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P-value and Some Other Quality Characters of Tomato Cultivars Grown in Greenhouse

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Abstract: The qualities of daily consumption of the products have been questionnaire densely and the products quality measures have been searched deeply nowadays. In this study measurements of products sizes, weights, contains of vitamins and minerals have been investigated and also ecological relationships have been studied. This study was held in Turkey. Tomatoes samples of cultivars Astona, Dürinta, F-144, Gokce 191, Ikram, Jabot, Malika, Newton, Paskal and Selin collected from producer greenhouses at June 2005 in Kumluca Antalya Turkey. Results were evaluated by statistical analyses and tabulated. P-values of tomato cultivars were between 501.96 μ W from variety Gokce 15th cluster and 309.59 μ W from variety Selin 5th cluster.

Key words: Tomato varieties, p-value, quality parameters, greenhouse, Turkey

INTRODUCTION

Products quality is being more important than production quantity in recent researches. Quality parameters have been measure by different new methods such as Bioelectronic Vincent methods. It is based on the three fundamental factors pH (acidity), oxidation reduction and the resistance value (R). In this method p-value is an electrochemical parameter of quality, is an integrating value, connecting acidity (pH), redoxsystems (rH), resistance (R). P-value is determined by $[30 \cdot (rH - 2pH)] / 2R$ (Hoffmann, 1991). It is indicated in micro Watt (μ W), (Wolf and Rey, 1997). P-value has using as one of the useful quality parameters and degrading of the quality of products some researches. Meanwhile, with better quality and/or "recover" samples are expected to achieve a low redox potential and a low p-value as well as a higher resistivity (Wolf and Rey, 1997).

In this study p-value was searched that on this subject it could be a measures of inner quality value that on the papers have been done by Hoffmann (1991), Keppel (1996), Walz (1996), Krautgartner (2002), Meltsch *et al.* (2004), Meltsch and Kappert (2004).

There was 9.82 million tons tomatoes produced at 2003 year at 230.000 ha open area and 1.94 million tons of it was produced in greenhouses in Turkey. At the same time world tomato production was 120.30 million ton at 4.23 million ha area. Turkey's production was almost 9 percent of total world production. Turkey's covered area was totally 53603 ha. 43% of it was plastic tunnels, 34% of it was PE greenhouses, 12% of it was glass houses and 11% of it was high tunnels. Covered area was generally (86%) in Mediterranean region. Turkey's

greenhouse producers have been using soil. Soilless culture area of Turkey's greenhouses was 75 ha at year 2004. There were producing mostly tomatoes, peppers, cucumber and lettuce and cut flowers (Tuzel *et al.*, 2005).

The aim of the study is to find out preliminary results of p-value for Turkey as able of measure of quality and degrade of inner quality by numbers. For this reason tomato varieties investigated that were grown in greenhouses and results were compared as theirs quality aspects.

MATERIALS AND METHODS

This study was held in Kumluca Antalya, Turkey. Tomatoes cultivars were grown in producers greenhouses for spring and summer periods. Totally 10 tomatoes varieties were used. The planting time of the varieties were respectively Astona at 20.10.04, Durinta at 11.03.2005, F-144 at 20.10.04, Gokçe 191 at 12.10.2004, Ikram at 7.10.2004, Jabot at 7.01.2005, Malika at 12.02.2005, Newton 22.01.05, Paskal at 25.02.2005 and Selin at 1.03.2005.

Fruits samples were collected at first time 13 June 2005 and second were 22 June 2005. Lab studies were done at the West Mediterranean Agricultural Research Labs Kumluca Antalya and Selcuk University Agricultural Faculty labs Konya. The tomato samples harvested based on their colors. Fruit colors were tested by Konika Minolta CR400 colorimeter. The color determinations were done just after harvests.

Fruits samples collected 10 days intervals. Second fruits of each cluster were choused for analysis. For each

replication was consisting of least 5 fruits, for small types collected much more fruits. Samples were bring in labs weighted, determined volumes, washed, cut into pieces and milled for p-value measurement by Be-t-analyze n. prof. Vincent instrument. Soluble solids of fruits juice were determined by Atago hand refraktometer. Total acidity of samples was analyzed by titration with 0.1 N NaOH. Vitamin C contents as mg ascorbic acid/100 ml fruit juices were analyzed by methaphosphoric acid titration methods. The samples pulps put in deep freezer at -18°C and a few weeks later cooled in refrigerator and analyzed.

The study was designed as 3 replicated randomized parcels. Results were evaluated by Minitab and Mstat statistical program.

RESULTS

Fruits colors: The color of fruits was the main factor for harvest in this study. The fruits colors of tomatoes varieties as L (as index of brightness), a (as from + red to-green), b (as from+yellow to-blue) were showed at Table 1. The first lines were the first harvest results for each variety. The samples collected 10 day intervals. There were statically significantly difference between tomatoes cultivars and harvest times. The ranges of L values were between 36.28 at Ikram 15th clusters and 31.49 Newton 5th clusters. The “a” values were between 27.53 at Malika 7th clusters and 18.60 Newton 5th clusters. The “b” values were between 16.63 at Malika 7th clusters and 12.46 Gokce 13th clusters.

Table 1: The fruits colors of tomatoes varieties

Tomato varieties	L*	a**	b***
Astona 13th cluster	33.30cdef	23.39bc	13.58bcde
Astona 15th cluster	34.62abc	21.67bcd	14.13bcde
Durinta 1st cluster	32.83cdefg	22.26bcd	13.04e
Durinta 3rd cluster	33.01cdefg	23.33bc	13.74bcde
F-144 13th cluster	33.24cdefg	22.43bcd	14.03bcde
F-144 15th cluster	32.58defg	18.69d	13.22de
Gokce 13th cluster	31.75fg	20.55cd	12.46e
Gokce 15th cluster	32.15efg	20.64cd	12.77e
Ikram 13th cluster	34.02bcd	22.70bc	14.57abcde
Ikram 15th cluster	36.28a	23.45bc	16.68a
Jabot 5th cluster	33.27cdefg	20.90cd	13.51cde
Jabot 7th cluster	33.21cdefg	22.14bcd	13.64bcde
Malika 5th cluster	34.29bcd	25.51ab	15.57abcd
Malika 7th cluster	35.81ab	27.53a	16.63a
Newton 5th cluster	31.49g	18.60d	12.79e
Newton 7th cluster	34.25bcd	22.88bc	15.87abc
Paskal 5th cluster	34.47bc	19.49cd	14.86abcde
Paskal 7th cluster	33.42cdef	22.84bc	14.27abcde
Selin 3rd cluster	34.23bcd	23.44bc	16.03ab
Selin 5th cluster	33.66cde	22.45bcd	14.62abcde
LSD values	p<0.05	p<0.01	p<0.01
	1.802	3.977	2.463

*L is an index of brightness; **a is color as from + red to - green; ***: b is color as from + yellow to - blue

Fruits dry weights, total acidity and soluble solids of fruits juice and vitamin C contents of fruits: Fruits dry weights, total acidity, soluble solids of fruit juice as °Brix and vitamin C contents of tomatoes varieties were showed at Table 2. The first lines were the first harvest results for each variety. There were statistically differences between tomatoes cultivars and harvest times. The ranges of dry weight values were found between 2.18% at Gokce 15th clusters and 6.11% at F 144 13th clusters. The total acidity values were analyzed between 0.93 mg/100 mL at Selin 5th clusters and 1.56 mg/100 mL Paskal 7th clusters. Soluble solids of fruit juice as °Brix were measured 3.27% at Newton 7th clusters as minimum and 4.70 % at Malika 7th clusters as maximum. The values of vitamin C contents of tomatoes varieties were analyzed between 2.21 mg/100 g at Ikram 15th clusters and 21.93 mg/100 g at F 144 13th clusters.

pH, EC, rH and p-values of tomatoes varieties: pH, rH, EC and p-values of tomatoes varieties measured by Be-t-analyze n. prof. Vincent instrument were showed Table 3 and Fig. 1. The first lines were the first harvest results for each variety. There were statistically significantly differences between tomatoes varieties of pH values (p<0.01). The range was from 4.46 measured 5th clusters of cultivars Newton 5th clusters to 4.01 obtained Paskal 5th clusters (Table 3). Same differences were also found between harvesting times and varieties.

There were no statistically significantly differences between tomatoes varieties of resistivity (rH in Ohm) and p-values (in μW). The range of rH values were from 5th

Table 2: Fruits dry weights, total acidity, soluble solids of fruit juice as °Brix and vitamin C contents of tomatoes varieties

Tomato varieties	Dry weight (%)	Total acidity (mg/100 mL)	°Brix (%)	Vitamin C* (mg/100g)
Astona 13th cluster	4.72g	1.35c	3.87def	5.80fg
Astona 15th cluster	2.72n	1.12ef	4.43abc	4.60hi
Durinta 1st cluster	3.57l	1.45b	4.20abcd	3.93i
Durinta 3rd cluster	2.56p	1.28d	4.57ab	7.42e
F-144 13th cluster	6.11a	1.37c	4.57ab	21.93a
F-144 15th cluster	2.54q	1.11efg	3.60efg	4.28i
Gokce 13th cluster	5.13d	0.97ij	4.13bcd	12.30d
Gokce 15th cluster	2.18t	1.09efg	3.57fg	5.88f
Ikram 13th cluster	5.88b	0.97ij	4.17bcd	4.34i
Ikram 15th cluster	3.64k	1.06gh	4.37abcd	2.21j
Jabot 5th cluster	4.83f	1.08fg	3.90def	2.31j
Jabot 7th cluster	2.93m	1.01hi	3.97cdef	5.55fgh
Malika 5th cluster	5.10e	1.02hi	3.57fg	17.17b
Malika 7th cluster	2.66o	1.15e	4.70a	4.78gh
Newton 5th cluster	3.76i	1.06gh	4.10bcde	2.53j
Newton 7th cluster	2.29s	1.02hi	3.27g	5.63fgh
Paskal 5th cluster	5.85c	1.50b	4.07bcdef	13.56c
Paskal 7th cluster	3.73j	1.56a	4.57ab	7.78e
Selin 3rd cluster	4.69h	1.13e	3.97cdef	2.49j
Selin 5th cluster	2.44r	0.93j	3.60efg	4.62hi
LSD values	0.007	0.056	0.524	1.036
(p<0.01)				

*Vitamin C is as ascorbic acid (mg/100 g)

Table 3: pH, EC and rH values of tomatoes varieties

Tomato varieties	pH	rH (Ohm*)	EC (mV**)
Astona 13th cluster	4.41ab	19.38	273.33abcd
Astona 15th cluster	4.38abc	19.06	274.33abcd
Durinta 1st cluster	4.17h	19.47	243.67cd
Durinta 3rd cluster	4.22fgh	18.90	255.33bcd
F-144 13th cluster	4.32cdef	19.20	270.33abcd
F-144 15th cluster	4.31cdef	19.05	294.33abc
Gokce 13th cluster	4.28efg	19.18	300.67abc
Gokce 15th cluster	4.29defg	18.63	215.63d
Ikram 13th cluster	4.43ab	18.85	273.00abcd
Ikram 15th cluster	4.31cdefg	18.85	286.67abc
Jabot 5th cluster	4.44ab	19.75	312.33ab
Jabot 7th cluster	4.21gh	19.03	289.67abc
Malika 5th cluster	4.38abcd	19.35	312.67ab
Malika 7th cluster	4.39abc	19.00	256.67bcd
Newton 5th cluster	4.46a	19.63	290.33abc
Newton 7th cluster	4.38abc	19.91	283.67abc
Paskal 5th cluster	4.01i	18.57	246.33cd
Paskal 7th cluster	4.03i	18.83	258.33bcd
Selin 3rd cluster	4.35bcde	19.80	327.67a
Selin 5th cluster	4.31cdefg	18.99	313.67ab
LSD Values (p<0.01)	0.098	ns	61.86

*Resistivity as rH in Ohm; **Electrical conductivity as EC in mV

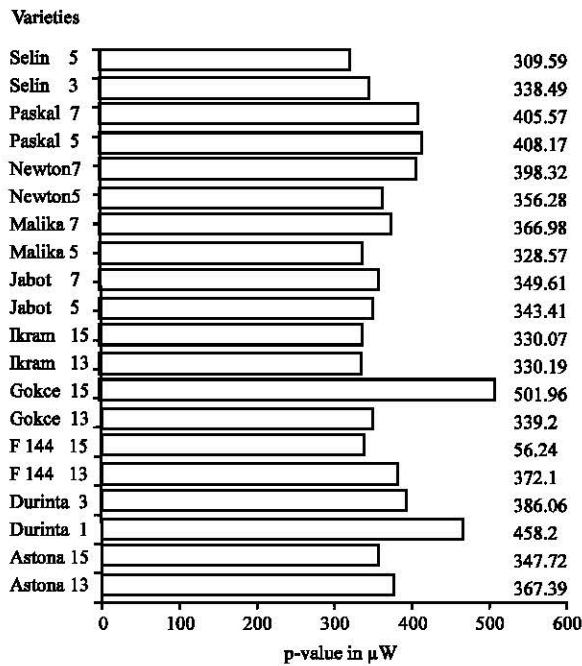


Fig. 1: p-values of tomatoes varieties

clusters of cultivars Pascal as 18.57 to the 7th clusters of Newton varieties as 19.91. There were statistically significant differences between tomatoes varieties of (EC in mV) values (p<0.01). The range was from 327.67 measured 3th clusters of cultivars Selin to 215.63 obtained Gokce 15th clusters. The p-values of tomatoes varieties were calculated between 309.59 at Selin 5th clusters and 501.96 at Gokce 15th clusters (Fig. 1).

DISCUSSION

Hoffmann (1991), Keppel (1996), Walz (1996), Krautgartner (2002), Meltsch *et al.* (2004), Meltsch and Kappert (2004) indicated that p-value would be useful for degradation of horticultural crops quality. Meltsch *et al.* (2005), found out of different orange juice ascorbic acid contents as between 280-330 mg L⁻¹, rH value as 17.5-19 and p-values between 400-540 μW. They couldn't any correlations between ascorbic acid and p-values and rH. There were positive correlations between rH and p-values. In the same study, researchers found in different apple juices the p-values between 300-800 μW and also negative correlations found between ascorbic acid and p-values and ascorbic acid and rH. They were found positive correlation between rH and p-values.

Pillsbury *et al.* (2004) studied on four grape tomato varieties (Chiquita, Sweet Olive, Red Grape and Tami-G), cultivar Chiquita was found to be significantly less appealing with regard to color than any of the other varieties. Since the colorimeter results showed that both high a and b values are desired, red and yellow hues are significant when deciding which variety to use. Similarly, a significant difference between Chiquita and the other three varieties was found with regard to overall acceptability.

Rotino *et al.* (2005) used parthenocarpic tomato lines transgenic for the DefH9-RI-iaaM gene cultivated under open field conditions to address some aspects of the equivalence of Genetically Modified (GM) fruit in comparison to controls (non-GM). Cultivars Allflesh, UC-82, Ri4 and Ri5 L values were 39.2-41.1, a values were 34.0-36.6 and b values were 25.4-27.9 and also significant differences between cultivars were observed.

Marcos *et al.* (2005) studied on Dorothy, Boludo, Dominique, Thomas and Yamile12 tomato varieties. The mean values and standard deviation obtained for the parameters studied were the following: weight = 106±25 g, Brix degree = 4.20±0.59, pH = 4.16±0.09, acidity = 0.50±0.08 g citric acid 100 g, moisture = 94.1±0.8%, ascorbic acid = 14.1±3.9 mg /100 g.

Nakvasil (2004), in the other study on inoculated cucumbers with zucchini yellow mosaic virus and found in inoculated cucumbers increasing redox potential and higher p values than in the comparing healthy group. He found a positive correlation between p-value and illness.

Krautgartner (2002) searched spinach in different production systems using fertilizers of different origin. She found rH value 17.5 and p-value as 296 μW and higher p values were found in conventional variant,

lowest p-values in zero option. She also studied on celery and found p-value 324 μ W, rH value 18.27 and she indicated that higher nitrate fertilize was increased p-value. In lettuces rH value was 23.6 and p-value was 1441 μ W announced by her.

In a carrot storage study, p-value was rise by going up storage time and p-value was fallen down in organically grown (Walz, 1996).

This study was the first work on electrochemical crops quality measure in our conditions. Schinagl (2004) studied on different production systems on tomatoes and cucumber varieties and indicated that samples collected different development stages have different p-values. The more study would be done the more clarified results would be reached for the tomatoes quality.

CONCLUSIONS

p-value as an electrochemical measurement of product quality of tomatoes would be useful together with some other quality characteristics for producers and consumers but this subject need to detailed studies in our conditions. In this study average p-value (as μ W) of cultivars was Selin (324.04), Ikram (330.13), Jabot (346.51), Malika (347.78), F-144 (352.89), Astona (357.56), Newton (377.30), Paskal (406.87), Gokce 191 (420.58) and Dürinta (422.13), respectively. The next study, we are searching on ecological variations of p-values and correlations of some other quality parameters of some fruits and vegetables.

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