

# CHEMICAL COMPOSITION AND GUIDE VALUES OF POMEGRANATE JUICE

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## Abstract

To contribute for setting reference guideline, chemical composition of 23 pomegranate juice samples from concentrate was investigated. The samples were collected in 2006 from 6 different producer companies. According to the findings, titratable acidity changed between 8.3-17.4 g/L (as anhydrous citric acid), citric acid 6.6-13.6 g/L, L-malic acid 0.5-0.9 g/L, D- isocitric acid 3.9-86 mg/L glucose 45.8-65.6 g/L, fructose 48.4-69.9 g/L, potassium 2093-2517 mg/L, phosphorus 93-151 mg/L, calcium 11-149 mg/L, magnesium 21-104 mg/L and sodium 20-128 mg/L in pomegranate juice at 14°.

**Keywords:** Pomegranate juice, chemical composition, reference guideline, mineral profile, acid profile, sugar profile

## NAR SUYUNUN KİMYASAL BİLEŞİMİ VE TANI DEĞERLERİ

### Özet

Tanı değerlerinin belirlenmesine katkıda bulunmak için, 23 konsantreden nar suyu örneğinin kimyasal bileşimi araştırıldı. Örnekler, 2006 yılında 6 farklı üretici firmadan sağlandı. Bulgulara göre; 14° briksteki nar suyunda titrasyon asitliği 8.3-17.4 g/L (susuz sitrik asit olarak), sitrik asit 6.6-13.6 g/L, L-malik asit 0.5-0.9 g/L, D-izositrik asit 3.9-86 mg/L, glukoz 45.8- 65.6 g/L, früktoz 48.4- 69.9 g/L, potasyum 2093-2517 mg/L, fosfor 93-151 mg/L, kalsiyum 11-149 mg/L, magnezyum 21-104 mg/L ve sodyum 20-128 mg/L arasında değişmektedir.

**Anahtar kelimeler:** Nar suyu, kimyasal bileşim, tanımlama kriterleri, mineral profili, asit profili, şeker profili

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## INTRODUCTION

Pomegranate (*Punica granatum*) is a tropical and subtropical fruit. It is native to Southwestern Asia, and spread from there to North Africa and South Europe, and then to America. Turkey is one of the main pomegranate producing countries of the world (1).

Pomegranate has become popular as a result of nutraceutical and therapeutic effect (2) such as reducing the blood pressure by preventing ACE enzyme activity, reversing the damage on vessels (3), preventing prostate cancer (4) and arthritis (5), stopping the diarrhea, protecting phagocyte cells against auto-oxidative damages through  $\beta$ -carotene, maintaining blood glucose level in normal range (2,3), stimulating T cell functions, supporting formation of cytokines, and increasing the capacity of cells which naturally inhibit the tumors. They have been also proven to be effective against AIDS and inflammation(6).

Most of the beneficial effects attributed to pomegranate and pomegranate juice are questionable. However, it is well known that pomegranate juice have high antioxidative capacity due to its anthocyanins such as delphinidin, cyanidine and pelargonidine (7) and ellagitannins such as ellagic acid, punicalagin and punicaline (8). Therefore, production and consumption of pomegranate juice have dramatically increased in recent years. In Turkey, pomegranate amount processed to juice increased from 17 600 tons in 2005 to 57500 tons in 2007 (9).

Parallel to this interest, it becomes important to establish criteria for authenticity control of pomegranate juice, especially to detect presence of foreign fruit juice (10). For this reason, it is necessary to reveal the chemical composition of pomegranate juice and to indicate its difference from other fruit juices.

There are a number studies published on principal constituents of pomegranate juice (11), distribution of organic and phenolic acids (12), main anthocyanins (7) and other components (13-16). However, it is obvious that these studies are not sufficient to establish the criteria for authenticity and identity control of pomegranate juice. Therefore, the reference guideline for pomegranate juice is still at preparation stage (17).

The chemical composition of fruit juices is affected by not only genetic and ecological factors but also

by processing conditions (18-20). It means that the analytical properties of fruit juices determined in laboratory conditions can not fully reflect those of fruit juices processed at industrial scale. The aim of this study was to contribute to the knowledge on chemical composition of pomegranate juice through the analysis of samples taken from the several fruit juice factories in Turkey.

## MATERIAL AND METHODS

### Materials

23 samples of concentrated pomegranate juice were obtained from 6 different fruit juice companies (Aroma in Bursa, Dimes in Izmir, Etap in Mersin, Konfrut in Denizli, Targid in Mersin and Penkon in Denizli) in 2006.

Brix degrees of the pomegranate juice concentrates were between 61.2 and 66.8.

### Methods

Brix values of the pomegranate juice concentrate samples were adjusted to 14 by diluting with distilled water before the analyses. Analyses conducted in duplicate are described below:

**Brix degree:** Brix value was measured with Bausch & Lomb refractometer according to the IFU method (21).

**Titrateable acidity:** Titrateable acidity was determined with Consort P407 model pH meter according to IFU method (22).

**Acid profile:** Enzymatic methods established by IFU (23, 24, 25) were used for determination of D-isocitric, L-malic and citric acid contents. UNICAM UV/VS spectrophotometer was used for absorbance measurements.

**Formol number:** Formol number was determined according to the method established by IFU (26) and calculated as mL 0.1N NaOH/100 mL fruit juice.

**Sugar profile:** Glucose, fructose and sucrose contents were determined according to enzymatic method established by IFU (27, 28). UNICAM UV/VS spectrophotometer was used for absorbance measurements.

**Mineral profile:** Sodium and potassium contents were determined with the flame photometric

method (29) and a Jenway PFPJ model flame photometer was used for the measurements. Calcium and magnesium were analyzed according to ICP method (30) using a Perkin Elmer Optima 2100 DV system. Analysis of phosphor was performed according to the spectrophotometric method described by IFU (31) and Unicam UV/VIS spectrophotometer was used for measurements.

## RESULTS AND DISCUSSION

### Chemical composition of pomegranate juice

Analysis results of 23 concentrated pomegranate juice samples at 14 brix degree are given in Table 1. According to these results, titratable acidity of the pomegranate juices varied between 8.3 and 17.4 g/L. Citric acid was the predominant component and its amount ranged between 6.6- 13.6 g/L. It is followed by L-malic acid with a range of 0.5-0.9 g/L. D-isocitric acid content was very low and found between 3.9- 86 mg/L. These findings are consistent with those of the previous studies (13, 15, 16). Formol number which reflects the amount of free amino acid varied from 8.6 to 16.2 mL 0.1N NaOH/ 100 mL.

The amount of glucose (46- 66 g/L) and fructose (48- 70 g/L) of pomegranate juices were approximately same. However, fructose content was

slightly higher than that of glucose and therefore, the glucose/fructose ratio varied between 0.7 and 1.0. In the literature (11, 13, 15), glucose/fructose ratio of pomegranate juice is reported to be between 0.81 and 0.99. Sucrose was not detected in 17 of the samples, but founded in trace amounts in the remaining 6 samples. The information in the literature about sucrose in pomegranate juice is contradictory. While Malgerojo and Artes(2000) reported that fresh pomegranate juice could contain up to 0.7 g/L sucrose (32), Fischer-Zorn and Ara (2007) expressed that also the trace amount of sucrose in the pomegranate juice could result from adulteration with another fruit juice (14).

The predominant mineral in pomegranate juice was potassium (2093- 2517 mg/L) followed by phosphorus, magnesium and calcium at levels of 93- 151 mg/L, 21- 104 mg/L and 11- 149 mg/L respectively. Sodium content ranged between 20 - 128 mg/L.

Most of the findings of the present study with regard to the mineral components of the pomegranate juice are consistent with the results of the other studies (11, 14, 16). However, potassium was found in a very narrow range which could be explained with the fact that different varieties of the fruits might have been processed together in the industrial scale while each variety of the same fruit were

Table 1. Descriptive values for analytical properties of the pomegranate juice at 14 °Bx N=23

Analytical Properties	Range of Variation	Mean Value	Standard Error	Coefficient of Variation
Titratable acidity <sup>a</sup> g/L	8.3-17.4	13.8	±0.58	20.1
Citric acid g/L	6.6-13.6	11.5	±0.48	20
L-Malic acid g/L	0.5-0.9	0.6	±0.02	18.3
D-Isocitric acid mg/L	3.9-86	48.4	±4.70	47
Formol number <sup>b</sup>	8.6-16.2	12.9	±0.41	15.1
Glucose g/L	46-66	52	±1.01	9.3
Fructose g/L	48-70	56	±1.21	10.3
Sucrose g/L	0-1.5	0.2	±0.08	189.7
Total sugar g/L	96-137	108	±2.05	9.1
Glu/ Fru ratio	0.7-1.1	0.9	±0.02	7.9
Potassium (K) mg/L	2093-2517	2288	±23.70	5
Calcium (Ca) mg/L	11-149	52	±6.59	61
Magnesium (Mg) mg/L	21-104	62	±4.93	39.4
Phosphorus(P) mg/L	93-151	112	±2.84	12.1
Sodium (Na) mg/L	20-128	66	±5.90	43.1

<sup>a</sup>: calculated as anhydrous citric acid b: mL 0.1N NaOH/100 mL

squeezed separately in the laboratory. Findings of the above-stated studies (14, 16) were based on the analysis of pomegranate juice samples squeezed in the laboratory. Similarly, sodium content was high compared to the other studies (14, 16). This high level of sodium could be transferred to juice from bentonite which was used for clarification (33).

### Confidence interval of pomegranate juice components

The reference guideline for fruit juices prepared by AIJN (17) is an important source for authenticity and quality control. Although all of the research findings for each fruit juice are taken into account during evaluation of these guide values, there are a lot of variations in the terms of genetic ecological and technological sources. Therefore, each study contributes to the coverage of more variation in these values.

The best solution for establishment of the reference guideline is to use 99% confidence interval, because the values exceeding this range will be quite limited. Therefore, 99% confidence intervals of analytical parameters were calculated and given in Table 2 together with limits in AIJN proposal (17).

As seen in Table 2, 99% confidence interval of each component except for sucrose and sodium remains

within AIJN limits. According to the comments of AIJN (17); presence of sucrose in pomegranate juice could be related to the analysis method. The high level of sodium could result from the raw material or the bentonite which was used as clarifying agent (31).

On the other hand, it is remarkable that citric acid varies in a wide range (1-48 g/L) in the draft established by AIJN (17). This is obviously due to the difference between sour and sweet pomegranate varieties (13, 15, 16). Similarly, the minimum value for calcium (5 mg/L) appeared to be very low. According to AIJN proposal (17), calcium content in the pomegranate juice is generally between 50 and 100 mg/L, however, it is stated that the amount of Ca could decrease due to possible oxalate sedimentation during clarifying..

### CONCLUSION

Because of the high capacity of antioxidants and other characteristics relating to health benefit, there has been a rapid increase in production and consumption of the pomegranate juice, which makes authenticity control more important with regard to the addition of foreign fruit juices.

Titration acidity in the 23 concentrated pomegranate juice samples collected from different

Table 2. Confidence intervals (99%) and AIJN proposal for certain analytical properties of pomegranate juice

Analytical properties	Confidence interval of 99%		AIJN proposal	
	Min	Max	Min	Max
Titrateable acidity <sup>a</sup> g/L	12.1	15.4	10.0	15.0
Citric acid g/L	10.2	12.9	1.0	48.0
L-malic acid g/L	0.56	0.69	-	1.5
D-isocitric acid mg/L	35	62	10	140
Formol number <sup>b</sup>	11.8	14.1	5	20
Glucose g/L	49	55	40	80
Fructose g/L	53	59	45	100
Glucose/fructose	0.9	1.0	0.8	1.0
Sucrose g/L	0.04	0.41	-	0
Sodium (Na) mg/L	50	83	-	30
Potassium (K) mg/L	2221	2355	1300	3000
Magnesium (Mg) mg/L	48	76	20	110
Calcium (Ca) mg/L	33	70	5	120
Phosphorus(P) mg/L	103	119	50	170

<sup>a</sup>: calculated as anhydrous citric acid b: mL 0.1 N NaOH/ 100 mL

companies, was found between 8.3 and 17.4 g/L (as anhydrous citric acid) and its predominant component was citric acid. Glucose, fructose and the ratio of glucose/ fructose were 46-66 g/L, 48-70 g/L and 0.7-1.1 respectively. Trace amount of sucrose founded in some samples can be due to analysis method (17). The predominant mineral was K with an average value of 2288 mg/L followed by P with a level of 112 mg/L. Ca and Mg levels (52 mg/L and 66 mg/L, respectively) were close to each other. However, their ranges were quite wide.

The results of present study are generally in compliance with data in the literature (13-16) and with values in AIJN proposal (17). Only, sodium content exceeded the limit of AIJN, which might be caused by rohware or clarification with bentonite (33) However, it is questionable whether the maximum limit for sodium in AIJN proposal could be managed.

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