



## RESEARCH PAPER

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## The relationship between tartaric acid levels and taste differences in grapes and the detachment strength of pedicels

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**Key words:** *Vitis vinifera* L., Tartaric acid, Taste, Detachment strength

<http://dx.doi.org/10.12692/ijb/12.6.385-390>

Article published on June 30, 2018

### Abstract

The physical and chemical properties of grape varieties are among the parameters that influence quality. This study has been made to investigate the effects of some of the physical and chemical properties of grape varieties on each other. In the study, which aims to determine how the detachment strength of grape pedicels and taste differ in terms of tartaric acid levels, two-way variance analysis has been used to determine the change in the levels of tartaric acid depending on the detachment strength of grapes and taste differences. The results of the two-way variance analysis showed that the highest tartaric acid levels were achieved in the 'slightly sweet' berries (Pertek Tilki Kuyruğu) that have a 'middle' breaking strength, and the lowest tartaric acid levels in the 'slightly sweet' berries (Pertek Boğazkere, Pertek Zehni) that break 'easily' and 'with difficulty'. The research results show that the 'slightly sweet' berries that have a 'middle' detachment strength should be focused on in order to increase the tartaric acid levels in grapes or if grape varieties with high tartaric acid levels are to be made use.

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## Introduction

The importance of grapes in human health has been known and studied for centuries. Grapes whose levels of carbohydrate and calorie are very high (fresh grape 67 cal/100 gr, dried grape 289 cal/100 gr) not only are rich in minerals including calcium, potassium, sodium, and iron, but also are considered an important source in terms of several vitamins (A, B1, B2, Niacin, and C vitamins) (Çelik *et al.*, 1998). They are also rich in several enzymes, hormones, flavoring substances, and organic acids. A lot of organic acids naturally exist in food structures. These organic acids are also used as food additives. Tartaric acid is one of the most well-known organic acids.

The determination of acidity is used for a lot of purposes such as determining maturity degree, the effects of color, taste, flavor, and physical properties on foods, durability to storage, applicable sterilization and pasteurization temperatures, proteins' extraction and denaturation degrees, fermentation limits in some fermented foods, and some food substances' compliance with standards. Tartaric acid is known as 'grape acid' because it is very difficult to find in any fruit except grape in nature (Ribereau-Gayon *et al.*, 2006).

Tartaric acid is used in several different sectors. It is used in adding sour or sourish tastes to foods, making gelatinous desserts, marmalade, jam, and soda pop, and vine fermentation as well as yarn dyeing, cleaning and polishing metals in the industry. It is used as food stabilizer, antioxidant, and baking powder. Tartaric acid or its chemically known name dihydroxybutanedioic acid is a biotechnological substance whose industrial importance is increasing day by day. Tartaric acid has four stereoisomers. These are *d*-(*dextro*) tartaric acid found in grapes and other fruit, *l*-(*levo*) tartaric acid obtained from racemic mixture, *dl* tartaric acid which is an artificially produced racemic mixture, and *meso* tartaric acid (Hasdemir *et al.*, 1998).

The concentrations of the potassium salts of tartaric and malic acid are determined in calculating the amount of acid in ripe grapes. The salt of tartaric acid is formed as potassium tartrate; the salt of malic acid is formed as potassium malate.

The effect of tartaric acid on pH is more than that of malic acid as it is stronger than malic acid (Mato *et al.*, 2005).

As a result of the analysis of organic acids in stum and wine, the information about the maturity degree of grapes, sugar-acid ratios, and the synthesis of organic acid in grapevines can be obtained (Zatou *et al.*, 2004). At the same time, organic acids are nutritive compounds that need to be found in yeast production area for yeast growth (Dartiguena *et al.*, 2000). In addition, acidity is one of the most important reasons that avoid microorganism growth and activity. Grape acids also avoid microorganism growth.

Tartaric and malic acids are the basic acids that form the acidity of wine and determine pH. Both are used to determine the maturity degree of grapes in oenology. Especially the amount of tartaric acid in grapes is handled as the critical control point in determining the stability of wine (Lamikanra *et al.*, 1995). In addition, determining the amounts and varieties of organic acids enables to understand whether wine diseases exist in wine or not (Mato *et al.*, 2005).

The loss of quality in grapes is related to the physical properties of grape berries. The varieties which have strong pedicel-berry connection and are resistant to cracking are told to be generally more durable to the implications such as transportation and storage after the harvest (Özer and Kiracı, 2002). Besides other properties, analyzing the detachment resistance of pedicel is important, therefore (Kamiloğlu, 2013).

The detaching force of grape berries from pedicel is closely related to berry shelling in bunches as it shows the force of berry's connecting pedicel. While grapes are ripening, the amount of sugar that they include increases, but the amount of acid decreases. If the amount of acid in grapes is lower than expected, it will affect the stability and freshness of wine made out of those grapes negatively while the low amount of sugar may lead the amount of alcohol in wine to be lower than expected. In addition, phenolic compounds and the amount of sugar and acid found in grapes lead to changes in taste.

This study has been planned to determine how the detachment strength of pedicel and taste differences will differ in grapes in terms of tartaric acid levels. The studies in which statistical controls have been made in Food Engineering field have increased recently (Çimen, 2012; Çimen, 2016a, b). The experimental models planned to be used in this study in which the effect of two factors on a dependable variable is determined are used in different disciplines (Çimen, 2006). The experimental models which search the effects of three factors related to grapes on one or more dependable variables are also encountered (Ongaratti *et al.*, 2014). Instead of using the experimental models which are developed based on one factor in accordance with one-way analysis of

variance, giving more weight to the studies like the present one which search the effect of two factors on one variable and will use two-way analysis of variance will provide more advantages in terms of reaching more specific findings.

## Material and method

### Materials

In the 2014-2015 growing season, the samples were taken from the grape varieties grown in Tunceli and analyzed in the food laboratory of the Food Engineering Department of Munzur University. Some characteristics of the varieties used in the province of Tunceli and used in the experiment are given in Table 1.

**Table 1.** Some properties of the varieties used in the experiment.

Genotype	Time of prebloom	Time of Full Bloom	Time of Veraison	Full Maturity Period of The Fruit	Autumn Color of Leaves
Akpazar Beyaz 3	9 very late	9 very late	9 very late	9 very late	3 red
Pertek Besni	9 very late	9 very late	9 very late	9 very late	1 yellow
Pertek Boğazkere	9 very late	9 very late	9 very late	9 very late	3 red
Pertek Keçi Memesi	9 very late	9 very late	9 very late	9 very late	1 yellow
Pertek Kırmızı 3	9 very late	9 very late	9 very late	9 very late	1 yellow
Pertek Tilki Kuyruğu	9 very late	9 very late	9 very late	9 very late	2 Reddish
Pertek Zehni	9 very late	9 very late	9 very late	9 very late	1 yellow
Pertek Hasani 2	9 very late	9 very late	9 very late	9 very late	1 yellow
Ulaş Beyaz	9 very late	9 very late	9 very late	9 very late	1 yellow

### Methods

Detachment in grape berry and the values of taste and tartaric acid have been evaluated in accordance with the method found in 'Descriptors for Grape' which was accepted and published by IBPGR (International Board for Plant Genetic Resources), OIV (Office International de la Vigne et du Vin), and UPOV (International Union for the Protection of New Varieties of Plants) in 1983 in order to provide the

unity of concepts, which is the method applied in determining ampelographic properties (Table 2). Every bud in the raceme produces a berry by opening after anthesis and pollination, and taste and detachment from pedicel are unique to varieties. The properties of berries in the bunches of grapes studied were analyzed by calculating the average of 100 berries taken from the central parts of 10 bunches as 10 berries from each bunch.

**Table 2.** The properties of berries, and the properties related to yield and quality.

Properties Code				Characters
Oiv	Ibpggr	Upov	Registration	
237	6.2.18			Classification of taste 1- Neutral, 2- Slightly sweet, 3- Slightly aromatic, 4- Aromatic, 5- Slightly muscat, 6- Very muscat, 7- Other
239-240	6.2.20	76	38	Detachment of pedicel 1- Very difficult, 3- Difficult, 5- Middle, 7- Easy, 9- Very easy
506	6.2.29			Acid in stum 1- Very low (<3.0g/l), 3- Low (3.0-7.4 g/l), 5- Middle (7.5-10.4 g/l), 7- High (10.5-13.5 g/l), 9- Very high (>5 g/l)

The samples after the harvest were observed by calculating the average of 10 bunches in order to evaluate the amount of acid which is among the properties of yield and quality. The acid content of grapes was found by using the tartaric acid kit with 'RQflex Plus 10'.

In order to analyze the data statistically, 3 classifications of taste (Slightly sweet, Sweet, Neutral) were formed depending on the taste properties of the grape varieties, and 3 sub-groups (Easy, Difficult, Middle) were determined according to the detachment strengths of the berries for each classification of taste. The tartaric acid levels were calculated three times for the levels of the detachment strengths of the berries belonging to each classification of taste.

### Statistics Analysis

Two-way analysis of variance (Two-way ANOVA) was used to find out the levels of changes in the tartaric acid levels depending on the detachment strengths of berries and taste differences (Çimen, 2015). The analysis was made with SPSS18.0.

### Findings

In this study carried out in Tunceli between 2014 and 2015, tartaric acid which is one of the properties of yield and quality, and taste and the detachment of pedicel which are two of the properties of berry in some grape varieties grown in Tunceli were investigated. The study was made with 9 grape varieties grown in the region. The properties of quality and berry found in the grape varieties are given in Table 3.

**Table 3.** The Properties of Taste, Berry, and Quality of the Grape Varieties.

No	Name of the Grape Variety	Classification of Taste	Detachment of Pedicel	Tartaric Acid
1	Akpazar Beyaz 3	Sweet	Difficult	0.39
2	Pertek Besni	Neutral	Difficult	0.41
3	Pertek Boğazkere	Slightly Sweet	Easy	0.52
4	Pertek Keçi Memesi	Neutral	Middle	0.48
5	Pertek Kırmızı 3	Sweet	Middle	0.35
6	Pertek Tilki Kuyruğu	Slightly Sweet	Middle	0.68
7	Pertek Zehni	Slightly Sweet	Difficult	0.58
8	Pertek Hasani 2	Neutral	Easy	0.44
9	Ulaş Beyaz	Sweet	Easy	0.38

In terms of the property of the detachment of berry from pedicel, it was found that Akpazar Beyaz 3, Pertek Besni, and Pertek Zehni are detached 'with difficult'; Pertek Hasani 1, Pertek Kırmızı 3, and Pertek Tilki Kuyruğu have a 'middle' detachment strength; Pertek Boğazkere, Şilfoni 4, and Yusuf ağa 4 are detached 'easily'.

In terms of the properties of taste, the findings show that Akpazar Beyaz 3, Pertek Kırmızı 3, and Yusuf ağa 4 are 'sweet'; Pertek Besni, Pertek Hasani 1, and Şilfoni 4 are 'neutral'; Pertek Boğazkere, Pertek Tilki Kuyruğu, and Pertek Zehni are 'slightly sweet'. Two-way analysis of variance was applied to the data. The results of the analysis are indicated in Table 4 and 5.

**Table 4.** The Tartaric Acid Levels According to the Detachment Strengths of the Pedicels.

	The Level of the Detachment Strength of the Pedicel			Standard Error
	Easy	Difficult	Middle	
Tartaric acid	0.44 a	0.46 a	0.50 b	0.005

As it is seen in Table 3, the varieties whose pedicels are detached easily and with difficult are found to have the similar levels of tartaric acid content. The tartaric acids levels of the varieties with middle detachment strength show statistically a higher average than those of the other two groups.

According to the results of the two-way variance analysis, it was found that the highest tartaric acid levels were obtained in the 'slightly sweet' berries that have a 'middle' detachment strength, and the lowest tartaric acid levels are obtained in the 'slightly sweet' berries that break 'easily' and 'with difficulty'.

**Table 5.** The Tartaric Acid Levels According to Taste Differences.

	Taste Differences			
	Slightly Sweet	Neutral	Sweet	Standard Error
Tartaric acid	0.59 c	0.44 b	0.37 a	0.011

**Discussion**

The tartaric acid levels found in the study showed close results to the values (between 0.40 and 0.49) that (Soyer *et al.*, 2003). explained for the tartaric acid contents in their research on white grape.

Peker (1994) found that the amount of tartaric acid in grape pomece and wine was 9.19% and 1.19g/l in wine grapes respectively. Demiray (2006) reported that tartaric acid was found the highest value among the organic acids in wines.

That the analysis of the factors which affect dependable variables like tartaric acid in grapes and other types of fruits should be made by focusing on two factors like the one made in this study instead of one factor will provide more effective results. Also, the studies using three-way analysis of variance, the advanced version of two-way ANOVA, have been encountered in the literature recently (Ongaratti *et al.*, 2014).

It is understood from the results that the 'slightly sweet' berries that have a 'middle' detachment strength should be focused on in order to make use of the grape varieties with high tartaric acid levels or to increase the tartaric acid levels in grapes.

The amount and proportions of organic acids in grapes are very effective on the taste and wine quality of grapes. According to the results obtained from the study, especially the high amount of tartaric acid is required for wine quality and it has been detected in sweet varieties with medium hardness breaking. these varieties should be focused on. This and similar studies are further important to ensure that the product is shed on the precautions to be taken to increase the quality of the wine while on the plant before the wine production.

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