VARIABILITY OF SOME BIOCHEMICAL CHARACTERISTICS IN THE PERSPECTIVE TOMATO VARIETIES

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Abstract. There are presented the results of the test of some perspective varieties created at the Institute of Genetics, Physiology and Plant Protection based on some biochemical characteristics of the fruit. The varieties with a high content of vitamin C and a high ratio sugar / acidity, which is an indicator of the quality of the fruit, were selected. The varieties Jubiliar, Elvira, Prestij are characterized by the highest indexes of studied biochemical characters and can be successfully used as the initial material in breeding to improve the quality of tomato fruits.

Keywords: tomato, varieties, biochemical characters.

Rezumat. Variabilitatea caracterelor biochimice la soiurile de tomate de perspectivă. Sunt prezentate date despre rezultatele testării soiurilor de perspectivă create în Institutul de Genetică, Fiziologie și Protecție a Plantelor în baza caracterelor biochimice ale fructului. Au fost selectate soiuri cu un conținut înalt de vitamina C și un raport înalt a zahărului / aciditate, care este un indicator al calității fructelor. Soiurile Jubiliar, Elvira, Prestij se caracterizează prin indici mai înalți ai caracterelor biochimice luate în studiu și pot fi cu succes utilizate ca material inițial în ameliorarea calității fructelor de tomate.

Cuvinte cheie: tomate, soiuri, caractere biochimice.

INTRODUCTION

The high quality of tomato fruits is one of the main aims of this culture improving, i.e. the improving of the characters of production as well as other characteristics of the variety is important. In this context, taking into account the widespread use of tomato products, enhance of research in this direction in national programs is fully justified (MIHNEA et al., 2007). Varieties with high solid content, sugar, vitamins, pigments, and other characters are required for the canning industry. These characters are not often found in approved varieties (BOTNARI, 2015). Fruits quality characteristic has two main aspects: biochemical and morphological. From the biochemical point of view, they must be rich in vitamins. The highest level in tomato has vitamin C. Vitamins, solid content, acidity, sugar / acid ratio determine the taste and aroma of fruits. Morphological aspects as quality factors are shape, color and fruit size. The shape and color depend on the consumer's preferences. High diversity of shapes and colors constitutes the base of attraction for consumers. The request regarding fruit size is determined by final destination: large fruits are preferred for the consumption as fresh, paste and juice, and the smaller ones are required by the food service sector and preserving of fruits at home.

Taking into account that most characters which obtain the productivity have a polygenic determinism, it is not possible to make analysis and description of each polygenic effect separately. This is an entire complex of genes that control the respective character. Thus, it is important for the practical improvement that the phenotypic expression of a quantitative character does not depend on the effect of individual gene. It depends on the cumulative effect of genes and their interactions with the environment.

The breeding is a sure way to improve the biochemical composition of tomato fruits: the solid content, the gluco-acidic ratio, sugar, vitamin C, etc. Creating new varieties, hybrids, lines with a high level of dry matters is one of the main requirements in modern agriculture and intensive technologies implementing. Therefore, the test of selective material based on this character is very important in breeding (ANDRIUSCHENKO, 1987; GRATI, 2007.).

Biochemical and aesthetic quality of tomato fruits is often a priority for middle-income consumer's decision, even more important than price (GÓMEZ et al. 2001, SEYMOUR et al. 2002). Taste, appearance, color of tomatoes *L. esculentum* Mill. are decisive for fresh fruits, while consistency, sugar, acidity, solid content are important for processing tomato industry. The amount of solid content in the fruit on rare occasions exceeds 6%, this is known from many literature data (MORENO et al. 2014). Yield and quality of tomato fruits are not only depending on optimization of the conditions for plants growth but on the use of varieties with high genetic performance. This factor is a link that is decisive for the innovational progress in agriculture and ensures obtaining of big productions with highest quality and required organoleptic properties (ALPATIEV, 1981; CARLI et al. 2011; ERCOLANO et al., 2008; SEYMOUR et al., 2002).

For the last 50 years, intensification of tomato breeding programs, aimed initially to the increase of the production yield, in many cases led indirectly to the considerable decrease of the biochemical characteristics of fruits, such as flavor and nutrient content. Mostly, the deterioration of the taste is directly determined by genetic and biochemical complexity of this character that erects serious impediments on the way of creating tomato genotypes with successful qualitative associations. Moreover, the lack of fundamental knowledge about the specifity of synthesis of biochemically valuable substances, as well as about genes involved in the control and regulation of metabolic pathways may often impede the right and directed strategy in creating peform tomato genotypes that maintain high gustatory and aromatic qualities for a long time after harvesting. This currently presents a major challenge (KLEE & TIEMAN,

2013). First of all, classical breeding of plants requires the use of the initial material with high biological value (SIMINEL, 1998), the determination of genetic variation and selection of those forms that are of interest from segregating or natural populations with subsequent and directed conservation of valuable genetic sources (BARRERO & TANKSLEY, 2004; GEPTS, 2002; 2006). The general efficiency of tomato breeding, strategic planification of selection and its future realization depends mainly on the choice or correct use of the original material.

The research goal is to evaluate new varieties of tomatoes on the base of biochemical characteristics of the fruit for subsequent use in breeding schemes.

MATERIAL AND METHODS

Three varieties created by interspecific crosses (Tomis, Mihaela, Milenium) and three – by intraspecific crosses (Jubilee 60/20, Prestij, Elvira) were used as a material for research. The determination of the solid content in a fruit was carried out according to the author Tretiakova (TRETIAKOVA, 1982), the sugar – Valter, Pinevug, Varasova (VALTER, 1957), the acidity and vitamin C – Pleshkov (PLESHKOV, 1967). The processing of the obtained data was performed by descriptive statistical analysis, the software package STATISTICA 7.

RESULTS AND DISCUSSION

In terms of chemical composition, the studied varieties in the compared crops demonstrate the value and high quality of the fruit (Table 1). The results of the solid content in tomatoes show significant differences between the studied genotypes. It has been found that the solid content ranged within the limits of 5.2- 6.2%. Analysis of the results revealed varieties Prestij, Elvira, Mihaela, in which the solids content reached of 6.0 - 6.2%.

In the created varieties there were established differences in the sugar content in the fruit that varied within the limits of 4.3- 5.5%. The varieties Jubiliar 60/20, Prestij and Elvira were recorded as having the highest sugar content.

The content of ascorbic acid is also important for the quality of the fruit. The results show that a high variability of vitamin C was registered in the studied varieties: from 27.3 mg% (Tomis) to 52.0 mg% (Prestij). The crucial importance for the variety performance has the ratio sugar / acid that determines many gustative properties of the fruit (BALDWIN et al. 2000; BALDWIN et al., 2008; GEORGELIS et al., 2004; GOFF & KLEE, 2006; RONEN et al., 2000). As a result of the research, it has been found relatively high variation – within the limits of 6.6 - 10.8. . Based on this character, the varieties Jubiliar 60/20 (10.8), Tomis (8.6), Milenium (8.3), Elvira (8.2) were highlighted.

Table 1. Chemical composition of the tomato fruit in the created varieties.

Variety	Solid content, %	Sugar total, %	Vitamin C, mg/%	Acidity, %	Index sugar / acidity
Jubiliar 60/20	5.5	5.4	46.0	0.50	10.8
Prestij	6.2	5.5	52.0	0.78	7.1
Elvira	6.0	5.4	47.6	0.66	8.2
Mihaela	6.0	4.5	35.2	0.58	7.8
Milenium	5.8	4.0	37.9	0.48	8.3
Tomis	5.2	4.3	27.3	0.5	8.6
Solearis (martor)	5.7	5.0	52.0	0.80	6.6

Some dependences (r) between the biochemical characteristics of the created tomato varieties were found by the correlational analysis. Some of them had no statistical significance. For example, the relationships between *the solid content and vitamin C* $r = 0.66$ ($p > 0.05$), *the solid content and acidity* $r = 0.77$ ($p > 0.05$), *total sugar and acidity* $r = 0.67$ ($p > 0.05$). This pattern reflects a tendency of associations rather than a true dependence. However, it has been found a strong relationship between *vitamin C content* and *total sugar*: $r = 0.85$ * ($p \leq 0.05$), regression equation is shown in Figure 1.

The analysis of the dendrogram distribution of varieties on the base of biochemical characters demonstrated their separation into two large clusters. The first cluster consists of the genotypes Jubiliar, Elvira, Prestij, Solearis (standard), and cluster 2 is composed of Mihaela, Milenium and Tomis (Fig. 2). It must be mentioned that the first cluster, compared with cluster 2, is characterized by the highest indexes of the studied biochemical characteristics.

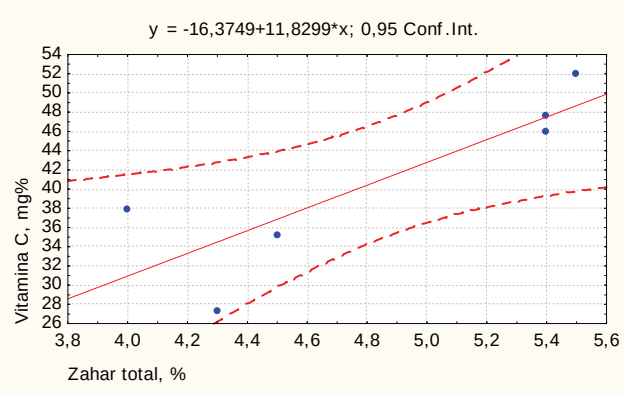

Figure 1. Regression equation of the dependence *vitamin C content - total sugar* in the created tomato varieties.

The analysis of inter- and intracluster variance (k-means method) showed that the most powerful factor discriminating the analyzed genotypes was vitamin C content, followed by the decreasing ratio gluco-acid, total sugar, acidity. Intercluster differences on the basis of solid content had no statistical significance ($p > 0.05$), namely this factor was not relevant to establish differences between the studied genotypes (Table 2).

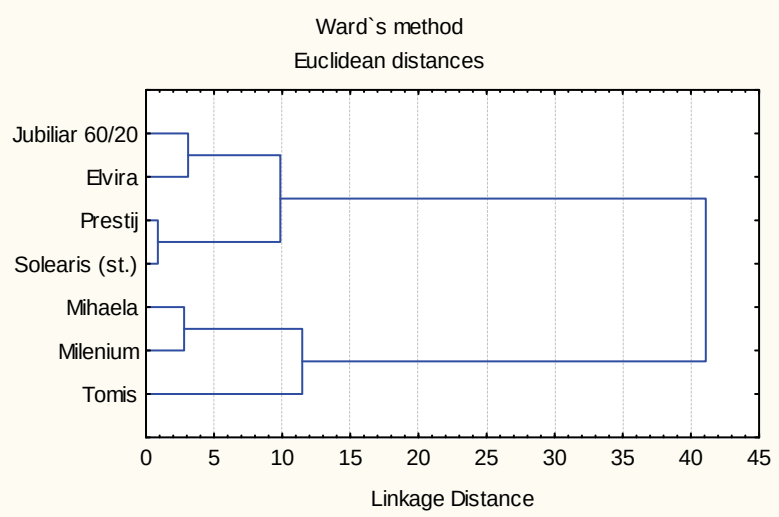

Figure 2. Dendrogram distribution of tomato varieties based on biochemical characteristics of the fruit (2008).

Thus, the created varieties are distinguished from the control with their appreciated biochemical indexes. It must be mentioned that all created varieties exceeded the standard variety in terms of the ratio sugar / acidity, which is an indicator of fruit quality. So, the created varieties manifest increased productivity as well as high gustative properties.

Table 2. Analysis of inter- and intracluster variance (k-means method) based on the biochemical characteristics of the tomato varieties.

Indicator	Intercluster variance	Degree of freedom	Intracluster variance	Degree of freedom	F	Significance p
Solid content	0.0976	2	0.5967	4	0.3272	0.7386
Sugar total	1.9426	2	0.2517	4	15.4380*	0.0132
Vitamin C	462.2476	2	61.9667	4	14.9192*	0.0140
Acidity	0.0908	2	0.0186	4	9.7604*	0.0289
Ratio gluco-acid	7.0283	2	3.8317	4	3.6686*	0.1245

Legend: $p \leq 0,05$.

CONCLUSIONS

1. The biochemical analysis of fruits shows that the varieties Prestij, Elvira, Jubiliar due to high indicators of studied biochemical characteristics can be successfully used for fresh production, as well as for the processing and may be applied like the initial material in breeding to improve the quality of tomato fruits.

2. The dendrogram distribution of the studied tomato varieties has demonstrated that they showed pronounced differences taking into account their distribution in clusters at different levels of aggregation.

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