

# Determination of the Wine Quality of Different Apple Cultivars Grown in Turkey

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#### ABSTRACT

*Fruit wine production is important food processing area nowadays and Turkey has a very important potential to produce fruit wines because of variable and sufficient growth of fruits. Apple is commonly used for fruit wine production all over the World.*

*Laboratory works have been designed by fermenting the Amasya, Golden delicious and Starking delicious apple varieties' musts, with two different S. cerevisiae strains, as two replications. The quality and the discrepancy parameters of the cider samples that depend on the different apple varieties and yeast strains have been determined.*

*According to the results of our research, Golden delicious and Starking delicious varieties are determined as more applicative for cider production than Amasya variety. Although any critical differences were not observed between HEFIX 1000 and Maurivin/AWRI 350 yeasts, the production with Maurivin/AWRI 350 was found more applicative according to organic acid content and the sensory analysis of wines.*

**Key words:** Amasya , Apple, Fruit, Golden delicious, Starking delicious, Wine.

## 1. INTRODUCTION

Apple is the pomaceous fruit of the apple tree, species *Malus domestica* in the rose family *Rosaceae* and all over the World, nearly 60 million tones/year of 6500 different apple varieties are grown. Turkey has a third place after China and USA as an apple producer country that produce 2,5 million tones/year. According to the improvement of the wine industry in Turkey, cider is getting more interesting for the wine producers as an alternative product.

Fruit wine production has been executed in European countries since 6<sup>th</sup> century and fruit wines are still important and lucrative agricultural products nowadays. Apple is the most commonly used fruit for wine production. France, Germany, England, Austria, Russia, Poland and Switzerland are the biggest cider producer countries and 30-40% of harvested apples are used for cider production. In France, nearly 20 million L/year and in Germany 15 million L/year cider is produced. In Turkish market, cider has a very restrictive district and “cider” called products are mostly aromatized grape wines. This situation must be go around Turkish laws that explain fruit wines as; “Fruit wines are the wines that are produced by the fermentation of only the fresh fruit juices. The wine must have the characteristic properties of the fruit and named as the name of the fruit’s wine.”

## 2. MATERIALS AND METHODS

### 2.1. Sampling

Apple samples had been supplied from Nigde/Turkey as 50 kg/each variety and cider samples were produced by microvinification under controlled laboratory conditions. Microvinification have been designed by fermenting the *Amasya*, *Golden delicious* and *Starking delicious* apple varieties’ (that have the biggest proportions of Turkish market) musts, with two different *S. cerevisiae* strains (commercial active dried yeasts; HEFIX 1000 (Yeast A) and Maurivin/AWRI 350 (Yeast B), as two replications.

Fermentation temperature set as 18°C. Brix is set as 16° (for 8-9° alcohol) and fermentation progress of each sample were controlled by measuring the decrease of density every day. Cider production process has been given in Figure 1.

### 2.2. Chemical analyses

Total acidity (Kourkoutas et al., 2002), pH (Ough & Amerine, 1988), density (Yavuzer, 1989), volatile acidity (Aktan&Kalkan, 2000), alcohol (Yavuzer, 1989), %ashes (Yavuzer, 1989), and reducing sugar (Yavuzer, 1989) analyses were performed for cider samples.

### 2.3. Instrumental analyses

#### 2.3.1. Total phenol analyses

The concentration of phenolics in the extracts was determined by the Folin-Ciocalteu colorimetric method (Jayaprakasha & Jaganmohan, 2000), and results were expressed as gallic acid equivalents. 1 mL of each cider sample was diluted in 9 mL distilled water. Samples (0.2 mL) were mixed with 1.0 mL of 10-fold diluted Folin-Ciocalteu reagent and 0.8 mL of 7.5% sodium carbonate solution. After standing for 30 min at room temperature, the absorbance was measured at 765 nm using Shimadzu UV-visible spectrophotometer (1601 UV-VIS Kyoto, Japan). The estimation of phenolic compounds in the extracts was carried out in triplicate.

## 2.3.2. Organic acid analyses

### 2.3.2.1. SPE conditions

25 mL wine sample was adjusted to pH 10.50 with 0.1 M NaOH and stirred for 15 min at room temperature. Then, this solution was adjusted to pH 5.00 with 0.1 M H<sub>2</sub>SO<sub>4</sub>. This procedure is carried out to avoid interferences in the baseline. A 10 mL volume of this solution was filtered through a 0.45 mm cellulose acetate membrane and SPE applied. This procedure involved an ion-exchange cartridge (C18). The cartridge was activated with 10 mL of 0.1 M sodium hydroxide solution (percolation rate 3 mL/min) passed at a flow-rate of 0.5 mL/min. The cartridge was washed with 10 mL of water (3 mL/min) and the organic acids were eluted with 4 mL of 0.1 M sulfuric acid (0.5 mL/min). This solution was injected directly into the HPLC (Suarez-Luque et al., 2002).

### 2.3.2.2. Chromatographic conditions

Chromatographic separation was achieved with the Shimadzu VP class HPLC system (LC-10AD VP) with Diode Array Detector (DAD (SPD-M10A VP) and TEKNOKROMA TR- 416056, TRACER EXTRASIL ODS2 5 µm, 25 x 0,4 cm (TEKNOKROMA, Barcelona, Spain) column (thermostated at 25°C). The procedure was carried out isocratically using 4.5% metaphosphoric acid (pH 2.20) as the eluent at a flow-rate of 0.7 ml/min. Previously it was filtered through membrane filters (0.45 mm). This mobile phase must be prepared fresh daily.

The injection volume was 20 µL. Standards and wine samples were injected in triplicate.

Organic acids were detected at 215 nm (Suarez-Luque et al., 2002).

## 2.4. Statistical analyses

One way ANOVA was used for total phenol content and Duncan test was used for organic acid content by applying SAS (version 6,0) statistic program. Results of wine analyses were given as arithmetic mean (P<0,05) (Sokal & Wolf, 1995).

## 3. RESULTS AND DISCUSSION

Total acidity, pH, density, volatile acidity, alcohol, %ashes and reducing sugar analyses were performed for cider samples and the results are given at Tab. 1. as arithmetic mean. Due to the results, the fermentation process of all samples finished clearly as “dry” wines.

Polyphenols are important secondary metabolites in cider apple fruits that are involved in essential organoleptic criteria such as color, bitterness, astringency and colloidal stability of cider. In addition, some phenolics are precursors of cider aromas (i.e. volatile phenols) (Lea, 2003). During cider making, polyphenols may also influence important technologic steps such as clarification or fermentation. For example, tannins may act as inhibitors of pectic enzymes involved in the clarification process (Hatway&Seakins, 1958). Polyphenols are also powerful antioxidants with a wide range of biological activities. Recently, it was shown that some particular phenolics of alcoholic ciders (i.e., caffeic acid, quercetin, and phloretin) are metabolized or excreted by humans (Dupont et al., 2002).

In apples, a wide diversity of polyphenols is present: flavan-3-ols (catechins and rocyanidins), hydroxycinnamic acids, dihydrochalcones, flavonols and anthocyanins (Amiot et al., 1992). Total phenol content is determined for each sample and the results are given at Tab. 2. Due to the results, *Amasya* variety has more phenolic content than the others and there Organic acids present in wine and fruits are important low-weight components because of their effects on organoleptic properties (aroma,

color, and taste), stability and microbial control. The source of organic acids in wine can be not only from fruits but also fermentation process (Peynaud, 1999; Mato et al., 2005; Mato et al., 2007).

Organic acid content of the cider samples are determined and given at Tab. 3. Due to the results 3 different organic acids (malic, succinic acid and fumaric acid) are determined in cider samples.

Malic acid is one of the basic organic acids that come from raw material. The taste of malic acid is green, rude and this organic acid doesn't have harmony with tannins that is different with the other common organic acids.

Malic acid content of the cider samples are determined and *Golden delicious* variety has more malic acid content than the others. Also statistically important differences between two yeasts at all varieties are determined (Tab. 3.).

Succinic acid is a fermentation byproduct and the taste of this organic acid acidic, salty and bitter. Succinic acid forms esters while aging that are rich aroma sources (Teysse et al., 1999; Thoukis et al., 1965).

Succinic acid content of the cider samples are determined and *Starking delicious* variety has more succinic acid and *Amasya ve Golden delicious* varieties came after in order statistically. Also statistically important differences between two yeasts at all varieties are determined and ciders produced with Yeast A has more succinic acid content than ciders produced with Yeast B (Tab. 3.).

Fumaric acid content may come from either raw material or fermentation process and the taste of this organic acid is sour acidic (Montanari, 1999; Erbaş et al., 2006).

Fumaric acid content of the cider samples are determined and *Amasya* variety has more succinic acid and *Golden delicious, Starking delicious* varieties came after in order statistically. Also statistically important differences between two yeasts at all varieties are determined and ciders produced with Yeast A have more fumaric acid content than ciders produced with Yeast B (Tab. 3.).

#### 4. CONCLUSIONS

*Golden delicious* and *Starking delicious* varieties are determined more suitable for cider production than *Amasya* variety after the evaluation of all results. The weak point of *Amasya* was enzymatic browning because of high phenol and low acid content.

Although no significant differences are determined between two yeasts' fermentative skills, Yeast B (Maurivin/AWRI 350) is contrived better due to organic acid content and sensory properties.

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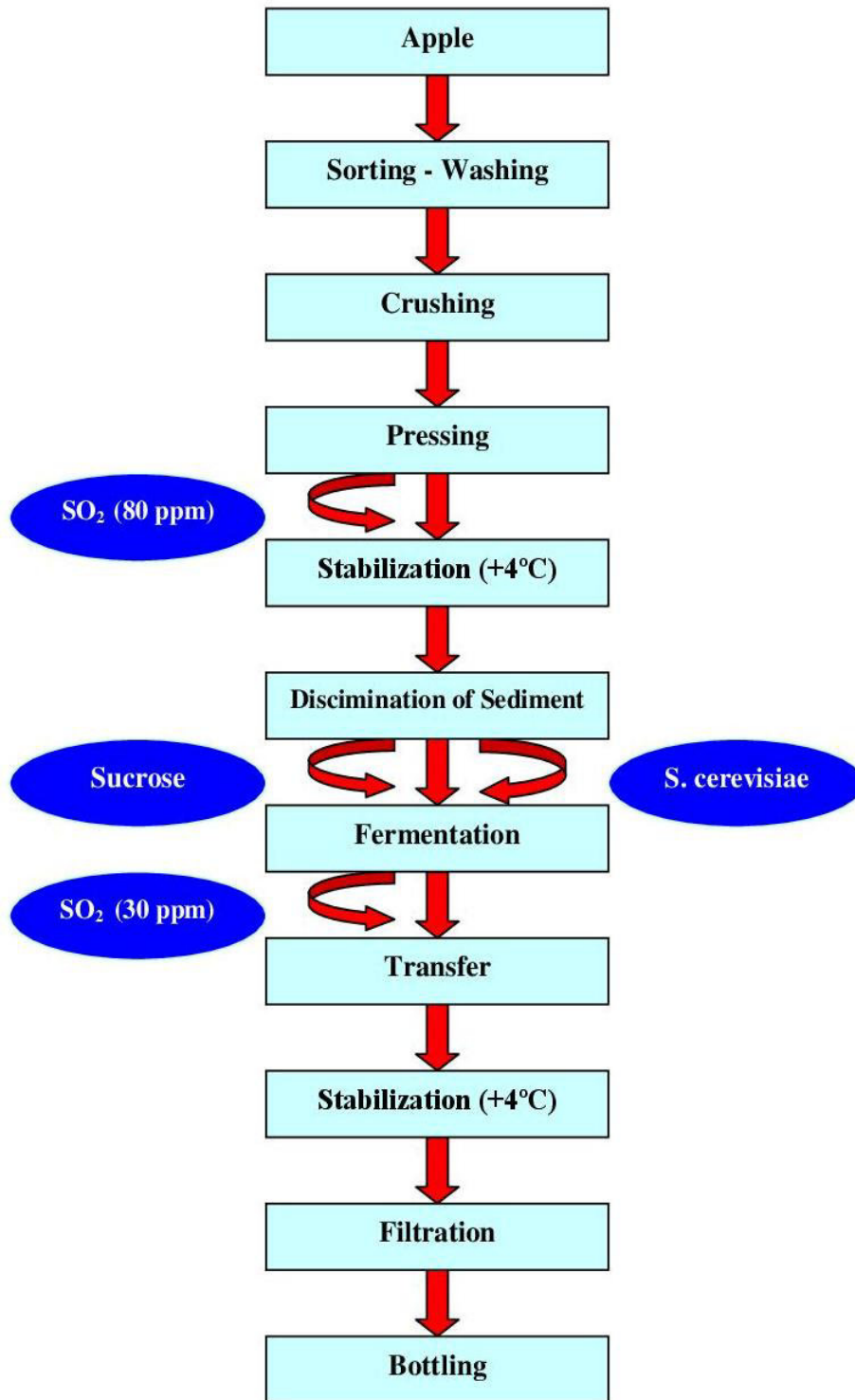
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Figure 1. Cider production process



**Table 1.** Wine composition analyses

	Density		Volatile		Titrable		Reducing
	Density	pH	acidity	Alcohol	acidity	Ashes	Sugar
	(kg/m <sup>3</sup> )		(g/L)	(v/v)	(g/L)	(%)	(g/L)
<b>Amasya A</b>	994	3,76	1,0	8,6	4,1	0,2249	1,0
<b>Amasya B</b>	994	3,63	1,3	8,7	4,1	0,2253	0,9
<b>Golden d. A</b>	995	3,30	1,2	8,7	5,8	0,2276	0,9
<b>Golden d. B</b>	997	3,14	1,7	8,7	5,9	0,2259	1,0
<b>Starking d. A</b>	992	3,40	1,7	8,9	5,6	0,2213	0,8
<b>Starking d. B</b>	993	3,28	1,8	8,8	5,7	0,2221	0,8

**Table 2.** Total phenol content (P<0,05)

	Total phenol (ppm)
<b>Amasya A</b>	1071± 65,43 A
<b>Amasya B</b>	1068,5±62,18 A
<b>Golden delicious A</b>	777,5±63,11 B
<b>Golden delicious B</b>	793± 58,43 B
<b>Starking delicious A</b>	758±60,25 B
<b>Starking delicious B</b>	766,33±19,03 B



**Table 3.** Organic acid content (P<0,05)

	<b>Amasya A</b>	<b>Amasya B</b>	<b>Golden A</b>	<b>Golden B</b>	<b>Starking A</b>	<b>Starking B</b>
<b>Malic acid</b>	1871,88±13,71	1932,81±20,81	2690,60±34,92	2578,85±26,21	2279,36±31,30	2257,55±19,39
<b>Fumaric acid</b>	3,88±0,11	2,1±0,13	4,04±0,14	1,48±0,08	1,65±3,54	1,37±0,06
<b>Succinic acid</b>	259±2,57	295,54±7,85	247,49±3,65	248,65±9,45	432,36±15,92	293,67±7,72