COMPARISION OF EIGHT TOMATO CULTIVARS (*Lycopersicon esculentum* Mill) IN SULAIMANI GOVERNORATE

Samal Jalal Omar
Ph.D.- College of Agricultural science University of Sulaimani
samal.omar@univsul.edu.iq.

Hawar Ali Maruf
M.Sc.- Agricultural Technical Institute of Bakrajo- Selemani Polytechnic University
hawarmaruf @ yahoo.com.

ABSTRACT

This study was carried out from (March to October 2014) at two different locations (Bakrajo and Kanipanka) in Sulaimani governorate to compare some chemical and physical properties and genetic diversity of eight tomato cultivars "Sangaw", "Early Person", "Dimond Star" ,"Guja Faranji", "Aljinan" ,"Egemen" " Heinz 2274" and "Sun" using RCBD design with four replications and the results shows that "Sangaw" had higher value of fruit equatorial diameter and lower value of polar diameter which gave it a broad shape, with lowest firmness .

Whereas "Sun" had gave a long cylindrical shape and the highest value of firmness obtained from "Sun". Fruits of "Sangaw" cultivar was superior in their Lycopene, Total acidity% and pH contents . "Early Person" had higher amount of Ascorbic acid, whereas "Dimond Star" gave maximum values of total sugar% "Guja Faranji" was superior in total soluble solid (Brix %), total soluble solid/ total acidity and dry matter% . Random Amplified Polymorphic DNA (RAPD) analysis was carried out on (8) tomato cultivars by (4) primers (OPB-18, OPC-08, OPC-09 and OPV-19). The genetic similarity among evaluated cultivars ranged from (0.4) to (1.00). The lowest genetic distance was (0.4) between "Sangaw" and "Egemen" cultivars which means that the presence of similarity is high, while the highest genetic distance was (1.0) existed among "Sun" , "Sangaw" , "Dimoned Star", "Guja Faranji", "Aljinan" and "Egemen" which means that presence of similarity is low.

....

Key words: tomato, cultivars, physical and chemical properties, genetic diversity.
Part of M.Sc. thesis of the 2nd author

ISSN 2072-3875

INTRODUCTION

Tomato is the most important vegetable crop and considered the first rank in some countries whereas; in others it will be the second in rank after potatoes. Tomato crop belongs to solanaceae (nightshade family) and originated in the west coast of South America which extends from Ecuador to Chile [29]. Tomato fruit used freshly or in salad as well as cooking, also it is used in food processing such as canning, drying, freezing, tomato paste, ketchup and juice because tomato fruit is the most prevailed and common vegetable crop all over the world, it is getting more interest and studies compared to any other horticultural or vegetable crops [34].

In addition to its important characteristics, the tomato yield is typical for physiological, cellular and biochemical studies. Tomato is easily cultivated with no long life cycle and the plants respond well to cultural practices and tests concerned with tissue culture and transfer of genetic characteristics [14].

The most important antioxidant present in tomato fruits is carotenoids such as Lycopene which differs in the fruits according to ripening stage, environmental conditions and variety. Carotenoids amounts and their activities as anticancer are affected significantly by varieties [33]. The economic value of tomato fruits is varied with the variation in its contents of total soluble solids (TSS), non-soluble solids (NSS), Lycopene, vitamin C, total acidity (TA), total sugar, fruit size, color, weight and fruit firmness. These characteristics plus marketable yield enhance fruit value and raise the prices for consumers.

Rab and Haq [24]observed that TSS of Roma tomato cultivar was, 4.08%. Beckles [7] indicated that sugars and their influence on taste are gauged in several ways. Total soluble solids (TSS), the TSS-to titratable acid ratio and the total sweetness index (TSI) are three common measures. Radzevicius *et al.* [26] have showed that tomato skin firmness ranged from 6.05 kg. cm^{-2} till 10.05 kg. cm^{-2} in "Saint Perrie" and "Benito H", respectively, The highest significant amount of ascorbic acid(16.2 mg $100g^{-1}$) and soluble solids(4.90%) were detected in "Tolstoi H". Aoun *et al.* [4] have found that among (16) tomato varieties, "IRA 9" and "IRA 162" gave maximum value for fruit diameter (92.57 cm), whereas "IRA 103" gave minimum value for fruit diameter (27.02 cm). All varieties had pH values equal or below 4.49.. Dufera [11] reported that higher total soluble solids (Brix)

ISSN 2072-3875

value (4.93) recorded by gene type "Roma VF", whereas lower value (1.68) recorded by "Beefsteak". Tigist *et al*. (36) indicated that titratable acidity varied from 0.89% to 0.25%. pH values ranged from 3.37 to 4.92 .

Genetic diversity: Archak *et al.* [5] found that genetic diversity of 27 tomato cultivars grown in India was analysed with RAPD markers, generated by 42 random primers. Kulkarni and Deshpande [19] have showed that ten tomato (Lycopersicon esculentum) genotypes showing distinct variation in morphological and anatomical features were screened for random amplified polymorphic DNA (RAPD).Kumar and Gurusubramanian [20] concluded that RAPD markers have found a wide range of application in gene mapping, population genetics, molecular evolutionary genetics and plant and animal breeding. Therefore, RAPD technique can be performed in a moderate laboratory for most of its applications. Sharifova *et al.* [30] mentioned that RAPD analysis was carried out on 19 Azerbaijan tomato genotypes. The lowest similarity was observed between cultivars "Azerbaijan" and "Shaker" (0.188), while the highest was between "Elnur" and "Garatag" (1.000).

This investigation was therefore carried out to study and compared chemical and physical properties and genetic diversity of different tomato genotypes cultivated under the climatic condition of two Locations in Sulaimani.

MATERIALS AND METHODS

Location: A field experiment was conducted from March to October, 2014 at two different locations in Sulaimani governorate, Kurdistan Region- Iraq. The first location, Bakrajo Agricultural Research Station, located on (34◦ , 35′ , 134″ N), (45◦ , 22′ , 879″ E) with an altitude of (741 meters above mean sea level), the second location, Kanipanka Agricultural Research Center was located on 35 km east of Sulaimani city, with (35◦, 22′ ,25″ N), (45◦ , 43′ , 25″ E) and an altitude of (550 m above sea level). Some physical and chemical soil properties of both locations during the study period are shown in (Table 1).

Cultivars, Seed sowing and cultivation: Eight tomato cultivars (‘Sangaw” (local), “Early Person”, “Dimond Star”, “GugaFaranji”, “Aljinan”, “Egemen”, “Heinz 2274” and “Sun”) were used in the experiment. Each cultivar was hand sown in 64 cell filling peat moss portrays by putting (2-3) seeds in each cell and germinated in the greenhouse to provide heat for germination. Seeds planted on (March 1,

ISSN 2072-3875

2014) and seedling were transplanted when attained the height of transplanting after reached (2-3) leaves on (April 10, 2014). The field was prepared through cultivating by rotary rotivator and the rows were prepared mechanically with (8 m) length and (1 m) width. The seedlings were planted in one side of the rows at (40 cm) distance between the plants with (20) plants in each row to represent one plot or one replication.

The experiment was laid down using a Randomized Complete Block Design including (8) treatments to represent the (8) tomato cultivars with four replications. The spacing between adjacent blocks was (1 m).Drip irrigation system was used in both locations with fertilization (4 kg) for each replication being carried out in four stages, with transplanting, flowering, setting and at harvest time. (water soluble fertilizer NPK (20-20-20) according to the nutrient levels previously obtained by soil analysis and as a function of crop demand. Standard agricultural practices such as weeding and liquid fertilizer application were carried out uniformly during the growing season for all replications; the field was irrigated as needed which was approximately every 1-2 days.

GENETIC DIVERSITY: The genomic DNA Mini Kit (Generaid Biotech.Ltd Taiwan Company) provides a quick and easy method for purifying total DNA (including genomic DNA, mitochondrial and chloroplast DNA) from plant tissue. DNA was isolated from leaves according to the method protocol. DNA was extracted from fresh leaves of seedling according to [28]. The quality and quantity of nucleic acids were determined on the agarose gel. Four RAPD primers: OPB-18, OPC-08, OPC-09 and OPV-19 (Operon Technologies Inc., USA) were used for amplification, as shown below:

Primer name	Sequence
OPB-18	CCACAGCAGT
OPC-08	TGGACCGGTG
OPC-09	CTCACCGCTCC
OPV-19	GGGTGTGCAG

ISSN 2072-3875

STATISTICAL ANALYSIS: Data were analyzed statistically by using analysis of variance techniques with the help of computer software (XLSTAT-Pro 7.5). Duncan's new multiple range test was used to compare the differences among the means at significant level of 1% for chemical characteristics and 5% for other characteristics.

Table (1): Some physical and chemical properties of the experiment locations soils.

Properties	Sand%	Silt%	Clay%	Texture	EC(ds. m^{-1})	pH	N%	Available P (ppm)
Bakrajo	4.66	54.05	41.29	Silty-clay	0.27	7.77	0.12	5.2
Kanipanka	4.69	53.2	42.11	Silty-clay	0.11	7.70	0.15	8.4
Properties	Soluble Na^+ (Meq/L)	Soluble Ca^+ (Meq/L)	Soluble Mg^+ (Meq/L)	Soluble K^+ (Meq/L)	Cl- (Meq/L)	O.M. %	$CaCo_3$	HCO_3
Bakrajo	0.234	1.9	0.8	0.066	0.5	1.99	25	2
Kanipanka	0.152	1.4	1.5	0.058	0.4	1.66	23.5	1.7

Data collected from Bacrajo Agricultural Research Station.

Table (2): Some meteorological data of the experiment locations during the study period (2014)

Months	Bakrajo				Kanipanka			
	Average Tem.(C^o)	Max. Tem.(C^o)	Min. Tem.(C^o)	Rainfall (mm)	Average Tem.(C^o)	Max. Tem.(C^o)	Min. Tem.(C^o)	Rainfall (mm)
1/4-30/4	18.4	27.6	8.5	36.6	16.7	27.6	5.9	27.2
1/5-31/5	24.9	33.0	14.6	17.0	23.3	35.2	11.3	5.7
1/6-	30.3	40.3	20.4	1.0	29.3	41.9	16.7	0.0

ISSN 2072-3875

31/6								
1/7-31/7	33.7	43.3	24.2	0.0	38.7	44.8	20.5	0.0
1/8-31/8	33.8	42.6	24.4	0.0	31.6	44.6	18.5	0.0
1/9-30/9	28.2	37.0	19.6	0.0	26.6	38.9	14.3	0.0
1/10-31/10	20.7	28.3	13.2	43.0	20.2	29.8	10.6	69.6

Data collected from meteorological station in Sulaimani

RESULTS AND DISCUSSION

Consistency (Firmness) ($kg.cm^{-2}$): Firmness is one of the major factors of tomato fruit quality [28], and one of the most important qualitative characteristics in tomato fruits which is usually referred as the second rank following morphological characteristics particularly for the purpose of long distant export. Table (3) shows cultivars differ significantly in respect to the firmness. "Sun" (4.39 $kg.cm^{-2}$) and "Heinz 2274" (4.21 $kg.cm^{-2}$) were the most firmness, whereas the less firmness was "Sangaw" (1.78 $kg.cm^{-2}$). Our results were in agreement with [24] and [26]. Most consumers prefer firmed fruit that do not lose juice during cutting. Cultivar firmness differences may be due to their differences in firmness of fruit walls, as the cells of such walls are small and compact in varieties of firm fruits compared to the lower ones [12].

Shape index: Shape index (fruit length/fruit width) or (polar/equatorial) ratio of the fruits was significantly different ($p \leq 0.05$) among the cultivars (table 3). "Sangaw" have greatest equatorial and smallest polar diameter among other cultivars and have smallest shape index (0.46) and have Broad shape. Whereas "Sun" has largest shape index (1.11) and have long cylindrical shape. Increase in shape index lead to become fruit longer and decrease in shape index lead to become fruit shape broader [1].

ISSN 2072-3875

Table (3): Physical characteristics responses of (8) tomato cultivars

Treatments	Consistency ($kg.cm^{-1}$)	Fruit polar diameter (cm)	Fruit equatorial diameter (cm)	Shape index	Shape
Sangaw (Local)	1.78 c	2.85 d	6.13 a	0.46 e	Broad
Early person	2.87 b	5.05 ab	5.10 cde	0.98 bc	Round
Diamond star	2.67 b	5.05 ab	5.51 bc	0.90 cd	Round broad
Guja Faranji	3.31 b	4.12 c	4.08 f	0.99 bc	Round broad
Aljinan	3.41 b	4.72 c	5.23 bcd	0.90 cd	Round broad
Egemen	3.33 b	4.87 ab	5.70 ab	0.85 d	Round broad
Heinz 2274	4.21 a	5.03 ab	4.77 de	1.06 ab	Long round
Sun	4.39 a	5.13 a	4.63 e	1.11 a	Long cylindrical

Means followed by the same letters are not significantly different at 5% P . Numbers represents average of the two locations

Similar finding observed by [24]. These differential criteria follow genetic makeup for the variety, that is, each variety has its own genetic structure, making the variety different from another. Physical properties of tomato fruits are related to same distinct morphological criteria such as weight, length, size, diameter firmness, which give the plant its economic value. These properties are basically depending on cell division and enlargement; these are subjected to environmental and genetic factors

ISSN 2072-3875

and are incident to the range of plant responses [29].

Lycopene (mg.100g $^{-1}$): Tomatoes are the main source of lycopene compounds which is a powerful antioxidant carotenoid naturally synthesized in tomato [11]. From data presented Table (4) it can be seem that the cultivars are high significantly different ($P \leq 0.01$) in lycopene contents. In order to show the differences of lycopene content, the results are ranged in three groups. It can be observed that "Sangaw" gave the higher value (9.42 mg.100g^{-1}). ""Dimond Star" gave the lower value (4.15 mg.100g^{-1}). While the other cultivars values ranged between the two. Similar finding observed by [11] and [26]. High lycopene content of "Sangaw" is more likely to be a characteristic associated with cultivar [16].

Ascorbic acid (mg. 100g^{-1}): Tomatoes are a good dietary source of ascorbic acid (Vitamin C); however the ascorbic acid content varies greatly. Data in Table (4) illustrate that cultivars had high significant effect ($P \leq 0.01$) on vitamin C contents in both locations and their average. Ascorbic acid content was maximum in cultivar "Early Person" (20.33 mg.100g^{-1}) at the average . Whereas "Egemen" gave minimum contents (10.36 mg.100g $^{-1}$). Similar finding observed by [3]. Many factors contribute in this variation, but environmental growing conditions and cultivar has been recorded as having major effects on the ascorbic acid composition [26].

Titratable acidity (T.A. %): Table (4) show that titratable acidity (T.A.) of tomato varieties varied from highest T.A. % (1.16%) observed in "Sangaw" to lowest T.A. %(0.41) observed in "Earley Person" at Kanipanka and average, respectively. Similar finding reported by [1], [2] and [3]. According to Kamis *et al*.(18), high sugar and acid content is a sign of good taste and flavor.

Total Soluble solids (T.S.S. %)(Brix): Table (4) shows that maximum values of Brix obtained from “Guja Faranji” (6.21) Whereas the minimum Brix (3.23) obtained from “Sun”. Similar findings were reported by [4] and [35]. In cultivated tomato, the soluble solids (S.S.) account for about 75% of the total solids [21]. Reducing sugars (glucose and fructose) are the main components beside sucrose in very small quantities and organic acids, lipids, minerals and pigments [4]. The difference in value between different cultivars may be attributed to genetic and physiological potential existed for developing tomatoes. Ibarbia and Lambeth [15] estimated that allelic variation at about three

ISSN 2072-3875

gene loci controlled soluble solid concentration (SSC). Different tomato varieties vary greatly in the form and abundance of the metabolites that determine Brix and the relationship between the concentrations of these metabolites and yield [6].

T.S.S. /TA: This parameter that represents maturity [32] which related with the taste index was significantly (P≤ 0.01) different among tomato cultivars (Table 4). The greatest TSS/TA was observed in “Guja Faranji" (13.08). Whereas lowest TSS/TA was observed in "Sangaw" (5.02). Suarez *et al*. [12] and Abutalibi *et al*. [1] observed similar results on six tomato cultivars. Maturity index is usually a better predictor of an acid flavor impact than Brix degree or acidity alone. TSS and TSS: TA ratios are only proxies for tomato taste and quality [7]. The taste index is calculated using the values of Brix degree and acidity applying the equation performed by [31].as follows:

$$\text{Taste index} = \frac{\text{Brix degree}}{20 \times \text{acidity}} + \text{acidity}$$

By using this equation, we show that taste index in all tomato cultivars higher than (0.84), which means that tomato cultivars are tasty. If the value of the taste index is lower than (0.7), the tomato is considered as having little taste [22].

Total sugar%: Table (4) show that maximum total sugar (4.07%) observed in "Dimond Star", whereas minimum total sugar (2.65 %) observed in "Early Person". Our results are in agreement with [25] and [26] and it is clear that different varieties have possibilities to express their own genetic makeup and consequently holding their physical and chemical characteristics if the environmental condition under which plants grown and developed excluding any limiting factor that prevent the plant from growth and development. High sugars and relatively high acid are required for the best flavor. High acid and low sugar will produce a tart tomato, while high sugars and low acids will result in a bland taste, insipid tomato [17].

pH: Table (4) show that "Sangaw" gave maximum pH value whereas "Guja Faranji" gave minimum pH values. The results seemed to confirm the literature information available on the pH values of tomato fruits [1] and [36].Differences in pH values among cultivars could be due to genotypic variability. Our results shows that titratable acidity and pH

ISSN 2072-3875

value have an inverse relationship and are commonly used acidity indicators of tomato. According to Compos *et al*. [8], appropriate pH value for industrial tomato varies from 4.3 to 4.4.In our analysis of measurement, it was determined that pH content of "Sangaw" (4.51), "Dimond Star" (4.43) cultivars are above 4.4 and this not suitable for industrial tomatoes.

Dry matter%: Significant dissimilarities ($P \leq 0.01$) were observed within dry matters (DM) among different cultivars grown in Bakrajo, Kanipanka, as shown in (Average) (Table 4). Maximum dry matter content obtained from "Guja Faranji" (9.27%) in the average. The results are similar to these reported by [36] and [37].. According to Cuartero and Fernandez [9], several characteristics such as dry matter are important quality parameters for both fresh market and processing tomatoes. The high DM is desired in processing paste products and canned tomatoes industry because they improve the quality of the product [10]. Guja Faranji" had the highest percent of dry weight, this higher value for total solids is associated mainly with increased TSS (6.21) (Table 4) possibly due to increased sink strength [13].

ISSN 2072-3875

Table (4): Chemical characteristics responses of (8) tomato cultivars (Average)

Treatment	Lycopen (mg.100g^{-1})	Ascorbic acid (mg.100g^{-1})	T.A. %	T.S.S. (Brix)	Tss/TA	Total sugar %	pH	Dry matter%
Sangaw (Local)	9.42 a	11.80 cd	1.16 a	5.53 ab	5.02 d	3.0 bc	4.51 a	7.20 b
Early person	7.03 b	20.33 a	0.41 b	5.11 bc	12.55 ab	2.71 c	4.31 c	8.0 ab
Diamond star	4.15 e	12.61 c	0.78 ab	5.61 ab	9.53 abcd	3.65 a	4.43 ab	8.1 a
Guja Faranji	7.71 b	15.11 b	0,48 b	6.21 a	13.08 a	3.42 ab	4.15 d	9.27 a
Aljinan	4.93 d	12.26 cd	0.83 ab	4.48 c	6.09 cd	3.03 bc	4.32 c	7.5 ab
Egemen	4.08 e	10.36 e	0.49 b	5.63 ab	11.69 abc	3.2abc	4.37 bc	7.9 b
Heinz 2274	5.79 c	13.02 c	0.69 ab	6.13 a	11.07 abc	2.85 bc	4.19 d	7.2 b
Sun	5.57 cd	11.18 de	0.62 ab	3.23 d	6.96 bcd	3.15 bc	4.34 bc	8.1 ab

Means followed by the same letters are not significantly different at 1% P. Numbers represents average of the two locations

Genetic diversity:

The polymorphic bands obtained with the primers: OPB-18, OPC-08, OPC-09 and OPV-19 were scored as (1) for presence or (0) for absence and imported into SPSS programs (Table 5).

Primer OPB-18 as shown in figure (1) and Table (5) gave a total number of 4 fragments, 3 of them were polymorphic scoring polymorphism percentage of 75%. The

ISSN 2072-3875

molecular sizes of produced fragments ranged from (900bp) to (350bp). Comparison between all entries indicated the distinctness of V5 genotype from the others.

Table (5): Presence (1) and absence (0) of bands in some tomato cultivars.

varieties	OPB-18-1	OPB-18-2	OPB-18-3	OPC-08-1	OPC-08-2	OPC-08-3	OPC-08-4	OPC-09-1	OPC-09-2	OPC-09-3	OPV-19-1	OPV-19-2
Sangaw (Local)	0	1	1	1	0	0	0	0	0	0	1	0
Early person	0	1	0	1	0	1	1	1	1	1	1	0
Diamond star	0	1	0	1	0	1	0	0	0	0	1	0
Guja Faranji	0	0	0	1	0	0	0	0	0	0	1	1
Aljinan	1	0	1	1	0	0	0	1	1	1	0	0
Egemen	1	0	1	1	0	1	0	0	0	0	0	0
Heinz 2274	0	1	0	1	1	0	1	0	0	1	1	0
Sun	0	1	0	0	0	0	1	0	0	0	1	0

ISSN 2072-3875

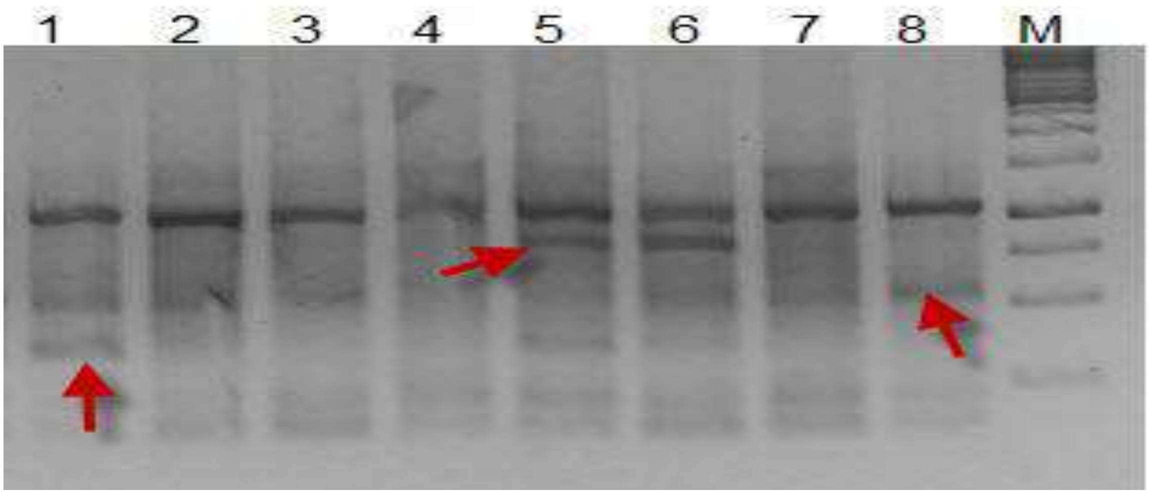

Figure (1): PCR Amplified products of 8 tomato genotypes (Lane 1-8) using RAPD primer OPB-18. M= Molecular marker (1Kb ladder).

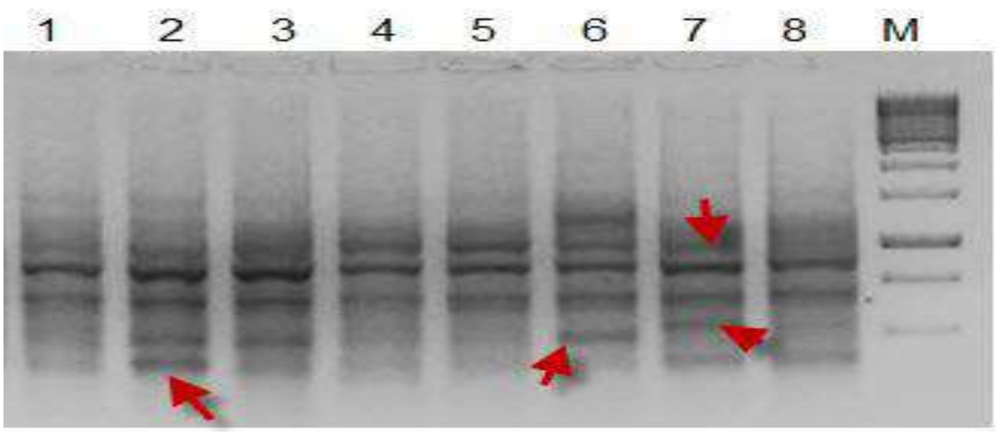

Figure (2): PCR Amplified products of 8 tomato genotypes (Lane 1-8) using RAPD primer OPC-08. M= Molecular marker (1Kb ladder).

(6) Fragments were generated from OPC-08 primer (figure 2 and Table 5), (4) of them were polymorphic. This primer showed the percentage of polymorphism (66%). The amplified products ranged in molecular size between (1000bp) and (300bp). Monomorphic fragments among all tomato genotypes expressed the common genetic relationship

ISSN 2072-3875

among them, while polymorphic fragments expressed the genetic diversity. The primer did not produce unique fragmenting patterns allowing the discrimination of original against their descends.

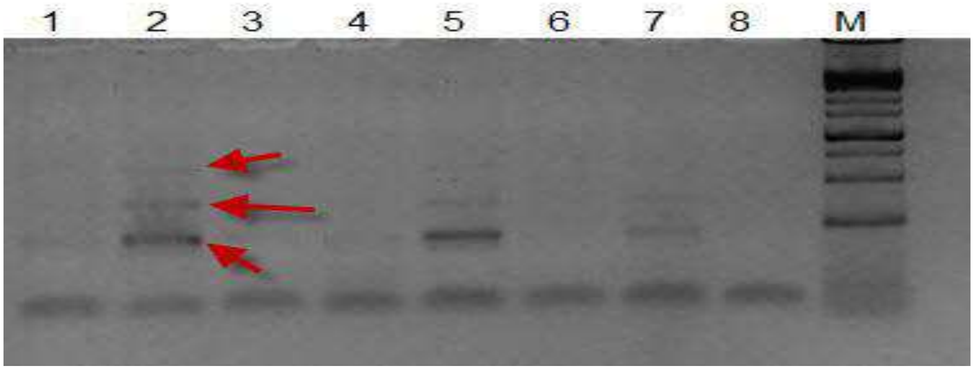

Figure (3): PCR Amplified products of 8 tomato genotypes (Lane 1-8) using RAPD primer OPC-09. M= Molecular marker (1Kb ladder).

Primer OPC-09 scored (4) of amplified fragments in all studied genotypes (figure 3 and Table 5). These fragments ranged in molecular size between (900bp) and (250bp). (3) out of the total number of scorable fragments were polymorphic, indicated polymorphism percentage of (75%).

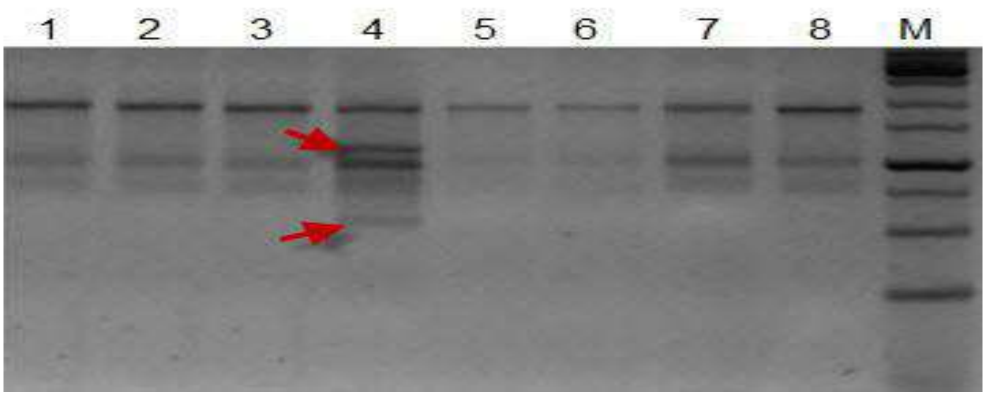

Figure (4): PCR Amplified products of 8 tomato genotypes (Lane 1-8) using RAPD primer OPV-19. M= Molecular marker (1Kb ladder).

ISSN 2072-3875

A total of (4) fragments were produced by OPV-19 primer (figure 4 and Table 5). As (2) out of the total fragment number were polymorphic, a low value of polymorphism percentage was reported (50%). The molecular sizes of amplified fragments were ranged from (2000bp) to(750bp). Fragmenting pattern obtained from using OPV-19 primer was discriminative to changes in allele frequency between genotypes. The presence of four different fragments in V4 and its absence in others confirmed it's uniquely molecular size of (1100bp) and (530bp).

Table (6): Securable DNA fragments generated by 4 RAPD decamer primers through PCR, polymorphic fragments and percent polymorphism of tomato genotypes

Primer name	No. of product bands	No. of polymorphic bands	polymorphic bands (%)
OPB-18	4	3	75
OPC-08	6	4	66
OPC-09	4	3	75
OPV-19	4	2	50

The genetic relationship between the varieties was determined using the genetic distances. This difference between the two varieties can provide a good estimate of how divergent they are genetically. The genetic relationships between the genotypes were estimated with Jaccard Coefficient. The matrix for genetic distance estimates is shown in Table 10. The lowest genetic distance was (0.4) between V6 with both varieties V1 and V3 which means that the presence of similarity between these two varieties is high degree using RAPD markers; may be because they were from local varieties and cultivated in the country. The highest genetic distance was (1) between varieties V8 with V1, V3, V4, V5 and V6 which means that the presence of similarity between them are very low and they were collected from different geographical origins (Kurdistan region).

ISSN 2072-3875

Table (7): The genetic distance values between tomato varieties studied in RAPD analysis.

	Sangaw (Local) V1	Early person V2	Diamond star V3	Guja Faranji V4	Aljinan V5	Egemen V6	Heinz 2274 V7	Sun V8
Sangaw (Local) V1	0							
Early person V2	0.750	0						
Diamond star V3	0500	0.571	0					
Guja Faranji V4	0.800	0.889	0.800	0				
Aljinan V5	0.714	0.556	0.875	0.875	0			
Egemen V6	**0.400**	0.667	0.400	0.857	0.625	0		
Heinz 2274 V7	0.857	0.500	0.857	0.857	0.625	0.889	0	
Sun V8	**1.000**	0.875	**1.000**	**1.000**	**1.000**	**1.000**	0.600	0

CONCLUSIONS:

"Sangaw" fruits had the least firmness while "Sun" fruits had the most. Fruits of different cultivars had different forms between broad and long cylindrical. Genetic diversity with RADP indicated similarity in some characteristics among some cultivars, while non- similarity is obvious among others.

ISSN 2072-3875

REFERNCES

1. Aboutalebi, A., H.H. Khankahdani, and E. Zakeri (2012). Study on yield and quality of 16 tomato cultivars in South of Iran. *International Research J. of Basic Science*, 3(4): 838-841.
2. Adubofuor, J., E.A. Amankwah, B.S. Arthur and F. Appiah (2010).Comparative study related to physico-chemical properties and sensory qualities of tomato juice and cocktail juice produced from oranges, tomatoes and carrots. *African J. of Food Science*.,4(7) : 427-433.
3. Aguirre, N. C. and F.A.V. Cabtera (2012) Evaluating the fruit production and quality of cherry tomato (*Solanum Lycopersicum*var. cerasiforme). *Revista Facultad Nacional de Agronomia-Medellin*., 65, 2: 6599-6610.
4. Aoun , A. B., B. Lechiheb , L. Benyahya, and A. Ferchichi (2013).Evaluation of fruit quality traits of traditional varieties of tomato (*Solanum Lycopercicum*) grown in Tunisia. *Global J. of Food and Nutrition* .,1(1) . 14-18.
5. Archak, S., J.L. Karihaloo and A. Jain (2002). RAPD markers reveal narrowing genetic base of Indian tomato cultivars. *Current Science*, 82 (9) : 1139-1143.
6. Baxter, C. J. , S. Mohammed , W.P. Quick and L.J. Sweetlove (2005). Comparison of changes in fruit gene expression in tomato introgression lines provides evidence of genome. Wide transcriptional changes and reveals links to mapped QTLS and described traits. *J. of Experimental Botany*, (56) 416: 1591-1604.
7. Beckles, D. M. (2012) . Factors affecting the postharvest soluble solids and sugar content of tomato (*Solanum Lycopersicum*) fruit. *Postharvest Biology and Technology*, 63 : 129-140.
8. Compos, C. A. B.,P.D. Fernundes, H.R. Gheyi, and S.A.F. Compos (2006). Yield and fruit quality of industrial tomato under saline irrigation. *Sci Agric*., 2: 63.69 (C.F. Turhan, 2009).
9. Cuartero, J. and M.R. Fernandez (1999). Tomato and Salinity. Scienta Horticulturae, 78: 83-125 (Abstract).

ISSN 2072-3875

10. Depascale, S., A.Maggio, V.Fogliano, P. Ambrosion and A. Retieni (2001). Irrigation with saline water improves carotenoids content and antioxidant activity of tomato. *J. Hortic.Sci. Biotechnol.*, 76: 447-453(Abstract.).

11. Dufera, J. T. (2013). Evaluation of agronomic performance and lycopene variation in tomato (*Lycopersicon esculentum* Mill) genetypes in Mizan, Southwestern Ethiopia. *World Applied Sciences J.*, 27(11): 1450-1454.

12. Hasan, A. A. (1998). Tomato production technology and physiology, agricultural practices, harvesting and storage. Al. Dar Al. Arabia for Publishing and Distribution. Arabic Egyption Republic.Cairo. p (511).

13. Hewitt, J. D., M.Dinar and M.A. Stevens (1982). Sink strength of fruits of two tomato genotypes differing in total fruit soild content. *J. Amer. Soc. Hort. Sci.*, 107: 896-900 (Abstract).

14. Hille. J., M. Koornneef, M.S. Ramanna, and P. Zable (1989). Tomato: a crop species amenable to improvement by cellular and molecular methods. *Euphytica*,42: 1-23.

15. Ibarbia, E. A. and V.N. Lambeth (1969). Inheritance of soluble solids in a large/ small. fruited tomato cross. *J.Amer. Soc. Hort. Sci.*,94: 496-498.

16. Ibitoye, D. O., P.E. Akin-Idown and O.T. demoyegu (2009). Agronomic and lycopene evaluation in tomato (*Lycopersicon Lycopersicum* Mill) As a function of Genotype. *World J. of Agricultural Science*, 5(s): 892-895.

17. Kader, A. A. (1986). Effect of post-harvest handling procedures on tomato quality. *Acta Hort*, 190: 209-221.

18. Kamis, A.B., A.S. Modu, and B. Mwajim (2004). Effect of ripening on the proximate and some biochemical composition of a local tomato cultivar grown at lake Alau Region of Borono. J.App. I.Sci., 4(3): 424-426.

19. Kulkarni , M. and U. Deshpande (2006). RAPD Based fingerprinting of tomato genotypes for identification of mutant and wild cherry specific markers .*J. of plant. Sci*. 1 (3): 192-200

ISSN 2072-3875

20. Kumar, N. S. and G. Gurusubramanian (2011). Random amplified polymorphic DNA (RAPD) markers and its applicatons. *Scivis*, 11(3), 116-124.

21. Majid, R. (2007): Genome moping and molecular breeding of tomato. *Int.J. Plant Genomics*, p.52 (Abstract).06

22. Navez, B., M. Letard, D. Groselly and M. Jost, (1999). Les oriteres de qualite de la tomate. Infos-Ctifl, ISS, 4.47 (Cit. from Suarez, 2008).

23. Pino, M. D. , A. Nicu , G. Granitto, S. Gamboa and C. Pineda (2014). Evaluation of tomato varieties for their use by small organic farms in Buenos Aires, Argentina .Proceeding of the 4 th ISOFAR Scientific conference.

24. Rab. , A. and I. Haq (2012). Foliar application of calcium chloride and bora α influences plant growth, yield and yield quality of tomato *(Lycopersicom esculentum* Mill) fruit. *Turk J. AgricFor*., 36: 295-701.

25. Radzevicius, A. , P. Viskelis, R. Bobinaite, R. Karkleliene and D. Juskeviciene (2013). Tomato fruit quality of different cultivars growth in lithuania. *International J. of Biological, Veterinary, Agricultural and Food Engineering.*, 7(7) : 381-384.

26. Radzevicius, A., R. Karkleline, C. Bobina and P. Viskelis (2009). Nutrition quality of different tomato cultivars. Zemdirbyste. *Agriculture*, 98(3): 67-75.

27. Rosenfeld, D., I. Shmulevich and N. Galili (1994). Measuring firmness through mechanical acoustic excitation for quality control of tomatoes food Automation Congress, February. (Abstract).

28. Roubos, K., M. Moustakas and F.A. Aravanopoulos (2010). Molecular identification of Greek olive (*Oleaeuro paea*) cultivars based on microsatellite loci, *Genet. Mol.Res*, 9(3): 1865 -1876 .

29. Sharif, CH. M. (2004). Response of some tomato cultivars *(Lycopericon esculentum*Mill) to plant spacing and nitrogen levels in Sulaimani region. MSc. Thesis, College of Agriculture, Sulaimani University. (160 pages).

30. Sharifova , S. , S. Mehdiyeva, K. Theodorikas and K. Robuos (2013). Assessment of genetic diversity in

ISSN 2072-3875

cultivated in cultivated tomato (*Solanum lycopersicum)* genotypes using RAPD primers. *J. of Horticultural Research*, 21 (1): 83-89.

31. Suarez, M. H., E.M. Rodriguez, and C. Diaz Romero (2008). Chemical composition of tomato (*Lycopersicon esculentum*) from Tenerife, the canary Islands. Availab.le on line at www. Sciencedirect.com .*Food Chemistry*, 106: 1046-1056 .
32. Suarez, M. H., E.M. Rodriguez and C. Diaz Romero (2007). Analysis of organic acid content in cultivars of tomato harvested in Tenerife. European Food research and Technology
33. Susanne, R., Z.O. Beer and P.M. Kuznesof (2009) Lycopene extract from tomato. Chemical and Technical Assessment (CTA). FAO/ WHO.
34. Tigchelaar , E. C. and V.L. Foley (1991) : Horticultural technology . acase study. Hort. Technology 1 .7-16.
35. Tigist, M., T.S. Workneh and K. Woldet Sadik (2013). Effects of variety on the quality of tomato stored under ambient conditions. *J. Food Sci Technol., 50*(3): 477-486.
36. Turhan, A. and V. Seniz (2009). Estimation of certain chemical conststuents of fruits of selscted tomato genotypes grownin Turkey. *African J. of Agricultural Resaerch*,4 (10) : 1086-1092.
37. Young, T. E., J.A. Juvik and J.G. Sullivan (1993). Accumulation of the component of total solids in ripening fruits of tomato. *J. Amer. Soc. Hort. Sci.*, 118(2): 286-292.

ISSN 2072-3875

مقارنة الصفات النوعية لثمار ثمانية اصناف من الطماطة (*Lycopersicon esculentum* Mill) في محافظة السـليمانية

سامال جلال عمر

Ph.D- كلية العلوم الزراعية

جامعة السليمانية

هوار علي معروف

M.Sc.- المعهد الزراعي التقني في بكرجو

جامعة بوليتكنيك في السليمانية

المستخلص

اجريت هذه الدراسة خلال (مارت- تشرين الأول 2014) في موقعين مختلفين (بكرجو و كانيبانكة) في محافظة السليمانية لمقارنة بعض الصفات الكيميائية و الفيزيائية و التغيرات الوراثية لثمانية اصناف من الطماطة "Sangaw", "Early Person", "Dimond Star" ,"Guja Faranji", "Aljinan" ,"Egemen" " Heinz 2274" and "Sun". **باستخدام تصميم القطاعات العشوائية الكاملة باربع مكررات. بينت النتائج بان** "Sangaw " **اعطت اكبر قيمة لطول الثمار واقل قيمة للعرض مما ياخذ الشكل المفلطح مع اقل قيمة للصلابة في حين اعطى** "Sun " **الشكل الاسطواني الطويل و اكبر قيمة للصلابة.. كان لصنف** "Sangaw" **اكبر محتوى لللايكوبين و الحموظة الكلية% وال pH. اعطى الصنف** "Dimond Star" **اكبر قيمة للسكريات الكلية اما الصنف** "Early Person" **كان لها اكبر محتوى من حامض الاسكوربيك. الصنف** "Guja Faranji" **كان متقدما ف محتواها من المواد الصلبة الكلية المواد الصلبة الكلية/الحموضة الكلية و الوزن الجاف%. انجز تحليل ال (DNA) ل 8 اصناف من الطماطة باستخدام اربع بادئات (**OPB-18, OPC-08, OPC-09 and OPV-19.**) و التشابه الوراثي بين الأصناف المدروسة كانت في مدى (0.4) و (1). اقل بعد وراثي كان (0.4) بين** "Sangaw " **و** "Egemen " **الذي يدل على ان التشابه بينهما كبير ، بينما اعلى بعد وراثي (1) بين** "Sun " **وكل من** "Sangaw " **و**"Dimoned Star" و"Guja Faranji" و "Aljinan" و "Egemen" **والذي يدل على الأختلاف الموجود بينهم.**

الكلمات المفتاحية:الطماطة ، الأصناف ، الصفات الكيميائية و الفيزيائية ، التغيرات الوراثية.

البحث مســتل من رسالة ماجســتير للباحث الثاني