

Research on Certain Biochemical and Agrochemical Characteristics of Tomatoes Grown in the South of Romania

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Abstract. Research study was performed on nine samples of common tomatoes and cherry tomatoes from different cultivars recently introduced crop in southern Romania and the results showed that although variation, tomatoes were within the limits and are good for consumption.

Keywords: tomato, acidity, vitamin C, lycopene.

INTRODUCTION

Tomatoes are one of the most consumed vegetables in the world. Their popularity comes from the fact that they can be eaten fresh or processed in a multiple of forms. (Heuvelink, 2005).

There are a variety of tomatoes, they range from ordinary tomatoes of different sizes, small, cherry, colors and flavors, fresh consumption or for storage (Dorais et al., 2001).

According to the practices of tomatoes in solarium, a tomato crop absorbs nutrients important to the following average rates: nitrogen, 370 g/ha, phosphorus, 50 kg/ha, potassium, 680 kg/ha, magnesium, 290 kg/ha and calcium 45 kg/ha. Manage their manure is adjusted regularly throughout the production season to match the nutritional needs culture change, depending on growing conditions and environment. Fertilizer is used to control plant growth and fruit quality, increased production of tomato in solar capacity depending on the manufacturer to maintain the dynamic balance between vegetative and reproductive growth throughout the harvest season (New Ag International, 2011).

The major difference between regular and cherry tomatoes is the size and some cultural characteristics, biochemical and agrochemical. Biochemical characteristics that influence the quality of tomatoes are pH, acidity, vitamin C and lycopene which provide their quality of taste and the agrochemical characteristics are content in nitrates, phosphorus and potassium.

Vitamin C, known as ascorbic acid, a vitamin is water soluble, highly effective antioxidant with beneficial role on the human body and providing health and human immune system (Higdon Jane, 2003, Carr AC, Frei B., 1999). Human body is unable to synthesize vitamin C, therefore, must obtain vitamin C through diet. An average red tomatoe (120 g) contains about 23 mg of vitamin C. (Laurence L.S., 2002). Total acidity is a general indicator of freshness of vegetables, fruits and alimentary products. Cantwell M. (2000) show that ripe tomatoes had titratable acidity of 0.43% on average, 48.3 µg/mg lycopene and vitamin C 22.5 mg/100g.

Lycopene is an antioxidant carotenoid pigment that gives powerful and tomatoes, watermelon, pink grapefruit their characteristic red color. Clinical studies have shown that lycopene works through a series of mechanisms that support cardiovascular health and immune function (ABL Biotechnologies Ltd., 2011). In laboratory conditions, lycopene has

antitoxic properties against many toxins such as aflatoxin, cyclosporin and cadmium (Phytochemicals, 2011).

Although this compound has been known since 1980 when it was shown that the antioxidant activity of lycopene is twice higher than β -carotene (American Center Society, 2011), interest has increased as a result of a study conducted in 1995 by Harvard University on people who consumed tomatoes or tomato juice for a certain period of time (Purdue News, 2002). According to studies conducted by Nguyen and Schwartz (1999) regular tomatoes, fresh containing between 3.1 to 7.74 mg/100 g lycopene.

The purpose of the investigations was to study the biochemical and agrochemical characteristics of different solarium tomatoes grown in 2011 in the south of Romania in the context of the introduction of new cultivars in production.

MATERIALS AND METHODS

Research has been undertaken on a number of 9 samples of tomatoes from different cultivars recently introduced in culture in greenhouses in southern Romania. Were analyzed as cherry tomatoes (small tomatoes, different colors tomatoes which recently have gained considerable importance in the diet worldwide and fresh consumed whole, in salads or cut in two) and medium and large tomatoes. These tomatoes have been harvested from various existing solarium in Romania in the south of the country.

Tomatoes were harvested at ripe for marketing and consumption during the spring of 2011. These samples were prepared for analysis, and features that were mentioned were: acidity, vitamin C, pH, lycopene and soluble carbohydrates (sugar). Along with these tests were performed and agrochemical analysis of the nitrate content, phosphorus and potassium in tomato.

Determination of acidity was carried out using 0.1 N NaOH solution, volumetric determination, vitamin C by titration method using KIO_3 in the presence of starch and soluble carbohydrates were dosed with ABBE method.

A novelty in the investigations in our country is the determination of lycopene and pH samples. For the determination of lycopene in the literature, was chosen method of Fish (2002) where lycopene was extracted with hexane in the presence of ethyl alcohol and acetone. Determination of lycopene is a sensible way as under the influence of temperature and brightness values of this feature may decrease. It is known from the literature that lycopene is found in smaller quantities in raw tomatoes than in tomatoes reached the stage of maturity (ripe tomatoes) and the place of the plant where tomatoes were harvested and variety/cultivation does not significantly affect the amount of lycopene (Kozukue Nobuyuki and Mendel Friedman, 2003). During the determination of lycopene extract maintaining temperatures around 0°C and for efficient extraction was still shaking. Spectrophotometric method is used.

The pH is an important feature of tomatoes because it influences nutrient balance in the body by eating tomatoes for a long time, considering that these vegetables can be grown both in greenhouse and solarium.

Determination of pH was performed by potentiometric method, using an extraction ratio of 1:2.5.

Regarding agrochemical analysis are considered nitrates, phosphorus and potassium. These tests were performed on samples still fresh, which is the method used for extraction with 2% acetic acid, ratio 1:20. Determination of nitrate by colorimetric reagent

was 2.4 phenoldisulphonic acid. Phosphates were obtained by colorimetric reagent dosing Duvall. Potassium was determined directly from the extract, flame-photometric method.

Each sample was analyzed in three repetitions and the data presented are averages of rehearsals.

RESULTS AND DISCUSSION

Biochemical analyses of tomatoes are presented in Figure 1. Limit of variation for biochemical characteristics studied of tomatoes are presented in Table 1.

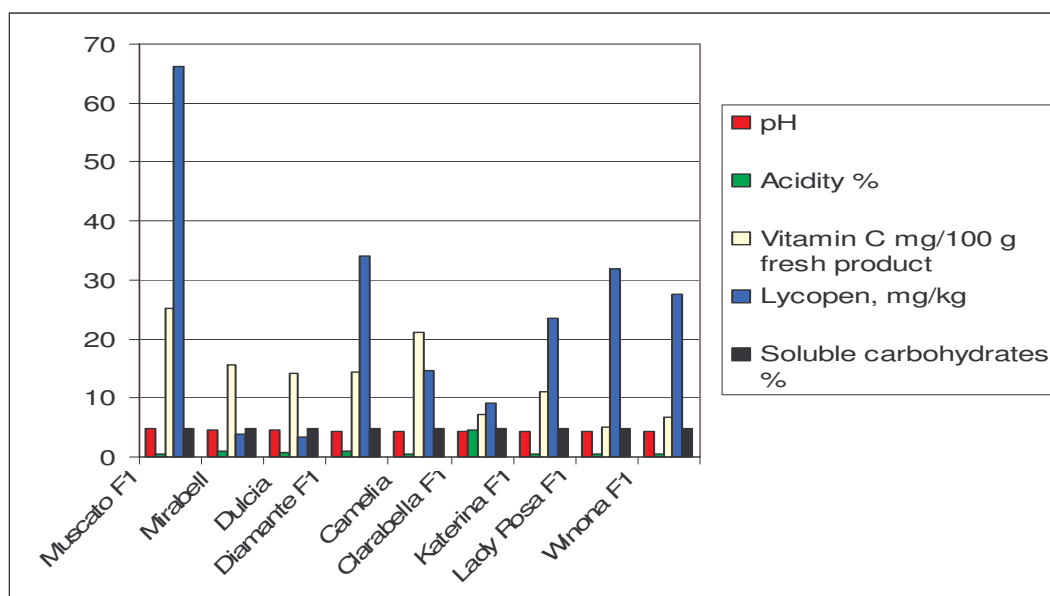


Fig.1. Results of some biochemical characteristics of tomatoes

Tab. 1

Limit of variation for biochemical characteristics studied of tomatoes

Sample	pH	Acidity %	Vitamin C mg/100 g fresh product	Lycopene, mg/kg	Soluble carbohydrates %
Limit of variation	4.2-4.8	0.43-0.99	6.6-25.2	3.38-66.07	4.77-4.85

Acidity varies between 0.43% and 0.99%. Variation limits are large, given the 9 types of tomatoes analyzed.

This feature is specific for the cultivar. The cherry tomatoes (variants 1-5) had high acidity, this indicator even reach 0.99% in variant 4.

The tomato cultivars with large size (Clarabella F1, Katerina F1, Lady Rosa F1, Winona F1), fluctuation of acidity is low, between 0.43% -0.5% with similar values.

Cantwell M. (2000) shows that tomatoes are ripe titratable acidity% around 0.43% and the comparison of results you can see an approximation of these results with the literature.

The **pH of tomatoes** ranged between 4.2 and 4.8. Higher pH values of 4.5 and 4.8 were obtained from cherry tomatoes and tomatoes with normal size had pH range between 4.2 and

4.3. This pH provides a buffering effect in the presence of digestive juice of tomato consumption. However, by comparing the two features previously considered that the pH and titratable acidity, it can be seen that the cherry tomatoes have the highest acidity and lowest pH.

Vitamin C is also a feature of the species. After Souci et al. (1981), ascorbic acid is found in 24 mg/100 g fresh product. According to the USDA Nutrient Database for Standard Reference Database (2010) in terms of nutritional values per 100 g product was determined that fresh yellow tomatoes contain 9.0 mg of vitamin C and red tomatoes have a content of 13.7 to 100 mg sample and total sugar in red tomato is 2.63 g/100 g sample and lycopene is the amount of 2.573 mg.

We notice very clearly that cherry tomatoes, any color and size, have accumulated a higher content of vitamin C, the variation is between 14.2 mg/100 g and 25.2 mg/100 g fresh product (variants 1-5) and the usual tomatoes of different cultivars (variants 6-9), vitamin C was accumulated in smaller amounts, and between 5 to 11 mg/100 g fresh product.

Accumulation of vitamin C and acidity are influenced by the type of culture used, the mode of irrigation and fertilization mode. For tomatoes studied here it was used fert-irrigation systems in solarium. The 2011 spring was cooler, with low temperatures, large temperature fluctuations between day and night, which sometimes caused a low accumulation of soluble carbohydrates and vitamin C.

Analysis of lycopene from tomatoes made to the both experimental variants shows that variants 2 and 3, respectively Mirabell and Dulcia, yellow tomatoes, had values from 3.38 to the 3.09 mg/kg. The other options included experimental red tomatoes, lycopene accumulation varied greatly. Thus, the cherry lycopene had values ranging from 14.57 to 66.07 mg/kg. This feature is attributed to different shades of red cultivar. The three cultivars Clarabella, Lady Rosa F1, Winona F1 had accumulated similar values of lycopene (23.57 to 32 mg/kg).

Accumulation of lycopene can be made and on behalf of solarium radiation in this case was reduced because the growing season, spring-summer 2011, was cloudy with low temperatures.

Regarding **soluble carbohydrates**, changes were small and ranged between 4.77 to 4.85%. After Souci et al. (1975), Ghergi et al. (1979, 2001) total carbohydrate content of tomato is on average 3.8% with a range of 1.8 to 4.3%. Comparing the results of analysis, this feature is within the limits set by the literature.

The research was continued by agrochemical analysis of the nitrate content, phosphorus and potassium in tomatoes, the results are presented in Table 2.

Table 2.

Results of agrochemical analysis of the nitrate content, phosphorus and potassium in tomatoes

Sample	NO ₃ (ppm)	PO ₄ (ppm)	K (ppm)
Muscato F1 (Grape-shaped red cherry tomatoes)	76.00	339	5800
Mirabell (Yellow cherry, midi)	38.00	332.2	3560
Dulcia (Big yellow cherry, 110-130 g)	57.00	352.5	3880
Diamante F1 (Round midi cherry for greenhouses and solariums)	57.00	334.9	3740
Camelia (Small red early cherry, 15 -20 g)	45.60	272.55	3400

Clarabella F1 (Dutch hybrid. new)	102.60	173.5	2060
Katerina F1 (Red extra-early, 100-120 g)	57.00	227.8	2740
Lady Rosa F1 (Common red extra-early tomato, 180-200 g)	34.20	235.9	2540
Winona F1 (Common tomato for protected areas, fruits medium to large, 140-180 g)	57.00	282.04	2880
Limit of variation	150	200-400	2000-3000

Analysis of nitrate in tomatoes (Fig. 2) shows that the highest content of 102.6 ppm was obtained from tomatoes cultivar Clarabella. The analysis results showed that the cherry tomatoes had low nitrate values, between 45.60 ppm and 76 ppm. To the four cultivars of tomatoes Clarabella, Katerina, Lady Rosa, Winona absorption was also low growing, Clarabella cultivar showing the highest value of 102.6 ppm.

Nitrate content is a risk factor for children's health and for the adults, the Maximum Admissible Limits in the case of tomatoes is 150 ppm. Comparing the contents analyzed content limit allowed, the tomatoes did not exceed 150 ppm. Considering that tomatoes are consumed either fresh or preserved, this indicator is a limited indicator, and in our case shows that it is possible marketing of these tomatoes.

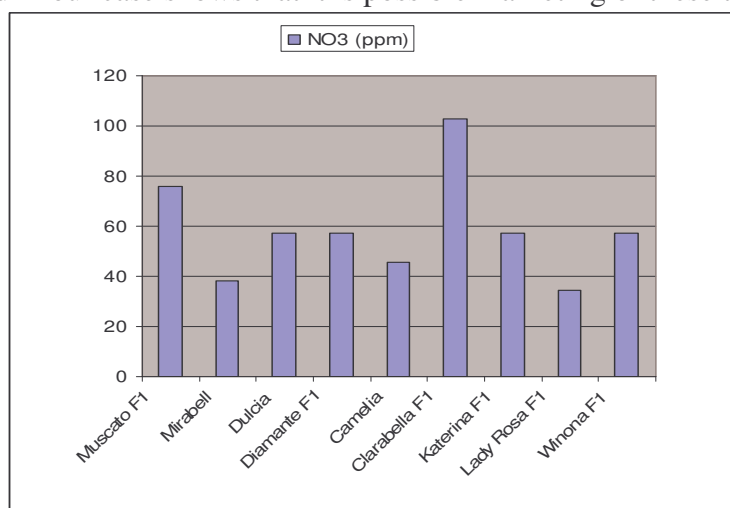


Fig.2. Analysis of nitrate of tomatoes

Phosphate content (Fig. 3) varies between 173,5 ppm (at Clarabella F1) and 339 ppm (grape-shaped cherry tomatoes). Phosphates are not compounds that give toxicity reactions and therefore are not the limiting factor. If the phosphorus content is between 200-400 ppm, tomatoes are good in terms of quality, there are no problems with storage and transport and bring a considerable contribution to human nutrition.

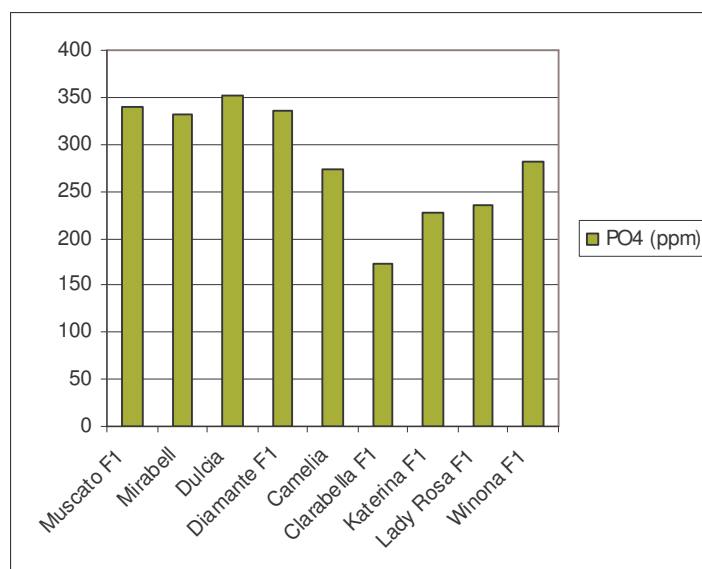


Fig. 3. Phosphate content of tomatoes

Potassium content (Fig. 4) of tomatoes that result from analysis, varies between of 2060 ppm to Clarabella F1 and 5800 ppm to grape-shaped cherry tomatoes. Although this item is not dangerous for human consumption, it can be considered an indicator consumption of tomatoes quality. Normally, potassium should be within the limits of 2000-3000 ppm. The analysis of cherry tomatoes shows that they have a greater capacity for absorption of potassium.

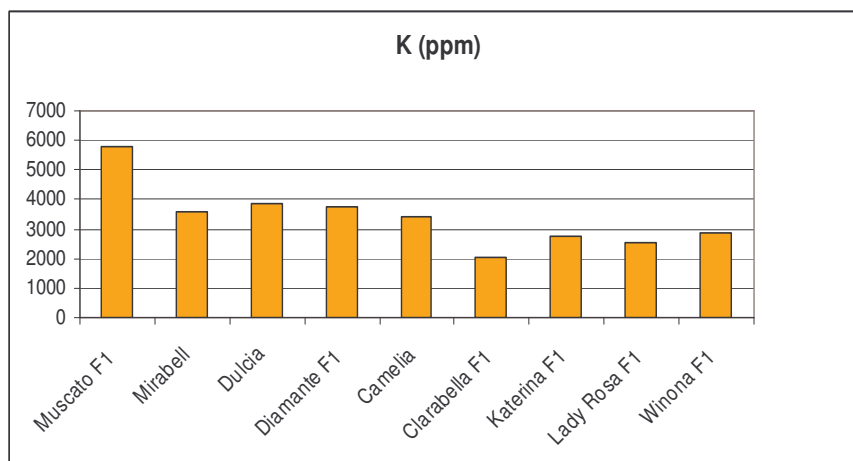


Fig.4. Potassium content of tomatoes

CONCLUSIONS

Analyzes the different cultivars of tomato products in south of Romania shows that:

1. The pH ranged between 4.2 and 4.8, a pH balance that ensures the body's acid-basic equilibrium.
2. Acidity is higher in cherry tomatoes than regular tomatoes for consumption.
3. Vitamin C has accumulated in large quantities in cherry tomatoes, reaching and 25.2 mg fresh product. Cherry tomato cultivars were low in acidity, recommending it for decorating dishes.

4. Following the cool conditions of early (first growing season of tomatoes), lycopene accumulated in small amounts, the highest value observed in red grape-shaped cherry tomato.

5. The sweet taste of tomatoes is provided by all cultivars analyzed, the differences between them are small.

6. Nitrates accumulate in tomato does not exceed a maximum of 150 ppm so tomatoes are good for consumption.

7. Phosphorus accumulated in normal quantities, ensuring good quality of tomatoes investigated.

8. Potassium is absorbed in large quantities, which permits the cultivars studied for human consumption.

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