Emir. J. Agric. Sci. (1989), 1: 117 – 124.

A Comparison Between Postharvest Quality of Tomato Fruits Produced in Hydroponics and Sandy Soil in Greenhouses.

Mustafa A. Al-Mughrabi
Plant Production Department
College of Agriculture,
King Saud University, Riyadh, Saudi Arabia.

Abstract: Fruits of two tomato (*Lycopersicon esculentum* Mill) cvs: Carmelo (Hybrid) and Trasque (Hybrid) were produced in hydroponic and sandy soil cultures inside greenhouses (controlled environment). Quality characteristics, including chemical and physical ones were compared for two cultural media, three picking stages and the two cultivars. Fruit weight and size were better in hydroponic than in soil cultures, whereas, moisture content, vitamin C, and T.S.S./acid ratio of the fruits were better in sandy soil culture. No significant differences were detected between cultivars for physical characters. Chemical characters showed variations in all treatments.

Additional key words: Tomato *(Lycopersicon esculentum)*, hydroponics, soil culture, quality.

INTRODUCTION

Tomato fruits (*Lycopersicon esculentum* Mill) now-a-days are produced on a large scale inside controlled environment such as greenhouses. Tomatoes can be produced either in hydroponic systems or in soil inside a greenshouse.

Hydroponic systems are two kinds; namely, shallow hydroponics, which are sometimes called nutrient film technique (NFT), and deep hydroponic cultures. Tomato fruits produced in hydroponics are superior to those produced in soil in quantity (Resh, 1978) but questionable for postharvest quality.

This investigation was conducted to compare some quality parameters between hydroponic and soil tomato fruits produced inside the greenhouse. It is also intended to detect differences among stages of maturity.

MATERIALS AND METHODS

Tomato fruits were produced in greenhouses at the Experimental Research Station at Dierab near Riyadh, College of Agriculture, King Saud University. Two kinds of root media were used; namely, hydropnic culture and sand soil.

In the hydroponic system (NFT), the water solution contained all macroelements and microelements required for tomato plants (Anonymous, 1984). The sandy soil culture was fertilized with Nitro-phos as a complete fertilizer. It was added broadcasting once a week. Foliar fertilizer was sprayed on plants in the form of Greenzit once during the seedling stage. In a controlled environment (greenhouse, 27-34°C day temperature, 17-20°C night temperature, 75% relative humidity), seeds were sown early in November and transplanted in rows after four weeks in sandy soil and hydroponic cultures. Cultivars used in this study were Carmelo (hybrid) and Trasque (hybrid). Plants in both cultivars were thinned to one main stem at 50 cm-distance among lines (Al-Mughrabi, 1986). The interrow spacings were 50 and 30 cm for hydroponic and sandy soil cultures, respectively.

Tomato fruits were picked at three ripening stages; i.e. mature-green, pink and red-ripe. The first pick was done at the beginning of March for the hydropnics and two weeks later for sandy soil culture. The following picks were accomplished at 15-day intervals afterwards. Fruits were brought to the laboratory where they were weighed (g/fruit) and fruit size (cm^3) was measured. Moisture content (%) and titratable acidity (%) were determined according to the methods described in Association

of Official Agricultural Chemists (1965). Total soluble solids (T.S.S. %) were determined by using Abbe refractometer. Readings obtained were corrected for temperaure variation according to Stevans and Baier recommedations which were cited by Joslyn (1950). Vitamin C content (mg/100 g) was determined according to the Association of Vitamin Chemists (1947).

The different treatments were arranged in a split-plot experimental design with three replications. Each replicate was taken from a plant in the greenhouse. Data were subjected to the analysis of variance (ANOVA) and the least significant difference was used to compare among means according to (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The analysis of variance and mean values for different treatments in this experiment are summarized in Tables 1,2 and 3.

1 - Media:

Tomato fruits of the two cultivars, Carmelo and Trasque, were highly sigificantly different when produced in hydroponic and soil in all media characters (Table 1). It was observed that tomatoes produced in soil were better than those grown in hydroponic in some quality characters. Particularly, they were significantly lower in moisture content, higher in vitamin C and higer in T.S.S. (Table 2). This finding was supported by Luoto (1984).

On the other hand, characters; namely, fruit weight and size, were found to be significantly better in hydroponic than in soil systems (Table 2). This means that tomatoes produced sifnificantly higher fruit yield when grown in hydroponics, its mean value being 145.6 g/fruit versus 83.6 g/fruit in soil culture (Table 2).

One can notice that physical characteristics such as fruit weight, fruit size and moisture content increased in hydroponic culture. Whereas, chemical characteristics such as vitamin C, titratable acidity, T.S.S., and T.S.S/Acid ratio increased in soil culture system. These findings were in close agreement with those of Luk'Yanenko and Luk'Yamenko (1981).

Table 1: Significance levels (ANOVA) of media, stages, cultivars and their interactions for different characters of tomato fruits.

S.O.V	d.f.	Characters						
		Weight (g/ fruit)	Size (cm^3/ fruit)	Moist (%)	Vit. C mg/100g)	TSS (%)	Acid (%)	Tss/Acid Ratio
Media (M)	1	**	**	**	**	**	**	*
Stages (S)	2	NS	NS	NS	**	**	**	**
Cultivars(CV)	1	NS	NS	*	**	**	*	*
(M) × (S)	2	NS	NS	NS	**	**	**	**
(M) × (CV)	1	NS	NS	**	NS	NS	NS	*
(S) × (CV)	2	NS	NS	NS	**	**	*	*
(M)×(S)×(CV)	2	NS	NS	NS	NS	*	*	NS

* Significant at 0.05, ** = Significant at 0.01, NS-Not significant; Moist = Moisture content, Vit.C = Vitamin C, TSS = Total soluble solids, and Acid = Acidity.

Table 2: Means of the three main factors, media, stages and cultivars for different charcters of tomato fruits.

Main Factor	Characters						
	Weight (g/fruit)	Size (cm^3/ fruit)	Moist. (%)	Vit. C (mg/100) g	TSS (%)	Acid (%)	TSS/acid Ratio
Media:							
Hydroponic	145.6a[z]	147.3a	95.5a	8.96b	3.84b	0.42b	8.97b
Soil	83.6b	82.8b	92.8b	14.9a	4.65a	0.59a	14.94a
Stages:							
Mature-green	106.3a	107.0a	94.0a	11.10b	4.80a	0.572a	8.39b
Pink	113.1a	114.6a	94.1a	17.56a	3.85b	0.553a	7.36b
Red-ripe	124.5a	123.5a	94.4a	16.17a	4.08b	0.398b	10.16a
Cultivars:							
Carmelo	122.5a	123.3a	94.3a	10.90b	3.77b	0.492b	8.18b
Trasque	106.7a	106.8a	94.0b	13.00a	4.71a	0.523a	9.10a

* Means followed by the same letter(s) are not significantly different at 0.05 level according to L.S.D. (0.05).

2 - **Picking stages:**

Table 1 shows that tomato fruit weitght, size and moisture content were not significantly influenced by picking stages. However, vitamin C, total slouble solids and acidity were highly significantly affected. This was further emphasized in Table 2 which indicated that vitamin C significantly increased as fruit approached red-ripe stage. This means that the stage of red-ripe was significantly different from mature-green stage, when vitamin C content in concern. On the other hand, acidity and T.S.S. decreased as tomato fruits reached their red-ripe stage; However, such decrease was more pronounced in acidity than in T.S.S., being 30% and 15%, respectively. This resulted in a highly significant T.S.S/ acid ratio at the red-ripe stage of tomatoes (Table 2). These results reveal that tomato fruits might improve their quality characters as they complete their ripening.

3 - **Cultivars:**

There were no significant differences between the two tomato cultivars in so far as fruit weight, size and moisture content were concerned (Table 1). However, both cultivars highly significantly differed in vitamin C content, T.S.S., acidity and T.S.S/acidity ratio. These results are further illustrated in Table 2. It is clear in this table that Trasque cultivar was superior to Carmelo in these quality characteristics, irrespective of media and stages of ripening. However, Carmelo cultivar slightly and nonsignificantly outyielded Trasque, its fruits being heavier and larger in size.

4 - **Interaction:**

The three two-way interactions (MxS, MxCV and SxCV) were not significant for fruit weight, size and moisture content, except for MxCV interaction that was highly significant in the case of moisture content. On the other hand, only MxS and SxCV interactions were highly significant for all chemical characteristics, as shown in Tables 1 and 3. Such chemical characteristics varied in both cultivars at the three picking stages, especially Trasque cultivar for which the T.S.S. values were similar at these stages. Similarly, the two media differed in their chemical

characteristics at picking stages, except for T.S.S. values which were not significantly different in the case of hydroponic system (Table 3).

Furthermore, the three-way ineraction among media, stages and cultivars was not significant for all charcters studied with the exception of T.S.S. and acidity (Table 1).

Table 3: Means of stage × cultivars and stages × media for characters with significant intercations.[z]

Intercation	Vit. C mg/100g	Acidity (%)	T.S.S. (%)
1. Stages × cultivars:			
Carmelo			
Mature-green	8.43 b	0.573 a	4.65 a
Pink	12.18 b	0.545 a	3.27
Red-ripe	15.59 a	0.357 b	3.60 b
Trasque			
Mature-green	7.74 b	0.570 a	4.95 a
Pink	13.03 b	0.562 b	4.33 a
Red-ripe	18.23 a	0.438 b	4.57 a
2. Stages × media:			
Hydroponic			
Mature-green	5.07 b	0.472 a	3.83 a
Pink	6.81 b	0.418 b	3.78 a
Red-ripe	15.01 a	0.378 b	3.70 a
Soil			
Mature-green	11.10 b	0.672 a	5.77 a
Pink	17.56 a	0.688 a	3.9 b
Red-ripe	16.17 a	0.417 b	4.47 b

(z) Means followed by common letter(s) are not significantly different at the 0.05 level according to L.S.D. (0.05).

In conclusion, it can be stated that growing tomatoes in hydroponic systems may increase fruit yield (weight and size) in comparison with the traditional soil culture systems. This may have the advantage of raising tomatoes in controlled environments, such as greenhouses, all year round without any fear of unsuitable conditions, especially high and cool temperatures and drought which seriously affect the tomato crop. In the mean time, it was suggested that further investigations might be necessary in order to throw more light on the effect of hydroponics on tomato cultivars, especially under stress, cool, heat and drought conditions prevailing in Saudi Arabia.

REFERENCE

Al-Mughrabi, M.A. 1986. Effect of picking stage on chemical and physical characteristics of tomato fruits produced in hydroponics. J. Coll. Agric. 8: 155-162. King Saud Univ., Riyadh, Saudi Arabia.

Anonymous. 1984. HydroGarden. Control Environment Hydroponic Growing Manual. TS Supplier of Seeds and services.

Association of Official Agricultural Chemists. 1965. Official and tentative methods of analysis. AOAC Publ. Washington, D.C., U.S.A.

Association of Vitamin Chemists. 1947. Methods of vitamin assay. Interscience Publishers Inc., New York., U.S.A.

Joslyn, M.A. 1950. Methods in Food Analysis. Academic press Inc. Publisher, New York., U.S.A.

Luk 'Yanenko, A.N., and E. KH. Luk 'Yanenko. 1982. Effect of growing techniques on changes in tomato fruit acidity. Hort. Abst. 52: 532.

Luoto, L. 1984. Effects of growing media on the postharvest quality of tomatoes and cucumbers. Acta Horticulturae 163: 237-243.

Resh, H. M. 1978. Hydroponic Food Production. Woodbridge Press Publishing Co., Santa Barbara, California, U.S.A.

Steel, R.G.D., and J.H. Torrie. 1980. Principles and Procedures of Statistics. McGraw-Hill Book Company, New York, U.S.A.