International Journal of Plant & Soil Science
3(9): 1083-1095, 2014; Article no. IJPSS.2014.9.006

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Physiochemical Juice Characteristics of Various *Citrus* Species in Syria

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Authors' contributions

This work was carried out in collaboration between both authors. They designed the study and author RAM did the practical work, performed the analysis, wrote the protocol, and wrote the first draft of the manuscript. Both authors managed the analyses of the study, the literature searches and the discussion, read and approved the final manuscript.

Original Research Article

Received 30th March 2014
Accepted 11th June 2014
Published 25th June 2014

ABSTRACT

Aims: The investigation of some physiochemical juice characteristics of 37 varieties of *Citrus* genus, maintained in the Department of *Citrus* Research in Tartous, Syria.
Place and Duration of Study: Laboratory of Molecular Genetic, Faculty of Agriculture, Tishreen University, Lattakia, Syria, from 2011 to 2013.
Methodology: Thirty seven varieties belonging to 4 groups of *Citrus* genus (Lemon, Sweet orange, Mandarin and Grapefruit) were used in this study. Three trees/variety, and 10 fruits/tree were used in the analysis. Fruits were harvested from trees at mature stage and juice was extracted and promptly used for physicochemical analysis.
The following parameters of fruit quality were evaluated: percentage of juice/fruit, total soluble solids (TSS), pH and titratable acidity (TA) and ascorbic acid (Vitamin C) content.
Results: The varieties produced the highest juice percentage were Meyer of lemon group (58.42%), Balady of sweet orange (57.61%), Ortanique from mandarin (56.10%) and Red blush of grapefruit group (49.41%).
For TSS parameter, Mandarin varieties showed the highest TSS values (9.5-13.9) while Lemon varieties showed the lowest ones (6.11-7.9).
Varieties of Lemon group exhibited the lowest pH values (2.21-2.46) while the highest pH value was detected in sweet orange varieties (5.94).
Percentage of total acidity in citrus juice varied and ranged from 0.08g\100ml in Succary (Sweet orange group) to 5g\100ml in Eureka (Lemon group).

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Ascorbic acid (Vitamin C) content showed large variations within and between *Citrus* groups where the highest value (50.66mg\100ml) was revealed in Clementine while the lowest one (22.52mg\100ml) was found in Nova (Mandarin group).
Conclusion: The citrus varieties grown in Syria showed large variations in their juice physiochemical characteristics between and within *Citrus* groups. The juice of all varieties was of a good quality on the base of the different studied parameters.

Keywords: Percentage of juice; total soluble solids (TSS); titratable acidity (TA); Vitamin C; Citrus; Syria.

1. INTRODUCTION

Citrus is one of the most economically important fruit trees in the world. It is mainly grown in the tropical and subtropical regions and Mediterranean countries. Citrus fruits are very popular worldwide and are recognized by their distinctive and varied flavor. They are widely used as sources of juices, where citrus juice is the most popular beverage in the world. They are also used for traditional medicines, where it is believed that consumption of citrus fruits - or their different products – is associated with reduced risk of different diseases. The health benefits of citrus fruit have mainly been attributed to the presence of important bioactive compounds like carotenoids [1,2], phenolics [3], and a large collection of mineral elements and vitamins [4,5]. All of these components are playing important roles in human nutrition especially ascorbic acid, generally called vitamin C. It plays a key role in total antioxidant capacity of citrus fruits as a free radical scavenger [6]. Vitamin C also inhibits the formation of carcinogens which attack DNA leading to mutagenic changes [7].

Fruit characters are one of the important parameters used for the selection of best genotypes of citrus trees, where farmers and consumers pay more attention to the fruit quality than to its size and yield [8].

The quality of citrus fruits depends on several factors including the amount of juice, its content of total soluble solids (TSS), the acidity level and the proportion of vitamin C in a defined volume.

The quality of citrus juice is an important economic factor in an industry that buys its fruit based on the sugar content and processes over 95% [9]. TSS content also forms the basis of payment for fruit by some juice processors in a number of countries, especially where the juice trade is based on frozen concentrate [10]. Citrus fruits are considered as acid fruits, since their content of soluble solids are composed mainly of organic acids and sugars [11].

The acid content in juice has an important role in determining the quality of a variety as well as maturity indices of fruit [12]. Amount of ascorbic acid, juice, TSS and TA contents are influenced by variety, cultural practice, maturity, climate and fruit growth stage [13].

Although citrus is one of the most important crops in Syria, physiochemical properties of citrus fruits were not adequately focused. The objective of this study was to evaluate some physiochemical juice characteristics of 37 varieties of *Citrus* genus, maintained in the Department of *Citrus* Research in Tartous, Syria.

2. MATERIALS AND METHODS

2.1 Plant Material

Thirty seven cultivars belonging to four main groups *of Citrus* genus, grown in the orchards of *Citrus* Research in Tartous, Syria, and subjected to the same cultural exercises, were used in this study (Table 1). Five lemon varieties, fifteen orange, twelve mandarin, three grapefruit and two pumelo varieties were sampled. Three trees/variety (each tree represents an accession), and 10fruits/tree were used in the analysis. In total, thirty fruits per variety were used in the analysis.

Fruits were harvested from trees at mature stage and juice was extracted and promptly used for physicochemical analysis.

2.2 Estimation of Juice%, Total Soluble Solids (TSS), pH and Titratable Acidity (TA)

Fruits were weighted, cut in two parts and squeezed to extract the juice. Juice was weighted and % of juice in the fruits was estimated and its pH was measured by a pH meter (Hanna Instruments' pH meters, HI 111 model).

Total soluble solids (TSS) was determined using a digital refractometer (Digital Abbe refractometer, KRUSS). Titratable acidity (TA) was determined by titrating the juice against standard NaOH to phenolphthalein end point. The TA was expressed as % of citric acid using the formula of American Organization Analytical Chemists (AOAC) [14]:

acid %= (0.1×0.064 ×? mL of NaOH used×100) /mL of the sample juice.

2.3 Estimation of Ascorbic Acid (Vitamin C) Content

The ascorbic acid content was determined using the method described in AOAC [14], with some slight modifications. 50ml of fresh juice and 50 ml of 4% oxalic acid were mixed in a conical flask. 10ml of this mixture was taken and titrated with 2, 6-dichlorophenol indophenol dye. The appearance and persistence of pink color was taken as end point. The amount of ascorbic acid (Vitamin C) was expressed in mg/100ml of juice according to the following formula:

Ascorbic acid (mg/100ml)= [Titer×Dye factor×Volume made up×100] / [Aliquot of sample used×Volume of sample].

2.4 Statistical Analysis

Data were expressed as means±standard deviations (SD) of three replicates using Microsoft excel 2003. Statistical analysis was performed using Genstat 12. One-way ANOVA (no Blocking) and the Duncan's New Multiple-range test were used to determine the differences among the means. The correlation coefficient was calculated between pH and TA according to SAS Analysis of variance of all data sets, and the mean values were considered significantly different at P=.05. A dendrogram based on the similarity between varieties on the base of their content of Vitamin C was established using NTSYS program [15].

Table 1. Varieties of *Citrus* used in this study and maintained in the orchards of *Citrus* research in tartous, Syria

Serial #	Common names	Species name according to Tanaka system	Groups of *Citrus* genus	Original places of collection	Introduction year*
1	Meyer	*C. meyeri* Tan.	Lemon	*San-Giuliano* Corsica	1980
2	Interdonato	*C. limon* (L.) Burm.f.	Lemon	New camp California	1982
3	Monachello	*C. limon* (L.) Burm.f.	Lemon	New camp California	1982
4	Santa Tereza	*C. limon* (L.) Burm.f.	Lemon	New camp California	1982
5	Eureka	*C. limon* (L.) Burm.f.	Lemon	Unknown	
6	Washington navel	*C. sinensis* (L.) Osb.	Sweet orange	*San-Giuliano* Corsica	1980
7	Cara Cara	*C. sinensis* (L.) Osb.	Sweet orange	Çukurova University - Turkey	2004
8	Gillette navel	*C. sinensis* (L.) Osb.	Sweet orange	*San-Giuliano* Corsica	1980
9	Newhall navel	*C. sinensis* (L.) Osb.	Sweet orange	*San-Giuliano* Corsica	1980
10	Valencia	*C. sinensis* (L.) Osb.	Sweet orange	*San-Giuliano* Corsica	1980
11	Jaffa	*C. sinensis* (L.) Osb.	Sweet orange	Local	
12	Salustiana	*C. sinensis* (L.) Osb.	Sweet orange	IVIA-Spain Station	1998
13	Maourdi	*C. sinensis* (L.) Osb.	Sweet orange	New camp California	1982
14	Sanguinelli	*C. sinensis* (L.) Osb.	Sweet orange	*San-Giuliano* Corsica	1980
15	Moro Blood	*C. sinensis* (L.) Osb.	Sweet orange	New camp- California	1982
16	Hamlin	*C. sinensis* (L.) Osb.	Sweet orange	*San-Giuliano* Corsica	1980
17	Cadenera	*C. sinensis* (L.) Osb.	Sweet orange	New camp California	1982
18	Balady	*C. sinensis* (L.) Osb.	Sweet orange	Local	
19	Succari	*C. sinensis* (L.) Osb.	Sweet orange	Local	
20	Khettmali	*C. sinensis* (L.) Osb.	Sweet orange	Local	
21	Common Mandarin	*C. reticulata* Blanco	Mandarin	Local	
22	Mandalina	*C. reticulata* Blanco	Mandarin	Local	
23	Clementine	*C. clementina*	Mandarin	IVIA-Spain Station	1998

Continued Table 1……..

24	Nova	*C. clementina* x (*C. paradisi* x *C. tangerina*)	Mandarin	*San-Giulian* Corsica	1980
25	Carvalhal	*C. reticulata* Blanco	Mandarin	*San-Giuliano* Corsica	1980
26	Dancy	C. *tangerina* Hort.ex.Tan.	Mandarin	*San-Giuliano* Corsica	1980
27	Klimntard	*C. reticulata* Blanco	Mandarin	IVIA-Spain Station	1998
28	Fortune	*C. reticulata* Blanco	Mandarin	*San-Giuliano* Corsica	1980
29	Ortanique	*C. sinensis* × *C. reticulata*	Mandarin	*San-Giuliano* Corsica	1980
30	Minneola	*C. reticuata* × *C. paradisi*	Mandarin	*San-Giuliano* Corsica	1980
31	Ponkan	*C. poonensis* Tan.	Mandarin	*San-Giuliano* Corsica	1980
32	Satsuma	*C. unshui*	Mandarin	*San-Giuliano* Corsica	1980
33	Marsh seedless	*C. paradisi* Macf.	Grapefruit	*San-Giuliano* Corsica	1980
34	Star ruby	*C. paradisi* Macf.	Grapefruit	*San-Giuliano* Corsica	1980
35	Red blush	*C. paradisi* Macf.	Grapefruit	*San-Giuliano* Corsica	1980
36	Pumelo	*C. grandis* (L.) Osb.	Pumelo	*San-Giuliano* Corsica	1980
37	Red Pumelo	*C. grandis* (L.) Osb.	Pumelo	*San-Giuliano* Corsica	1980

**The year where the varieties introduced to Syria and conserved in the orchards of Citrus Research in Tartous, Syria*

3. RESULTS AND DISCUSSION

The varieties analyzed varied in their contents of juice. In the varieties of lemon group, the highest juice percentage (58.42%) was found in Meyer variety, while the lowest juice percentage (30.22%) was produced by Monachello (Table 2). In sweet orange, Balady variety had the highest juice percentage (57.61%) while Newhall navel variety had the lowest percentage (43.02%) (Table 3). It was reported that the different varieties of oranges produced 26.3–59% of juice [16].

Among all varieties belonging to mandarin group, Ortanique had the highest juice content (56.10%) while common mandarin had the lowest content (37.00%) (Table 4). Between the three varieties of grapefruit, Red blush had the most juice content (49.41%) whereas Marsh seedless had the lowest percentage (45.09%) (Table 5). The content of juice in our grapefruit varieties were similar to the content of juice detected in the grapefruit varieties collected from 12 countries, where the juice percentage ranged from 37.89% to 53.55% [17].

The flavor and palatability of citrus fruit is a function of relative levels of TSS (total soluble solids), which are used as the main index of maturity and one of the major analytical measures of flavor quality [18].

Lemon varieties showed the lowest TSS value in comparison to varieties of other groups, where their values of TSS ranged from 6.11 in Meyer to 7.9 in Santa Tereza (Table 2) which accords with the results reported by other studies [19,20]. The highest TSS values were found in mandarin varieties (9.5-13.9) (Table 4) followed by sweet orange varieties (8.7-11.7) (Table 3). This result agreed with those reported by other studies [21]. The TSS values observed in our grapefruit varieties (9.9-11.3) (Table 5), were similar to those estimated by other researchers [22,19].

The measurement of hydrogen ion activity (pH) is a useful method of expressing the acidity of juice. The correlation between acidity and citric acid concentration is frequently obscured by a considerable variation in the Brix of citrus juice in the natural state, as obtained by extraction from fruits [23]. In general, the relative acidity of citrus juice may be expressed either by the Brix/acid ratio or by pH value. Varieties of Lemon group exhibited the lowest juice pH values, which were ranged from 2.21 in Santa Tereza to 2.46 in Meyer, while the highest pH value was detected in sweet orange group where a value of 5.94 was found in Succari variety. Between varieties of mandarin group, Clementine showed the highest pH value 3.5 while Fortune variety displayed the lowest value 2.67. In grapefruit varieties, pH value was ranged from 2.74 to 2.82, whereas both pumelo varieties showed similar pH values 2.84.

Total acidity percentage of citrus juice can be considered as of a limiting factor in overall juice quality parameters and in determining the harvest time in several citrus producing regions [23]. Our results showed that lemon varieties exhibited the highest acidity values, whereas it was ranged from 4.62g\100ml in Interdonato to 5g\100ml in Eureka. In sweet orange group, the highest value of acidity was revealed in Balady, (1.65g\100ml) and the lowest value (0.08g\100ml) was found in Succary. In mandarin group, Minneola contained high acidity value (1.62g\100ml) while Nova has lowest acidity value (0.49g\10ml).

From the obtained results, a significant differences between the four groups of citrus was observed (Table 2). The lemon varieties possessed the highest acidity values, while orange varieties had the lowest values, which is in accordance with several studies [24,25].

A remarkable variation of acidity within the group, or even within varieties of a single group was revealed, it ranges from 0.06 % to 8.00% titratable acids, expressed as citric acid, in the juices [23].

The correlation coefficient (r) was performed between pH and TA for each group and a strong correlation was observed in mandarin group (r =0.808) and in orange group (r=0.739). On the other hand, no significant correlation was found in lemon (r=0.161) and grapefruit+pumelo (r=0.109) groups (Table 6).

Generally, Brix/acid ratio (TSS/TA) is one of the most important indicators of the maturity of citrus fruits and is an important expression for acidity of citrus juice, where acidity is inversely proportional to the ratio. TSS\TA ratio was low in all varieties of lemon group, followed by grapefruit and pumelo. As expected, orange and mandarin groups possessed a high TSS\TA ratio, and the highest ratio was revealed in Succari (126.25), mainly due to the lowest acidity of its juice.

The comparison of ascorbic acid (Vitamin C) content within the different groups of *Citrus* showed high and close contents in sweet orange varieties. It was ranged between 36.59mg\100ml in Sanguinelli and 45.73mg\100ml in Valencia. Also, grapefruit varieties presented similar results, with a vitamin C content ranged from 40.22mg\100 ml in Marsh seedless to 43.55mg\100ml in Red blush. The situation was different in mandarin group where significant variations in ascorbic acid content was revealed between varieties. They were ranged from 17.82mg\100ml in Nova to 50.66mg\100ml in Clementine. Similar variations were detected between lemon varieties, where Santa Tereza had the highest value (31.11 mg\100ml) while the lowest value (22.52mg\100ml) was found in Interdonato. In pumelo, significant differences was detected, although pumelo and Red pumelo had close contents (37.46mg\100 and 38.22mg\100, respectively).

The concentration of ascorbic acid in citrus fruits varies according to the species. The orange generally contains 40-70mg per 100 ml of juice and lemon and grapefruit contains 20-50mg per 100ml juice [26]. Our results are in agreement with previous studies, except for mandarin varieties, where the values of vitamin C were less than 20mg/100ml in some varieties (Table 5).

Table 2. Physiochemical characteristics of *Citrus lemon* fruits

Common name	Juice (%)	PH	TSS%	TA%	TSS/ TA	Vitamin C mg/100ml
Meyer	58.42±0.526a	2.46±0.004d	6.1±0.047d	4.77±0.044b	1.278	25.47±0.278c
Interdonato	34.69±0.31c	2.24±0.008b	7.5±0.11b	4.62±0.049c	1.62	22.52±0.217e
Monachello	30.22±0.667d	2.24±0.012ab	7.3±0.081c	4.81±0.076b	1.517	24.79±0.412d
Santa Tereza	46.27±1.09b	2.21±0.012a	7.9±0.047a	4.87±0.102b	1.437	31.11±0.361a
Eureka	34.24±0.761c	2.36±0.009c	7.7±0.097b	5±0.0.077a	1.54	27.49±0.359b
Average	40.77±11.54	2.30±0.10	7.30±0.70	4.81±0.13	-	26.28±3.23
LSD at 5% level	1.851	0.025	0.209	0.096	-	0.569

Data are expressed as Means± S.D (standard deviation), (n=3).Values with different letters in the same column are statistically different at P=.05

The dendrogram in Fig. (1) displayed the similarity between varieties on the base of their content of Vitamin C. The varieties were distributed into two distinct groups. The first one is also divided in two subgroups well separated from each other. The first subgroup includes Meyer, Monchello, Ortanique and interdonato which have a similar content of vitamin C (from 22.52mg\100ml to 25.47mg\100ml), while the second one whish includes also four varieties (Mandarin common, Ponkan, Mandalina and Nova) but with the lowest content of vitamin C (from 17.82mg\100ml to 19.55mg\100ml). The second group was divided into three subgroups, one of them had one variety only (Clementine) which was very distant from all other varieties and had the most content of vitamin C (50.36mg\100ml). The second subgroup represented the majority of varieties used in this study and includes 22 varieties (all varieties of orange, grapefruit and pumelo in addition to Klimntard and Fortune from Mandarin group) forming four separated clusters with small variations in Vitamin C (between 36.59mg\100ml and 45.73mg\100ml). The third sub group was composed of 6 varieties belonging to three groups: Lemon (Santa Tereza and Eureka), Orange (Minneola, Carvalhal) and Mandarin (Satsuma, Dancy) with close vitamin C content ranged from 27.49mg\100ml to 35.20mg\100ml.

Table 3. Physiochemical characteristics of *Citrus sinensis* fruits

Common name	Juice (%)	PH	TSS%	TA%	TSS/ TA	Vitamin C mg/100ml
Washington	47.81±0.354e	3.52±0.014d	8.9±0.073jk	1±0.048e	8.9	41.15±0.781d
Cara Cara	53.15±0.433b	3.49±0.008g	8.9±0.042jk	0.99±0.053e	8.989	43.55±0.637b
Gillette	49.99±1.01c	3.67±0.004c	8.7±0.041k	0.84±0.041cd	10.357	39.41±0.344f
Newhall	43.02±0.354g	3.80±0.004b	8.8±0.028j	0.77±0.061c	11.428	38.51±0.334g
Valencia	57.46±0.298a	2.73±0.012n	10.5±0.069f	1.26±0.049f	8.33	45.73±0.348a
Jaffa	48.27±0.194e	3.41±0.016f	11.7±0.053a	0.85±0.065cd	13.76	41.47±0.295d
Salustiana	56.39±1.078a	3.27±0.009h	9.5±0.065i	1.03±0.095e	9.22	39.88±0.329g
Maourdi	51.10±0.680c	3.22±0.008i	10.8±0.035d	0.91±0.073d	11.868	38.67±0.376g
Sanguinelli	48.73±0.214de	3.1±0.004l	10.6±0.028e	1.23±0.038f	11.868	36.59±0.294i
Moroblood	45.85±0.836f	3.46±0.008e	10.6±0.035e	0.53±0.028b	20	40.42±0.34e
Hamlin	44.35±0.695f	3.13±0.009k	11.3±0.041c	1.24±0.047f	9.11	42.70±0.561c
Cadenera	48.18±0.632e	2.82±0.004m	11.5±0.043b	1.47±0,072g	7.82	42.68±0.477c
Balady	57.61±0.448a	3.17±0.009j	11.5±0.024b	1.65±0.03h	6.969	41.70±0.277d
Succari	49.87±0.198cd	5.94±0.002a	10.1±0.041g	0.08±0.004a	126.25	37.58±0.351h
Khettmali	47.77±0.092e	3.33±0.014g	9.9±0.051h	1.64±0.024h	6.036	43.46±0.457b
Average	51.17±7.83	3.47±0.74	10.22±1.06	1.03±0.41	-	40.90±2.5
LSD at 5% level	1.285	0.02	0.09	0.1	-	0.714

Data are expressed as Means± S.D (standard deviation), (n=3). Values with different letters in the same column are statistically different at P= .05

Table 4. Physiochemical characteristics of *Citrus reticulata* fruits

Common name	Juice (%)	PH	TSS%	TA%	TSS/ TA	Vitamin C mg/100ml
Mandarin common	37.00±0.496h	3.35±0.004c	11.8±0.041c	1.01±0.03d	11.68	18.66±0.494i
Mandalina	39.34±0.435g	3.08±0.002e	10.4±0.032g	1.18±0.067c	8.81	19.55±0.366h
Clementine	43.19±0.327e	3.5±0.002a	11.2±0.047d	0.59±0.094f	18.98	50.36±0.365a
Nova	50.72±0.281c	3.34±0.004c	13.9±0.032a	0.49±0.042g	28.367	17.82±0.367i
Carvalhal	46.84±0.525d	3.31±0.004c	10.4±0.037g	0.82±0.041e	12.68	33.41±0.247d
Dancy	54.88±0.422ab	2.84±0.002g	10.8±0.047f	1.43±0.53b	7.55	35.2±0.772c
Klimntard	45.98±0.623d	3.32±0.002c	12.7±0.061b	1.22±0.072c	10.409	39.20±0.441b
Fortune	53.13±0.909b	2.67±0.004n	10.8±0.036f	1.59±0.046a	6.79	39.11±0.722b
Ortanique	56.10±0.194a	2.93±0.004f	11.0±0.047e	1.19±0.033c	9.24	24.00±0.623g
Minneola	54.72±0.141ab	2.83±0.009g	10.1±0.035	1.62±0.032a	9.23	31.50±0.423e
Ponkan	41.15±0.218f	3.39±0.002b	11.2±0.04d	0.61±0.049f	18.36	18.60±0.186i
Satsuma	46.96±0.351d	3.17±0.004d	9.5±0.062h	0.86±0.053e	11.046	28.44±0.363f
Average	47.50±6.47	3.14±0.26	11.15±1.19	1.05±0.37	-	29.65±10.34
LSD at 5% level	1.099	0.03	0.08	0.06	-	0.899

Data are expressed as Means±S.D (standard deviation), (n=3). Values with different letters in the same column are statistically different at P=.05

Table 5. Physiochemical characteristics of *Citrus paradisi* and *Citrus maxima* fruits

Common name	Juice (%)	PH	TSS%	TA%	TSS/ TA	Vitamin C mg/100ml
Marsh	45.51±1.08b	2.74±0.009b	10.2±0.047b	1.73±0.05c	5.89	40.22±0.438b
Star ruby	46.33±0.236a	2.82±0.012a	11.3±0.092a	1.87±0.025a	6.04	41.33±757b
Red blush	49.18.232b	2.74±0.008b	9.9±0.041c	1.79±0.098b	5.307	43.55±0.457a
Average	47.00±1.93	2.76±0.04	10.47±0.74	1.80±0.07		41.70±1.69
LSD at 5% level	1.737	0.03	0.261	0.059		1.401
Pumelo	29.25±0.623	2.84±0.004	9.8±0.043	1.40±0.043	7	37.46±0.512
Red Pumelo	28.62±0.431	2.84±0.009	9.9±0.051	1.43±0.06	6.92	38.22±0.322
Average	28.93±0.44	2.84±0	9.85±0.07	1.42±0.02		37.84±0.54
LSD at 5% level	1.202	0.013	0.131	0.133		0.561

Data are expressed as Means± S.D (standard deviation), (n=3). Values with different letters in the same column are statistically different at P=.05.

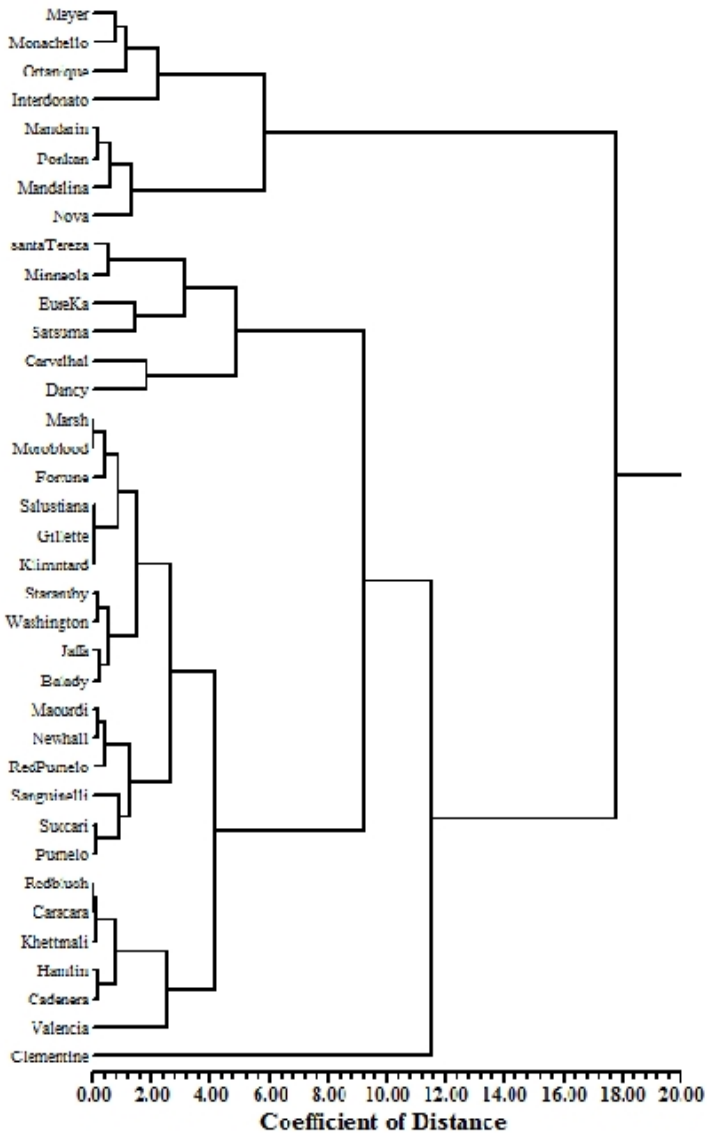

Fig. 1. Clustering of Citrus varieties on the base of their content of vitamine C.

Table 6. pH, TA values and correlation coefficient (r) between groups of *Citrus*

Groups	pH	TA	r	P≥F
Lemon	2.3c	4.81a	0.161	0.5647
Orange	3.47a	1.03c	0.739	0.0001
Mandarin	3.14a	1.05c	0.808	0.0001
Grapefruit+pumelo	2.80b	1.64b	0.109	0.6988
LSD at 5% level	0.306	0.231		

Values with different letters in the same column are statistically different at P=.05

According to the data obtained in this study, blood orange varieties did not have high ascorbic acid content in comparison with blond varieties, which opposite to the study of Arena et al. [27] who reported that all the blood juices have higher amounts of ascorbic acid than blond ones. Whereas Fattahi et al. [28] did not found a significant difference between blood and blond orange varieties. On the other hand, a slight decrease in vitamin C in the blood orange juice was detected [29].

4. CONCLUSION

The *Citrus* varieties grown in Syria showed a large variation in their physiochemical characteristics between species and within the same species. Out of all citrus varieties, orange group showed the best values for the percentage of juice (51.17%) and Vitamin C content (40.90mg\100ml), while mandarin group possessed the highest TSS value (11.1). In terms of acidity, the lemon group was the most acidic with TA=4.81g\100ml, and 2.30 of pH values.

The juice obtained from all locally grown citrus fruits was of a good quality on the base of amount of juice, TA, TSS and vitamin C, which represent the main internal parameters used to determine citrus quality in the world; hence it can be effectively represent a valuable source for the manufactures of different food products.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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