

## COMPARISON OF SUGAR AND ORGANIC ACID CONTENTS OF TURKISH ORANGES JUICES\*

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**Abstract:** Two different orange juices obtained from *cvs.* Kozan Misket and Kozan Yerli were compared in terms of sugar and organic acid composition. These two parameters are important in determining the ripeness of fruits. Samples were obtained from Cukurova region of Turkey and the analysis was carried out by high-performance liquid chromatographic methods. Four organic acids (citric, ascorbic, malic and succinic acids) and three sugars (sucrose, glucose and fructose) were determined. Sucrose had the majority in sugars in both samples with the concentration of 61.02 g/l in Kozan Misket and 63.23 g/l in Kozan Yerli, respectively. With regard to organic acids, citric acid was found to be present in the largest amounts having concentration of 16.25 g/l in Kozan Misket and 15.90 g/l in Kozan Yerli in both samples.

**Keywords:** Orange juice, organic acid, sugar, *cv.* Kozan

### Introduction

Orange, the third largest produced fruit crop after grape and apple in Turkey, is an important fruit in terms of its high nutritional value and organoleptic properties (Selli, 2011). Turkey has reached an average of 1,277,613 tonnes in orange production according to the data in FAO (FAO, 2014). It is produced mainly in southern and eastern regions of Turkey and Cukurova region is known as the main production area (Kelebek, 2011). In this region, Kozan oranges stand as a native orange variety grown in a large scale. The fruit is generally medium size and has a bright orange flesh (Kelebek, 2009). Kozan oranges are claimed to be of the best quality for processing when harvested in February and March (Selli, 2008). Important parts of oranges are consumed as fresh and the remaining parts are processed into orange juice and concentrated. Organic acids and sugars are in the group of major compounds of oranges varying to the species and environmental conditions. Their concentrations are known to have an important effect on sensory characteristics of oranges and juices (Albertini, 2006). Organic acid is a substantial criterion to ascertain the adulteration in fruits. Citric and malic acids are responsible for the majority of citrus fruits. In addition, benzoic, oxalic and succinic acids were also reported to present in trace amounts (Karadeniz, 2004). Sugars form the greater part of soluble solids in orange juice and it is reported that the sweetness of juice is pertained to the sugar composition (Kelebek, 2009). Glucose, fructose and sucrose are known as main sugars found in orange juices (Albertini, 2006). The aim of this study was to determine and compare these two important parameters in orange juices obtained from *cvs.* Kozan Yerli and Kozan Misket.

### Materials and Methods

Kozan Yerli (Figure 1) and Kozan Misket (Figure 2) oranges were obtained from Kozan district of Adana province of Turkey. Oranges were used for each variety with an average of 30 kg and age of the trees as well as the maturity of oranges was paid attention to be similar for picked fruits. Sugar and titration acidity were used in the determination of maturity. The samples were extracted by cutting the fruit in half and carefully hand-squeezing in a household type electric hand juicer (Siemens MC30000, Germany) on the same day of harvesting.



**Figure 1.** Kozan Yerli oranges



**Figure 2.** Kozan Misket oranges

Sugar and organic acid analyses of orange juices were carried out according to the methods of Lee and Coates (2000) with a slight modification. 100 ml sample from each variety was centrifuged at 12000 rot/min and 4°C, and then supernatants were passed through a 0.45 µm filter. Obtained extract was injected directly to a HPLC (LC-10A HPLC Series, Shimadzu, Kyoto, Japan) including SPD-20A UV/Vis (Shimadzu LC20AD) and RID 10A refractive index detectors. 5 mM sulfuric acid solution was used as mobile phase and flow rate is fixed as 1 ml/min.

External standard method was used in determination of sugar concentrations in samples. Calibration solutions were prepared using five different concentrations of sucrose, glucose and fructose standards and HPLC analyses were carried out. Calibration curves were obtained from the data and with the use of these curves, sugar concentrations of orange juices were determined.

Organic acid analysis was also performed with the same method using citric, ascorbic, malic and succinic acids as standards.

## Results and Discussion

### *Sugar Composition*

Sugars are one of the most significant compounds of citrus fruits. Three sugars (sucrose, glucose and fructose) were determined in the samples as displayed in Table 1. Total sugar concentration of Kozan Yerli and Kozan Misket orange juices were 126.52 g/l and 133.44 g/l respectively. Stella et al. (2011) indicated that the total sugar amounts of various ready-to-drink orange juices can change in between 95-165 g glucose/l. As Kelebek (2009) implied, three simple sugars which are sucrose, glucose and fructose are responsible for the main portion of carbohydrates in citrus fruits. It is also pointed out that these sugars form about 80% of the total soluble solids in orange juice. Kozan Yerli orange juices had the sugar composition as sucrose with an amount of 61.02 g/l, glucose with 35.16 g/l and fructose with 30.34 g/l. The sugar concentration of Kozan Misket juices was similar to Kozan Yerli including 63.23 g/l sucrose, 37.45 g/l glucose and 32.76 g/l fructose. Sucrose had the majority in sugars of both samples. As reported, the ratios of sucrose:glucose:fructose are generally about 2:1:1 (Kelebek, 2009). Our results show correlation with this information. As stated in the same study, cv. Kozan orange juices were found to have 59.34 g/l sucrose, 32.30 g/l glucose and 28.55

g/l fructose. Another study investigated *cv.* Dortyol orange juices specific to Turkey and determined the sugar composition as 46.60 g/l sucrose, 30.99 g/l glucose and 33.05 g/l fructose (Kelebek, 2011).

**Table 1:** Sugar composition of Kozan Yerli and Misket orange juices

Sugars	Kozan Yerli	Kozan Misket	F
Sucrose	61.02±0.03	63.23±0.23	*
Glucose	35.16±0.15	37.45±0.02	*
Fructose	30.34±0.16	32.76±0.07	*

Concentrations are given as g/l. \*Significance at which means differ as shown by analysis of variance ( $P < 0.05$ ).

### Organic Acid Composition

Citrus fruits are known for rich organic acid content. It is also reported that, organic acids and sugar contents are used for the determination of maturity and sensorial quality (Kelebek, 2011). Four organic acids (citric, ascorbic, malic and succinic acids) were separated and identified in both Kozan Yerli and Misket orange juices. As displayed in Table 2, citric acid was found to be present in the largest amounts in both samples having concentration of 16.25 g/l in Kozan Yerli and 15.90 g/l in Kozan Misket. Kelebek (2011) determined the citric acid concentration as 14.22 g/L in Dortyol orange juices. Saavedra (2001) indicated that the citric acid amount change in the range of 8.4-12.6 g/l in freshly hand-squeezed Navelina orange juices. Malic acid followed the lead with an amount of 4.01 g/L and 3.78 g/L in Kozan Yerli and Misket respectively. In the same study of Kelebek (2011), the malic acid concentration is reported to be 3.91 g/L in Dortyol variety. Acidic citrus fruits, especially oranges have high antioxidant activity resulting from the ascorbic acid concentrations. Ascorbic acids are known to be strong antioxidants and used as implication for quality of orange juices (Kelebek, 2011). In the results, Kozan Yerli is shown to have higher ascorbic acid concentration than Kozan Misket with amounts of 0.55 and 0.44 g/l respectively. Reported results show that Navel orange juices also have ascorbic acid in addition to Valencia and Dortyol orange juices. Navel orange juices are stated to have 0.49 g/l ascorbic acid, Dortyol whereas juices have 0.47 g/l and Valencia juices have 0.41 g/l of ascorbic acid (Melendez-Martinez, 2007; Selli, 2011). Ascorbic acid concentrations of different orange juices from Mediterranean region are reported to change between 0.39-0.62 g/l (Melendez-Martinez, 2007).

**Table 2:** Organic acid composition of samples.

Organic Acids	Kozan Yerli	Kozan Misket	F
Citric Acid	16.25±0.05	15.90±0.13	*
Ascorbic Acid	0.55±0.17	0.44±0.06	NI
Malic Acid	4.01±0.05	3.78±0.13	*
Succinic Acid	1.93	0.88	*

Concentrations are given as g/l. \*Significance at which means differ as shown by analysis of variance ( $P < 0.05$ ); NI: Not important in terms of statistical analysis.

### Conclusion

In present study, sugar and organic acid compositions of orange juices obtained from *cvs.* Kozan Yerli and Kozan Misket grown in from Cukurova region of Turkey were examined. The results displayed similarity between two varieties. Kozan Yerli had slightly higher organic acid while Kozan Misket had higher sugar concentration. Four organic acids (citric, ascorbic, malic and succinic acids) and three sugars (sucrose, glucose and fructose) were determined in both varieties. Sucrose had the majority in sugars in both samples with the concentration of 61.02 g/l in Kozan Misket and 63.23 g/l in Kozan Yerli, respectively. In terms of organic acids, citric acid was found to be the abundant compound with a concentration of 16.25 g/l in Kozan Misket and 15.90 g/l in Kozan Yerli in both samples. Malic acid was found to have the second highest concentration in all samples. Organic acid and sugar composition and

concentration are important in determination of quality in fruits and juices; hence this research is beneficial about orange juices. However, further investigation is advised.

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