darker shade around the stalk. The persistence of the yellow – green area around the peduncle and after ripening is a defect that depreciates the quality of the fruit.

The size of the fruit is most often appreciated by weight and varies within very wide limits, from 30 – 40 g to 300 – 500 g and even 800 g, depending on the variety and cultivation technology (Brezeanu P.M. *et al*, 2020). Cherry tomatoes have small fruits, only a few grams.

Tomatoes are covered with an elastic skin. The pulp is the most valuable part of the fruit, being rich in sugars, vitamins and minerals.

According to data from the literature (Jaramillo *et al*, 2007) tomatoes are rich in vitamins such as A, B₁, B₂, B₆, C, E minerals such as potassium, magnesium, manganese, zinc, copper, sodium, iron and calcium.

Therefore, tomatoes are a very important source for human nutrition because they have many bioactive compounds (Hallmann E. *et al*, 2013). Numerous studies worldwide have indicated that

organic tomatoes have a high content of biologically active compounds compared to conventional tomatoes (Juroszc *et al*, 2009; Hallmann E *et al*, 2007; 2013).

A diet rich in vegetables can be associated with a reduced risk of many diseases related to aging and modern life (Marti R. *et al.*, 2016). Many researchers have pointed out the relation between the intake of bioactive compounds present in tomato and a reduced risk of cancer. These bioactive compounds comprise phytochemicals such as carotenoids and polyphenols (Marti R. *et al.*, 2016).

The values of the primary statistical estimators corresponding to the data characterizing the degree of dispersion of the results obtained for water content, total dry matter, soluble dry matter, vitamin C, carotene, lycopene and acidity values for the 37 tomato genotypes (*Lycopersicon esculentum*) were reduced.

Thus, the standard error of the mean was within the limits of 0.02 – 1.51. Analyzing in terms of homogeneity of results for the parameters studied, the results obtained for water content (3.2%) and pH values (4.3%), being below the threshold of 5%, a relative homogeneity for soluble dry matter content values (15.4%) was within the 15% threshold while the results obtained for the other parameters were not not homogenous (*table 1*).

The 37 genotypes of *Lycopersicon esculentum* showed an average value of the total dry matter content of $7.7 \pm 0.5\%$, thus highlighting an oscillating amplitude of the values obtained that were within the minimum value limit of 4.6% (G223) and the maximum of 17.9% for G265 (*table 1*).

The water content was inversely proportional to the total dry matter content, with a range of variation of less than 82.1% for G265 and more than 95.4% for G223. The mean of water content for the 37 genotypes of *Lycopersicon esculentum* is $92.3 \pm 0.5\%$.

Referring to the data presented in the literature, which specifies an average water content of ripe fruit for the tomato species of 94%, it is clear that most genotypes have values that fall around this value, except for genotypes G184, G263, G265 and G267 showing lower values delimited by the range 82.1 – 86.9% (*table 1*).

Table 1

Estimators of the physico – chemical parameters of the genotypes of *Lycopersicon esculentum* cultivated in ecological system (TDM – total dry matter, AT – titrable acidity; SDM – soluble dry matter)

GENNOTIP	H ₂ O, %	TDM, %	pH	AT (citric acid)	SDM, %	Vit. C, mg/100g	Caroten, mg/100g	Licopen, mg/100g
n	37	37	37	37	37	37	37	37
Average	92.3	7.70	4.4	0.4	5.6	18.7	9.12	14.1
Variation	9.07	9.07	0.04	0.01	0.75	18.44	14.60	84.16
Standard deviation	3.01	3.01	0.19	0.12	0.87	4.29	3.82	9.17
Mean standard deviation	0.50	0.50	0.03	0.02	0.14	0.71	0.63	1.51
Coefficient of variation	3.3	39.1	4.3	28.6	15.4	22.9	41.8	65.4
Minimum	82.09	4.64	4.15	0.192	4.4	14	2.36	3.01
Maximum	95.4	17.9	4.85	0.64	7.8	29	21.2	33.7

The Analyzing the pH values identified for the representative samples of 4.4 ± 0.03 with the limits between the minimum value of 4.15 and the maximum value of 4.85. The mean of soluble dry matter content values defined a delimited range of variation of less than 4.4% (G261, G259 and G94) and more than 7.8% (G92). The identified sugar content values for G92 and G265 genotypes showed dominant superiority.

Vitamin C has values that fall within a range defined by the minimum limit of 14 mg/ 100 g and the maximum of 29 mg/ 100 g with an average of 18.7 mg/ 100 g. Compared to the values presented in the literature, there is a range in the domain of 15 – 30 mg/ 100 g.

It is also possible to analyze the role of tomatoes obtained in the ecological system as a source for natural carotenoids. The average value of carotenoids is 9.15 mg/ 100 g defined by the lower delimited range of 2.36 mg/ 100 g and upper of 21.22 mg/ 100 g. The values obtained for the 37 genotypes studied showed an oscillating trend. The following genotypes are highlighted by superiority in terms of carotene content: G290 with 21.2 mg/ 100 g, G270 with 17.35 mg/ 100 g, G85 with 13.5 mg/100 g, G184 with 13.8 mg/ 100 g, G279 with 12.7 mg/100 g, G228 with 12.06 mg/ 100 g, G271 with 11.3 mg/ 100 g and G187 with 11.2 mg/100 g (figure 1).

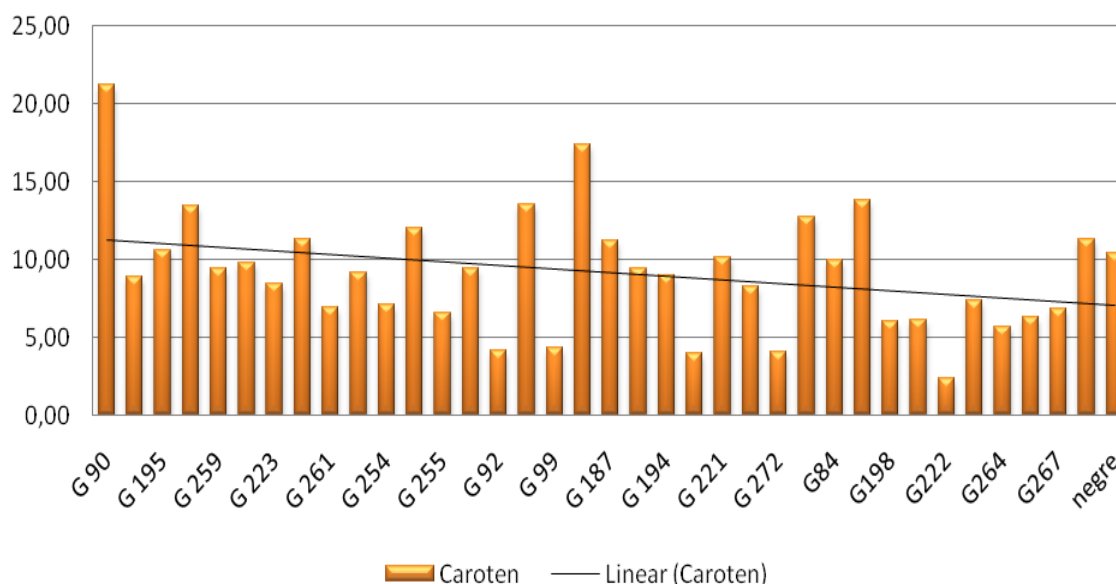


Figure 1 The carotene content (mg/ 100g) from *Lycopersicon esculentum* genotypes

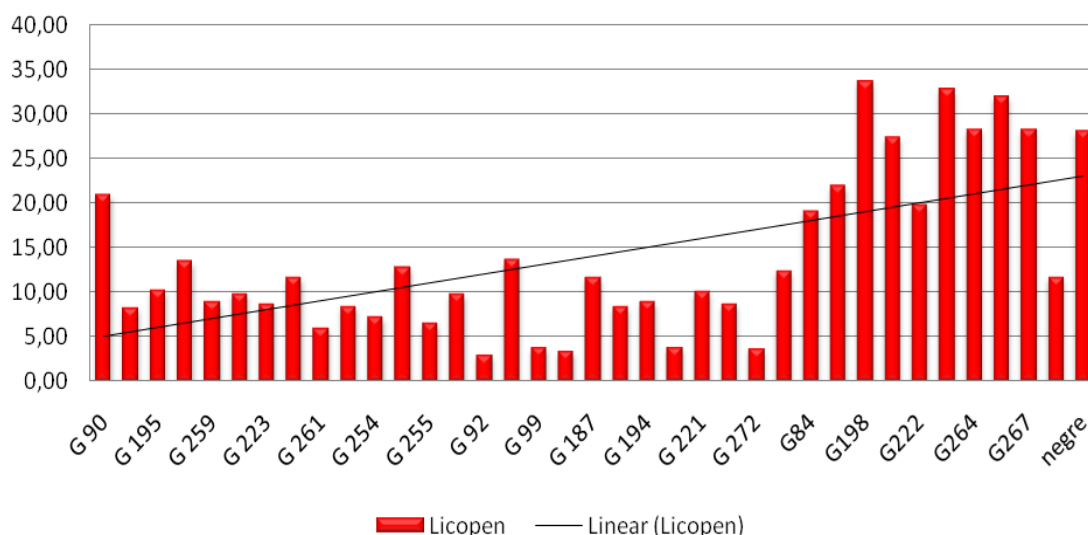


Figure 2 The lycopene content (mg/ 100g) from *Lycopersicon esculentum* genotype

The lycopene content of tomatoes falls within the range defined by 3.01 and 33.7 mg/100 g with a mean value of 14.03 ± 1.51 mg/ 100 g. the

The oscillating amplitude of the lycopene content values for the 37 genotypes determined a lack of homogeneity of the values for this parameter, exceeding the threshold of 15% with a value of the coefficient of variability of 65.4% (figure 2).

CONCLUSIONS

Consequently, tomatoes provide a convient matrix through which nutrients and other components play a beneficial role in consumer health. Tomatoes are rich in vitamin C, lycopene and β – carotene. Compared with phyto – nutrients, the most abundant components in tomatoes are carotenoids.

Lycopene is the most predominant carotenoid, followed by β – carotene. The antioxidant activity of lycopene as well as β – carotene along with the abundance of this in tomatoes make this food a rich source of antioxidant activity.

The remarkable results from the antioxidant point of view of the improved genotypes of tomatoes G198 and G90 are highlighted by the high values in the most important antioxidants, respectively lycopene is presented with a value of 33.8 mg/ 100 g (G198); 32.8 mg/ 100 g (G263); 32.03 mg/ 100 g (G265) and 21.06 mg/ 100 g (G90) and carotene with 21.2 mg/ 100 g (G90); 13.8 mg/ 100 g (G84); 13.4 mg/ 100 g (G202) and vitamin C with 29 mg/ 100 g (G92).

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