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Influence of environment in electro-chemical quality of tomato

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Summary: The aim of the research was to investigate the impact of different cultivation environments of tomato cultivars, the electro-chemical and the qualitative traits of the tomato fruits. The quality of tomato fruit harvesting was evaluated at the Laboratory of Institute of Horticulture and Viticulture University of Natural Resources and Applied Life Sciences, Vienna. Two hybrids of tomatoes were tested Belle-F1 and AmaF1, in two locations and two different treatments (open field and plastic tunnels). Model of experimental fields was based on random method and included three replications. Following parameters were analyzed and tested: pH, Rh, P-Value, Nitrates and the content of vitamin C. The values of pH for treatment in the open field and indoor production system were not significant (4.47 to 5.05). For P-Value derived from the two treatments the maximal values were without significant differences, while minimal values were significant. Study has shown also that the highest values of nitrate content (16.34 mg, open field) compared to average value differences were + 0.384 mg or 43.83% higher. In indoor production the nitrate content was lower in compared with plants cultivated in open fields, so these differences were +3.81 mg or 26.4 0%, and highly significant for both levels. In relation to vitamin C content, the highest value was identified in the indoor system of 298.6 mg, with variations from the overall average of 16.43% or + 42.15 mg. The coefficient of variation values for both levels was of 29.96 respectively 27.31%.

Key words: cultivar, environment, pH, P-Value, RH, R, nitrate, Vitamin C.

Introduction

Based on economic importance, nutritional value, methods of use in human nutrition and surfaces cultivated, tomatoes is part of a group of the most important vegetables in Kosovo. Currently Kosovo is net importer of tomato and the current orientations were focused mainly to increase yields. Influence of ecological factors in the tomato cultivar, location, and interaction between them is relatively high. This has a direct impact in plant and is part of the study about the quality of tomato. Factors influencing phytonutrient content of vegetables could be different: genotype, cultivation practices, environmental conditions, maturation, and post harvest handling. Tomato quality factors such are: size, firmness, color, taste and nutritional content are important criteria in tomato marketing and also quality of tomatoes varies in different maturity stages (*Helyes,* 2006 and 2008).

The consumption of fresh tomatoes and tomato products has been inversely related to the development of some types of cancer (*Giovannucci,* 1999) and to plasma lipid peroxidation (*Parfitt* et al., 1994). The levels of the essential antioxidant vitamins, in contrast to other ant oxidative defenses, are determined mainly by their dietary supply (*Audrius* et al., 2009). Also, ascorbic acid (Vitamin C) is a natural antioxidant mainly present in fruits and vegetables. However, from different authors the high levels of acid ascorbic acid human in human body could cause adverse effects. P-value has using as one of the useful quality parameters and degrading of the quality of products some researches. Several authors; *Hoffmann* (1991), *Keppel* (1996), *Walz* (1996), *Krautgartner* (2002), *Meltsch* et al. (2004), *Meltsch & Kappert* (2004) indicated that p-value would be useful for degradation of horticultural crops quality. Nitrate is a naturally occurring compound that is a part of the nitrogen cycle, as well as an approved food additive. It plays an important role in the nutrition and function of plants. Vegetables are the major vehicles for the entry of nitrate human system. Ever-increasing concern over nitrate toxicity has directed a number of countries to lay down maximum allowable threshold concentration with regards to nitrate-N in vegetables (*Corre, Breimer,* 1979; *Staugaitis,* 1997).

The goal of this research is to test two tomato cultivars for different qualitative parameters growing at different locations and treatments (open field and greenhouse) in agro ecological conditions of Kosovo.

Materials and Methods

The research took place during the vegetative period in 2008. Experiments were placed based on a block system with three repetitions. Research analyzed two tomato cultivars (hybrids); Belle F_1 and Amati F_1. Tomato cultivars were planted in two locations and two different treatments

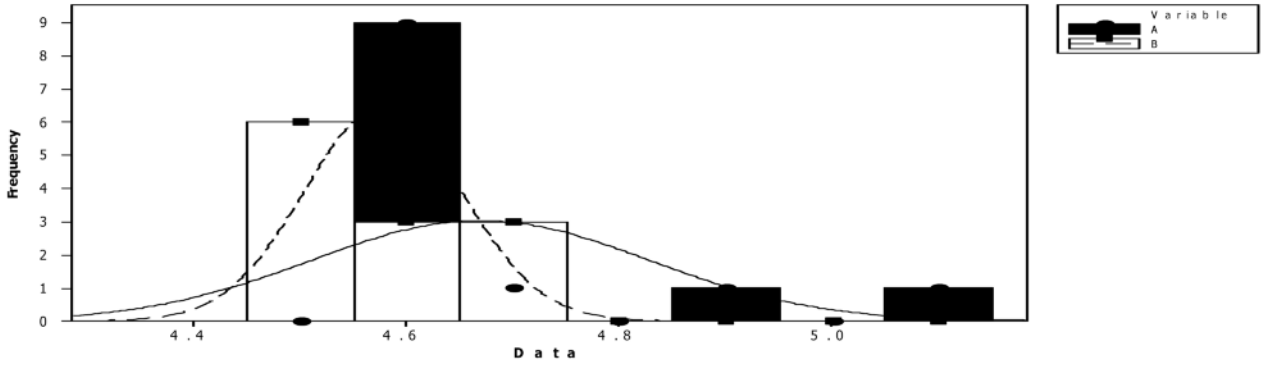

Figure 1: Results for pH in open field (A) and indoor (B)

(environments) (open field and greenhouse)**.** Samples were taken from the regular parcels used for commercial production of tomatoes in Kosovo (at the location Celine, where altitude is around 370 m. The type of soil is brown soil, annual average temperature is 17.6 °C, and annual average precipitation 427 mm while at Dardhishte location, where altitude is around 550 m The soil type is Pseudoglej, annual average temperature is 16.5 °C, annual average precipitation 581,7 mm,. The formula which was used in the experiment was: 2 hybrids x 2 locations x 2 treatments x 3 repetitions = 24 experimental plots x 6 parameters = 144 combinations.

Applied agro-technical measures were standard for the two hybrids using same treatments. The analyses of quality of produced tomatoes were carried out in a laboratory of Institute of Horticulture and Viticulture University of Natural Resources and Applied Life Sciences, Vienna. Samplings were taken using a random method. From 10 plants in each repetition four tomato fruits were taken from the two middle rows (Amati F_1 and Belle F_1). Analyses were performed by reflectoquant using the principle of reflectometry (remission photometry method) to quantify the ascorbic acid concentrations and the nitrate concentration. The determination of the electro-chemical parameters were carried out by the means of the following instruments for measure: Multi 340i and pH/Cond 340i (WTW company). The electrodes used for these measurements were: Sentix ORP – for the redox potential, Tetra Con 325 – for the conductivity and Sentix 81 – for the P value.

Results and discussion

pH – Highest values of pH in the open environment were achieved at cultivar Belle F1, valued 5.05 (Location Celine), while lowest values were achieved at cultivar Amati F1 (Celine) valued 4.56. Results presented in Table 1 show that the differences were not high (+0.49) or 10 – 20%. For varieties that were in the same locations but in indoor production (greenhouse) the highest value of pH were achieved by cultivar Amati F1 in Celina location (4.68), while for cultivar Belle F1 in location Dardhishte the pH value was 4.47. Differences between hybrids were + 0.21 or in relative values 4.59%. Differences for both treatments were + 0.28. The average variance values for at all treatments in open field and indoor production were 0.025, and 0.00635 respectively. Significant differences were found for locations, varieties for open field and indoor production, treatments at level of probability was p=0.01. The correlation between treatments (open field and indoor) had low value (r = 0.017), that when considering the conditions of the experiment is normal as it happened in two different environments and different agro-techniques were used. The value of the correlation coefficient for treatment in the open field was higher (3.39%) compared to value realized in the indoor (1.83%). Also minimal differences for both treatments are manifested for standard deviation (SD) values in open field are (0.158) and indoor values are (0.08). In *Figure 1.* the treatment results are presented and their groupings depend on their values for different class intervals.

Redoxsystems (redox-value **rH), –** gives information whether the system runs off predominantly within the oxidative or reductive range. As rH-value is negative, Briggs logarithm of redox potential is the smaller and the more strongly reductively the system runs off the more electrons are made available (Kappert, R 2006).

The average value for this parameter in the open field was 17.07, while for the indoor production system it was 16.95. Differences for the two extremes were +0.12 which was non significantly different at the level of probability p=0.01. The hybrid Amati F1 at location of Celina in open field has manifested higher values (18.8), while lower values were registered in the location of Dardhishte by cultivar Belle F1 (15.1). Differences for both levels were +3.7 or 21.75%. Variance for treatments in open field was 1:18, while the value of variation coefficient was 6.39%, with standard deviation (SD) 1.087. Indoors, high value was found at cultivar Amati F1 valued 18.5 in Celine location, but opposite performance was found at cultivar Belle F1 valued 16.0, in the location of Dardhishte. Differences for the two extreme values were +2.5 or 14.74%. The variance value for treatments was (0.726), low in comparison with varieties that were cultivated in open field – 0.454. The coefficient of variation was 5.03% followed by standard deviation (0.85). From the results presented in *Table 1*, no significant differences were found (d<LSD) same as in open fields in

both series. In *Figure 2*, figurative differences were shown clearly for two cultivars for treatment. The variations were not statistically significant, even though some values for treatment B were close to A.

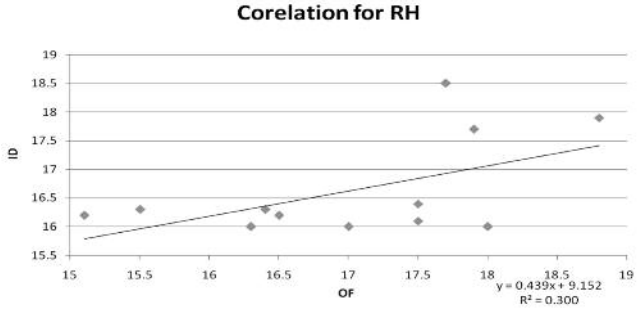

Figure 2. Probability plot of average values for RH in open field (OF) and indoor (ID).

Resistance: (R) It designates the handicap of the river of charge carriers inside a leader by collisions with atoms – **electrical conductivity** is the reciprocal value of the resistance and is to be understood as measured free ions in solution (*Kappert, R.* 2006).

R, for both research treatments was not significant because differences shown for average values for open field and indoor were minimal (+ 6.17) for the two levels of probability 0.05 and 0.01. Highest values for this parameter in open field indoor production system were achieved by Amati F1 in Celina location, valued 263, and 244, respectively. Lowest values in both treatments (open field and indoor) were achieved by Amati F1 cultivar in location of Dardhishte (175 and 168). Correlation coefficient for this parameter according to "Pearson" for both treatments was negative (- 0.71). Coefficient of variation was 14.20% in open field and 11.08% in indoor system, with variances from 529.88 to 819.18.

P-value is an integrating value. The p-value has the dimension of an achievement and according to the order of measured values usually is indicated in micro Watts (μW). (Wolf, G., 1997, cited by Kappert, R 2006).

P-Value – For treatment in open fields average value achieved was 264.3, while for indoor it was 270.5, so these differences were not statistically significant for both levels at 0.05 and 0.01.

The maximal values for both treatments were 388 and 355, while the minimal values were 135 and 194, respectively. The results show that for maximal values difference was not insignificant, while for the minimal values these differences were significant. Standard error (SE) was 19.9 for open field and 14.7 for indoor environment. The standard deviation was 68.8 and 51.0 respectively. Ayçen Akay and Zeki Kara (2006) have emphasized different results from 3th clusters of 327.67 measured to 215.63 and was obtained by cultivar Selin Gokce from15th clusters. The p-values were calculated for varieties of Tomatoes between Selin 5th clusters at 309.59 and 501.96 at Gokce 15th clusters.

Nitrate is an important component of vegetables due to its potential to accumulate and this is effected by a number of biotic and abiotic factors. From our study it is clear that the highest concentration of nitrates were in open field (16.34 mg). Compared with the average value of nitrate in plants cultivated indoor difference is highly significant + 3.84 mg or 43.83%. Highest value of nitrate achieved in plants cultivated in the indoor system was 44 mg. The cultivar with high nitrates absorption capacity was Belle F1 in the location of Celina, while for open field treatment it was cultivar Amati F1 in location of Dardhishte (47 mg) . In all treatments the concentration of nitrates was different. While, in the location of Celina at indoor production cultivar Belle F1 had highest nitrates concentration, in locality of Dardhishte the same cultivar had shown lower concentration. The value of coefficient of variation for both levels was relatively high.

Vitamin C- is very well known for its important role in biochemical processes, such as collagen formation, iron absorption and its inclusion in neurotransmission and immune responses (*Simone* (1992). Ascorbic acid levels in open field did not differ so much between different cultivars (*Helyes, L.,* 2008). High content of vitamin C is present in varieties cultivated indoor 266 mg representing an average value while this value for open field cultivation was 190.6 mg. Difference for both treatments was significantly high + 75.7 mg. The high content vitamin C in indoor system was present in

Table 1. Comparison of values for two different varieties of tomatoes, in two locations and two production environments (indoor & outdoor) for various parameters

Cultivar	Location	PH		RH		R		P-value		Nitrates		Vit C	
		OF	ID	OF	ID	OF	ID	OF	ID	OF	ID	OF	ID
Belle-F1	Celin	4.94	4.61	15.5	16.3	210	217	135	208	4.9	27.0	272	321
Belle- F1	Celin	5.05	4.68	17.5	16.4	197	220	250	203	20.0	44.0	303	347
Belle- F1	Celin	4.57	4.63	16.4	16.3	206	230	230	194	6.0	35.0	244	301
Amati- F1	Celin	4.63	4.53	17.9	17.7	211	244	318	263	4.8	5.0	178	145
Amati- F1	Celin	4.56	4.51	17.7	18.5	249	213	266	355	8.0	4.9	182	217
Amati- F1	Celin	4.64	4.52	18.8	17.9	263	215	310	310	6.0	6	78	171
Belle-F1	Dardhishte	4.67	4.47	16.3	16.0	178	175	245	261	17.0	4.9	184	342
Belle-F1	Dardhishte	4.57	4.51	15.1	16.2	178	178	180	261	25.0	4.8	180	342
Belle-F1	Dardhishte	4.59	4.52	17.0	16.0	186	177	296	259	7.0	4.6	240	341
Amati- F1	Dardhishte	4.63	4.63	16.5	16.2	175	168	270	282	23.0	4.8	233	372

cultivar Amati F1 in the location of Dardhishta village, with an average value of 372 mg, whereas in Celina this cultivar had lower content, value of 145 mg. Differences were highly significant (+ 227 mg), for the level 0.01. In open field for cultivar Belle F1, highest value for vitamin C was found in location of value of 303 mg. If compared differences of extreme values for the two treatment differences was +69 mg. The lowest values realized in open field for cultivar Amati (78 mg) in the location of Celina. Differences for both derived values were highly significant (+225 mg). The value of coefficient of variation for both levels was 29.96 and 27.31%, respectively. *Meltsch* et al. (2005), found out of different orange juice ascorbic acid contents were between 280-330 mg L_1, rH value were 17.5–19 and p-values between 400–540 uW. The researchers couldn't any correlations between ascorbic acid, p-values and rH. In the same study, researchers found in different apple juices the p-values between 300-800 uW and also negative correlations were found between ascorbic acid, p-values and ascorbic acid and rH , (*Ayçen Akay & Zeki Kara* (2006).

Conclusions

The results from the study showed that differences of RH for the two treatments were without significant variations, while differences between tomato hybrids were significant. For P-Value derived from the two treatments the maximal values were without significant differences, while minimal values were significant.

Also the highest values of nitrate content compared to indoor system was identified in the open field, while content of vitamin C, were identified in the indoor system for different variations.

Acknowledgement

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