

RESEARCHES ON THE CONTENT OF LYCOPENE AND CAROTENOIDS OF MANY BREEDS OF TOMATOES CULTIVATED IN ECOLOGIC SYSTEM

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Abstract

In the present paper was analyzed the content of lycopene and carotenoids for 13 breeds of tomatoes with different colors and a hybrid of tomatoes cultivated in ecologic system of culture, due to the huge therapeutic benefits in the healthy alimentation of the man by the high content of antioxidants as lycopene and β -carotene that contributes to the prevention of some diseases, reducing the risk of the appearance of some forms of cancer, reducing the level of LDL-cholesterol, having also an important mineralizing and vitaminizing action.

From the affirmation of Fraser et al. 2002, the tomatoes and the products obtained from the processing of tomatoes represent the main source of lycopene and other antioxidant substances from the human diet.

The color of the tomatoes is the most important factor in determining the quality of the tomatoes, from the consumers point of view and in its processing (Stevens and Rick, 1986) and is determined by the content of lycopene (Shi et al., 1999) and represents 90% of the total phenolic substances from the cropped fruits (Alba et al., 2000; Dumas et al., 2003).

Key words: culture of tomatoes in ecologic system, early productions of tomatoes, content of lycopene, content of carotenoids

INTRODUCTION

The tomatoes, without a doubt, among the most loved vegetables on the entire planet being used in an endless series of products in fresh condition and cooked in different gastronomic combinations: from the so called filled tomatoes from Mexico (tomates rellenos), the American ketchup, the Italian bruschettas, the Romanian broth, up to the Spanish gazpacho, the Turkish tomato sauce, the Greek salad, and many others.

The tomato fruits are consumed under endless forms, in fresh condition but also processed: sauces, pasta, ketchup, dehydrated, being very appreciated due to the tasting and nutritional qualities.

For the baking of the fruits, under the action of the polygalacturonase, the content of pectin decreases and the pulp becomes smooth, the content of chlorophyll decreases and increases the content of red pigments (lycopene) and yellow ones (β carotene and xantophyll). The report among these pigments determines the color of the fruit on maturation,

decreases the content of organic acids and increases the content of sugar (Indrea and collab., 2009). The red or pink color of the fruits is due to the carotenoid pigments from the pulp – the lycopene that dominates the β -carotene of up to 13 times), over which is overlapped the fruit epidermis, yellow or colorless. When the fruits contain more β -carotene than lycopene, they have yellow orange color. Before the maturity, the color of the fruits is uniform light green or green with a darker shade around the peduncle. The persistence of the area of yellow green color around the peduncle and after the maturity is a defect that deteriorates the quality of the fruit (Berar, 2006).

The optimum temperature for the synthesis of the lycopene varies between 16-26°C (Dumas et al., 2003). Helyes and Lugasi (2006), Helyes (1999) and Gautier et al., (2008) affirmă that at temperatures between 27-32°C lead to the decrease of lycopene.

MATERIAL AND METHODS

The biological material was represented by a number of 13 breeds and a hybrid of tomatoes, respectively Merveille des Marchés, Double Rich, Brandywine Pink, Roze de Berne, Giant Belgium, Osu Blue, Blue Fog, Caroten de Plovdiv, Blue Beauty, Pineapple, JL Midnight Select, Potiron Ecarlate, Estiva F1, obtained in a vegetable micro farm ecologically certified from Husasău de Tinca, locality situated in NW of Romania, an area of passage from the Western hills to the Western plain of Romania. The experiment was a mono factorial one organized with the method of sub divided blocks, the 14 versions had three repetitions, each version having 10 plants.

The witness of the experiment was Roze de Berne, an old breed of tomatoes that was already cultivated in the respective micro farm. The breeds from the experiment have the fruits with different colors at maturity. Beside the red color of different shades, we have fruits of yellow color, orange with different shades, pink and indigo mixed with red.

The lycopene from the tomato samples was extracted with a mixture of Hexane: ethanol: acetone (2:1:1) following the method Sharma and Le Maguer 1996.

The absorption is read at 472 nm and 502 nm, using the hexane as witness. The concentration in lycopene is calculated using the specific coefficients of extinction ($E_{1\% 1cm}$) 3450 for $\lambda=472$ nm (Toor, R.K, 2006) and 3150 la $\lambda=472$ nm. (Gergen I., 2004). The concentration of lycopene is expressed in mg/100 fresh substance (Toor, R.K, 2006).

All the determinations are repeated 3 times and is made an arithmetic average of the values obtained.

RESULTS AND DISCUSSION

In determining the quality of the fruits of tomato designated for the human consumption an important parameter beside the dimensions of the fruits is their color due to the carotenoid pigments contained in the pulp. The content of the fruits of tomato in lycopene and β -carotene is directly proportional with the color of the pulp and of the entire fruit at maturity, data presented in table 1 and 2.

Table 1.

Characteristics of the fruit					
No. crt.	Version	Form of the fruit	Color of the fruit at maturity	Color before the maturity	Color of the pulp at the maturity
1	Rose de Berne Mt	1	Pink	Green	Pink
2	Merveille de Marchés	1	Red	Green	Red
3	Double Rich	2	Red	Green	Red
4	Muscat	2	Red	Green	Red
5	Brandywine Pink	2	Pink	Green	Pink with white nervures
6	Giant Belgium	2	Red to pink	Green	Red
7	Osu Blue	1	Dark red	Violet with shades of green	Red purpurie
8	Blue Fog	5	Red	Green	Red
9	Caroten de Plovdiv	1	Orange	Green	Orange with red shades
10	Blue Beauty	2	Mixture of red and indigo	Mixture of green and indigo	Purple red
11	Pineapple	2	Orange yellow with shades of red on the basis of the fruit	Green	Yellow with red streaks
12	JL Midnight Select	1	Indigo with shades of red at the basis	Dark violet with green at the basis	Dark red
13	Estiva F1	1	Light red	Green	Red
14	Potiron Ecarlate	1	Pink	Green	Pink

Analyzing in ensemble the color of the fruits of tomato studied (table 1) is observed that these have different colors from red, the common color of the majority of the breeds cultivated and known by the great majority of the consumers up to orange of the breed Caroten de Plovdiv ad yellow orange with shades of red at the basis of the fruit of the Pineapple breed. The breeds Blue Beauty and JL Midnight Select are breeds of tomatoes of dark purple color to indigo in mixture with red and respectively indigo with shades of red at the basis, having the color of the pulp purple

red and respectively dark red.

The breeds Rose de Berne Mt, Potiron Ecarlate and Brandywine Pink have the color of the fruits and of the pulp at the maturity pink with the exception of the breed Brandywine Pink which has the color of the pulp at the maturity pink with white nervures, color that from the point of view of the content in lycopene and carotene was classified on 7 place of 14.

The breeds of tomatoes studies that have the color of fruits at maturity red are the breed Merveille de Marchés, the breed Double Rich, the breed Muscat, the breed Blue Fog to which is added the breed Giant Belgium of red to pink color, the hybrid Estiva F1 of light red color and the breed Osu Blue of dark red color.

The data regarding the content in lycopene and carotene at the breeds of tomatoes studied, are presented in table 2.

Table 2

The content in lycopene and carotenoid of the fruits of tomato obtained in ecologic culture in glass houses

No. crt.	Version	Color of the fruit at maturity	Average content in Lycopene mg/100g	Average content in Carotene mg/100g
1	Rose de Berne Mt	Pink	12.744	1.759
2	Merveille de Marchés	Red	13.274	1.379
3	Double Rich	Red	16.469	1.543
4	Muscat	Red	13.015	1.243
5	Brandywine Pink	Pink	13.137	1.645
6	Giant Belgium	Red to pink	12.977	1.600
7	Osu Blue	Dark red	12.066	2.07
8	Blue Fog	Red	12.678	1.47
9	Caroten de Plovdiv	Orange	7.068	8.99
10	Blue Beauty	Mixture of red and indigo	14.052	2.4
11	Pineapple	Orange yellow with shades of red on the basis of the fruit	6.020	1.91
12	JL Midnight Select	Indigo with shades of red at the basis	10,586	2,66
13	Estiva F1	Light red	13,371	1,800
14	Potiron Ecarlate	Pink	19,807	2,548

The greatest quantity of lycopene of 19.807 mg/100 g was registered at the breed Potiron Ecarlate, and the second is of the breed Double Rich with a quantity of lycopene of 16.469 mg/100g and on the third place being the breed Blue Beauty with 14.052 mg/100 g. The witness breed Rose de Berne has a content of lycopene of 12.744 mg/100g and the hybrid of tomatoes Estiva F1 has a content in lycopene of 13.371 mg/100g, which classifies it on the 4th place compared to the witness.

The most decreased quantity of lycopene, of 6.020 mg/100g was registered for the breed Pineapple and for the breed Caroten de Plovdiv to which the content of lycopene was of 7.068 mg/100g but which was imposed by the content of carotenoids of 8.99 mg/100g, record quantity for the breed of tomatoes, similar with that of the carrot and which was approximately 3.5 times greater than of the breed JL Midnight Select for which the quantity of carotenoids was of 2.66 mg/100g. The other breeds analyzed have a content of carotenoids under 2 mg/100g with the exception of the breeds Potiron Ecarlate, Blue Beauty and Osu Blue for which the quantity of carotenoids was of 2.548 mg/100g, of 2.4 mg/100g and respectively 2.07 mg/100g.

CONCLUSIONS

The researches regarding the content of lycopene and carotenoids for many breeds of tomatoes obtained in ecologic culture allowed the elaboration of some conclusions:

1. The content in lycopene was the greatest for two of the 14 breeds of tomatoes studies, the two breeds of tomatoes occupied the first places. Thus Potiron Ecarlate with 19.80 mg/100g, respectively 16.46 mg/100g for the breed Double Rich. The breed Blue Beauty with a content of lycopene of 14.052 mg/100 g was situated on the third place and the witness of the experiment occupied the 9th position from the point of view of content of lycopene.
2. A quantity of carotenoids of 8.99 mg/100g, represents a record for tomatoes (content similar to the carrot) was registered for the breed Caroten de Plovdiv. The other breeds had a content under 3 mg/100g.
3. On the basis of the content of lycopene and the antioxidant properties due to the capturing of oxygen singlet from the biological systems, and due to the mineralizing, alkalizing role of blood, revitalizing and anti-infectious, the tomatoes can be considered functional food recommended in many affections improving thus the condition of health, the condition of good and contributing in the same measure to the reduction of sickness as for example the reducing LDL of the cholesterol from the blood.

REFERENCES

1. Apahidean Al.S. et al., 2001, Legumicultură generală, Ed. Academic Pres, Cluj-Napoca.
2. Apahidean Al.S., 2003, Cultura legumelor, Ed. Academic Pres, Cluj-Napoca.
3. Berar, V., 2006, Legumicultură, Ed. MIRTON, Timișoara.
4. Brandt At et al., 2006, Lycopene content and color of ripening tomatoes as

- affected by environmental conditions, *J.Sci. Food Agric.* 86, 568-572.
5. Cărbunar M., Bei M., 2010, Studies concerning tomatoes hybrid tilled in solarium in ecological crop. *Analele Universității din Oradea, Fascicula Protecția Mediului*, Vol XV an 15 ISSN:1224-6255, p. 236-239, (B+). Editura Universității din Oradea.
 6. Ciofu R., Stan, N., Popescu, V., Pelaghia, Chilom, Apahidean S., Horogoș, A., Berar, V., Lauen, K.,F., Atanasiu, N., 2004, *Tratat de legumicultură*. Ed. Ceres, București.
 7. Chaux, F., C., Foury, 1994, *Productions legumiers*, TEC-DOC, Paris, France.
 8. Dumas et al., 2003, Effects of environmental factors and agricultural techniques on antioxidant content of tomatoes, *J.Sci.Food Agric.* 83, 369-382.
 9. Gautier et al., 2008, How does tomato quality (sugar, acid, and nutritional quality) vary with ripening stage, temperature, and irradiance? *J. Agric. Food Chem.* 56, 1241-1250.
 10. Helyes & Lugasi, 2006, Formation of certain compounds having technological and nutritional importance în tomato fruits during maturation. *Acta Alim.* 35 (2), 183-193.
 11. Helyes, 1999, *A paradicsom és termesztése*, Syca Kiadó, Budapest.
 12. Indrea, D. -coordonator, Apahidean S.Al., Apahidean M., D.N., Măniuțiu, R., Sima, 2009, *Cultura legumelor*, Ed. Ceres, București
 13. Jarquin-Enriqueza et al., 2013, Lycopene content and color index of tomatoes are affected by the greenhouse cover, *Scientia Horticulturae* 155: 43-48.
 14. Levy et al., 1978, Morphological and physiological characters affecting flower drop and fruit set of tomato at high temperatures, *Euphytica* 27:211-218
 15. Mcavoy, R.J., H.W., Janes., 1988, Alternative production strategies for greenhouse tomatoes using supplemental lighting, *Scientia Horticulture*, 35: 161-166.
 16. Papadopoulos & Pararajasingham, 1997, The influence of plant spacing on light interception and use in freenhouse tomato (*Lycopersicon esculentum* Mill): A review. *Scientia Horticulturae*, 69, p. 1-27.
 17. Pek, Z., L. Helyes, 2010, Color changes and antioxidant content of vine and postharvest ripened tomato fruit, *Hort Sci.* 45(3), 466-468.
 18. Pek, et al., 2011, The effect of natural light on changes in antioxidant content and color parameters of vine-ripened tomato (*Solanum lycopersicum* L.) fruit, *Hort Sci.* 46(4), 583-585.
 19. Sato, et al., 2000, Physiological factors limit fruit sets of tomato (*Lycopersicon esculentum*) under chronic high temperatures stress, *Plant Cel Environ* 23: 719-726.
 20. Verkerk, K., 1995, *Temperature, light and tomato*. Meded. Landboock. Wageningen.