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Investigation of Some Quality Values of the Wines Produced With Conventional Methods from the Grape Varieties Grown In Ancient Anatolia Territory

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Abstract
This investigation was made on 10 types of wine obtained amateurishly from hobby wine grape varieties of high quality, particularly Bogazkere and Öküzgözü, which are being grown intensively in Ancient Anatolia territory. The quality parametres analysis of the obtained wines was conducted in research and application laboratories of Ankara University, Faculty of Agriculture, Department of Horticulture.
Total phenolic compound (mg/l), total anthocyanin (mg/l), EC 50 (ml/ml dpph), D 280, Alcohol (%), Sugar (g/l), pH, total citric, volatile acid (me/l), free sulfur (mg/l) and total sulfur (mg/l) values were measured in the test.
It was observed that total phenolic compound (mg/l), total anthocyanin (mg/l), EC 50 (ml/ml dpph), D 280, Alcohol (%), Sugar (g/l), pH, Total citric, volatile acid (me/l), free sulfur (mg/l) and total sulfur (mg/l) values in the wines were significant statistically.
It was determined in accordance with the descriptive statistical information of the data that total phenolic compound value was 893,77 (mg/L) on average, total anthocyanin value was 29.97 (mg/L) on average, EC50 value was 0.75 (ml/ml dpph), D280 value was 28.85, alcohol value was 12.67, sugar value was 2.84 (g/l), and Ph value was 3.37. It was found out that total acidity value was 3.74 on average and volatile acidity value was 0.39 (g/l) (me/L). Free sulfur and total sulfur values were determined to be 32.40 (mg/L) and 55.20 (mg/L) on average, respectively.

Keywords: Ancient Anatolia, antioxidant, total phenolic, hobby wine

1. Introduction

Grapevine which is a Mediterranean plant and wine obtained from its fruits had important roles in antique age economy and cultures. This beverage which is as old as the history of humanity has always been preserved, from antique age to present. It has its origins in the period when the Old Testament was

written, and in Genesis (9:20) it is mentioned that Noah drank wine and got drunk (Anonymous 2015; Fidan 1975).

Grapes have been grown and wine has been produced in Anatolia since 2000 BC. Wine was first brought into Greece from Aegean coasts by Phoenician sailors, and then it spread throughout Europe after it became holy as the blood of Jesus with the spread of Christianity in Europe. The wines of Hittites who founded a big civilization in Anatolia were brought into Mesopotamia region by Assyrian merchants (Akar 2011). Wine, percieved as the indicator of a good life and as a godly drink making the humans unravel the mysteries of nature, is also a cult (means of worshipping) in all Eastern and Western cultures. Wine is the leading agricultural product attracting the attention of legislators, philosophers, the nobility and masses from every class. This phenomenon brings about a constant increase in wine production and has caused winemaking to be an occupation for the experts within time (Anonymous 2015).

Wine, whose production and consumption are regarded as some of the factors defining the socieconomic level of a country, should not be considered as a beverage containing alcohol. It is also a very precious nutrition with the vitamines, acids, nitrogenous compounds, a number of trace elements, and especially aroma substances it contains. Because of this reason, its production and consumption should be incentivized by finding ways for producing qualified wines and popularizing them.

In this study, the quality of different wines obtained amateurishly from hobby wine grape varieties of high quality, particularly Bogazkere and Öküzgözü, being grown in our city, which is in the center of Anatolia, is investigated.

1. Material and Method

In this study, the quality of different wines obtained amateurishly from important wine grape varieties in Ancient Anatolia territory in 2014 is investigated.

2.1. Material

Wines obtained from important wine grape varieties of Ancient Anatolia territory and our country, particulary Bogazkere and Öküzgözü as well as Kesbir, Köhnü Mikeri, and Tilki Kuyrugu, were used as vegetative materials in this study.

The vineyards containing the wine grape varieties, which are planted with intervals of 2 x 3 m., are usually under wire cultivation, unvaccinated, and irrigated 3-4 times in vegetation period.

2.2. Method

Total phenolic compound (mg/l), total anthocyanin (mg/l), EC 50 (ml/ml dpph), D 280, Alcohol (%), Sugar (g/l), pH, Total citric (me/L), volatile acid (g/l), free sulfur (mg/l) and total sulfur (mg/l) values of the wine on which the study lays emphasis were measured.

The relevant parameters belonging to the wines produced traditionally were put into practice in Ankara University, Faculty of Agriculture, Department of Horticulture, research and application laboratories.

1.2.1. Chemical Analyses

1. pH Determination : pH of stums and wines was measured using glass electrode Cyber-scan pH-meter (Ough and Amerine, 1988).
2. Total Acid Determination**:** 20 ml distilled water was added on 10 ml wine sample, and it was determined by titrating with 0.1 N NaOH until pH is 8.2. The results were given as g/L in terms of sulphuric acid (Ough and Amerine, 1988; Anonymous, 1990). Canbas (1983) determination of D280 index in the wines were performed.
3. Alcohol Analysis: The amount of the alcohol in the distilled liquid containing alcohol was determined with pyknometer. The amount of alcohol was expressed first as weight (g/L) and then as volume (%) (Ough and Amerine, 1988).
4. Sulfur Analysis: In free and total sulfur determination, wine sample of 25 mL was calculated by titrating with N/64 iodine solution (Aktan and Kalkan, 2000).
5. Volatile Acidity Analysis: Steam deflecting method was applied, and the results were given as g/L (Ough and Amerine, 1988).
6. Sugar Analysis: Reducing sugar was detected in the wines that were decolorized and puridifed with Carrez solutions based on Luff-Schoorl method (Ough and Amerine, 1988).
7. Total Phenolic Substance Analysis: The amount of total phenolic compounds were determined according to Folin-Ciocalteu method. The amount of total phenolic compounds corresponding to the absorbances of the samples were determined with a standard graphic drawn using gallic acid and expressed as mg/L in terms of gallic acid (Ough and Amerine, 1988).

8. Total Anthocyanin Compund Analysis: Total anthocyanin contents of the wine samples were determined using pH differential method developed by Giusti and Wrolstad (2001). The samples belonging to the investigated wines had 3 repetitions, and 5 analyses were done for each repetition.

1.2.2. Statistical Analyses

The statistical analysis of the test was made according to one way anova and Duncan test method.

2. Research Findings

3.1. Descriptive Statistical Data

According to Table 1, it was determined, in accordance with the values belonging to the descriptive statistical information of the data, that total phenolic compound value was 893,77 (mg/L) on average, total anthocyanin value was 29.97 (mg/L) on average, EC50 value was 0.75 (ml/ml dpph), D280 value was 28.85, alcohol value was 12.67, sugar value was 2.84 (g/l), and Ph value was 3.37. It was found out for acidity values that total acidity value was 3.74 (me/L) on average and volatile acidity value was 0.39 (g/l). Free sulfur and total sulfur values were determined to be 32.40 (mg/L) and 55.20 (mg/L) on average, respectively.

Table 1. Descriptive Statistics

Data	Number	Mean	Standard Deviation
Wine samples and repetition	30	5,50	2,92
Total phenolic compound (mg/L)	30	893,77	386,98
Total Anthocyanin Toplam (mg/L)	30	29,97	30,01
EC50 (ml/ml dpph)	30	0,75	0,20
D280	30	28,85	0,99
Alcohol (%)	30	12,67	1,98
Sugar (g/l)	30	2,84	0,90
Ph	30	3,37	0,46
Total Acid (%)	30	3,74	0,53
Volatile Acid (g/l)	30	0,39	0,12
Free Sulfur (mg/l)	30	32,40	10,30
Total Sulfur (mg/l)	30	55,20	9,50

3.1.1. Total Anthocyanin and Total Phenolic Compound

Total anthocyanin values and total phenolic compound are given on Figure 1. Total Phenolic compound value is at its peak value, 1650.67 (mg/L), in 4th wine sample repetition and at its lowest value, 544.67 (mg/L), in 10th wine sample repetition. There are differences between total phenolic compound mean values in terms of wine samples and repetitions ($P<0.01$). The differences between total anthocyanin mean values revealed significant statistical differences in terms of wine samples ($P<0.01$), 4. Total anthocyanin value in the sample was found in the peak value, as 88.51 (mg/L), on average (Table 2).

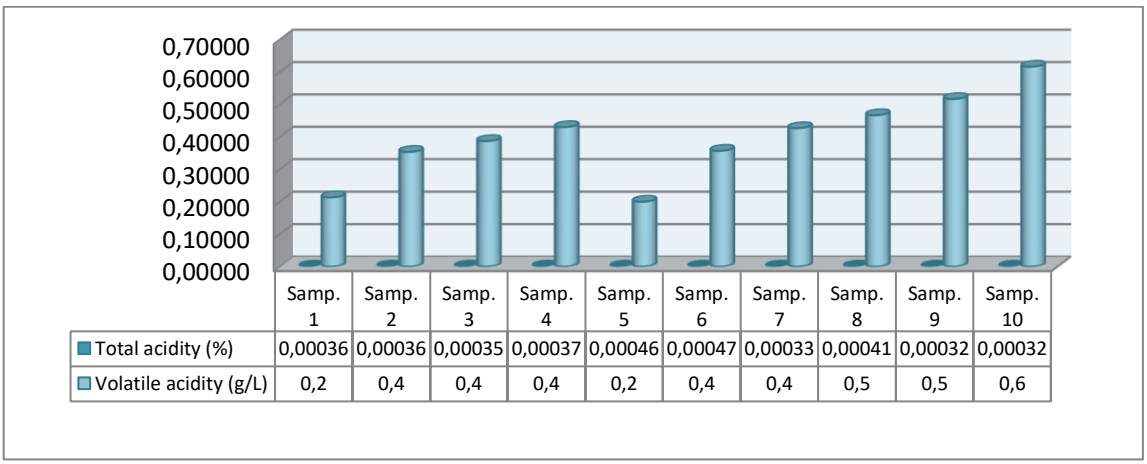


Figure 1. Total Phenolic Compound and Total Anthocyanin

Table 2. Total Phenolic Compound and Total Anthocyanin Values

Wine Samples and Repetition	Total Phenolic Compound			Total Anthocyanin		
	Mea.	Std. D	Std. E	Mea.	Std. D	Std. E
Samp. 1	3045,00^{d}	25,53	14,74	41,85^{j}	0,92	0,53
Samp. 2	898,00^{c}	47,63	27,50	21,32^{h}	1,15	0,66
Samp. 3	574,00^{a}	22,60	13,05	8,91^{g}	0,70	0,40
Samp. 4	1650,67^{f}	7,23	4,17	88,51^{f}	1,34	0,77
Samp. 5	1521,67^{e}	81,68	47,16	79,81^{e}	0,60	0,34
Samp. 6	747,00^{b}	72,27	41,72	18,86^{d}	0,39	0,23
Samp. 7	839,00^{c}	12,76	7,37	27,92^{c}	0,23	0,13
Samp. 8	595,33^{a}	21,38	12,34	4,95^{b}	0,15	0,08
Samp. 9	552,33^{a}	5,85	3,38	4,97^{b}	0,71	0,41
Samp. 10	544,67^{a}	33,72	19,47	2,54^{a}	0,45	0,26
Total	**893,77**	**386,98**	**70,65**	**29,97**	**30,01**	**5,47**
F and P value	278.787, 0.000***			499.616, 0.000***		

W. S. and Rep.: Wine Samples and Repetition

Mea: Mean, Std.D: Standard Deviation, Std. E: Standart Error; $^{a,j:}$ the difference between different letters between the means in the same column is significant *** P<0.01

3.1.2 EC50 and D280

EC50 and D280 values of the varieties are given in Figure 2. In accordance with the calculations on the samples, EC50 mean value and standard deviation are 0.76 (ml/ml dpph) and 0.20 respectively, while D280 mean value and standard deviation are 28.85 and 0.99 respectively. The differences between EC50 mean values are regarded as statistically significant (P<0.01), and it was determined that the peak EC50 value was 1.05 (ml/ml dpph) for 7th and 9th samples. The differences between the means of D280 values are regarded as statistically significant, and D280 values of 4th and 5th samples were found to be 30.55 and 30.77 respectively, which is higher than the other varieties (Table 3).

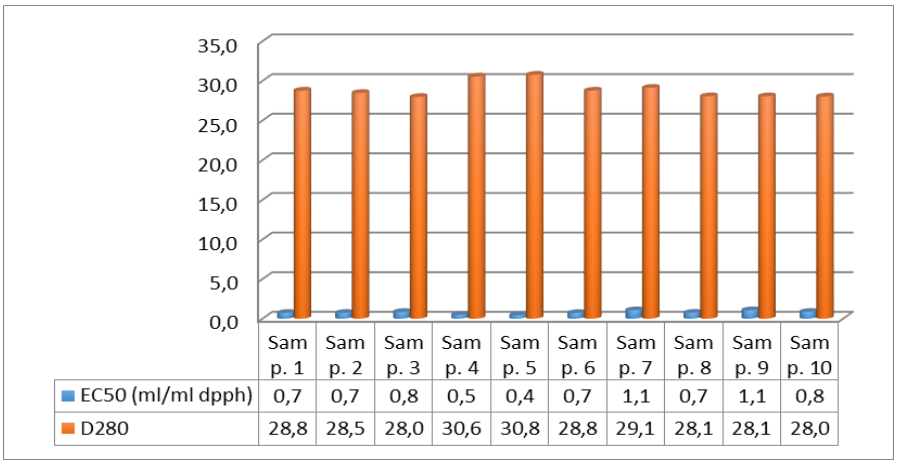


Figure 2. EC50 and D280 values

Table 3. EC50 and D280 values

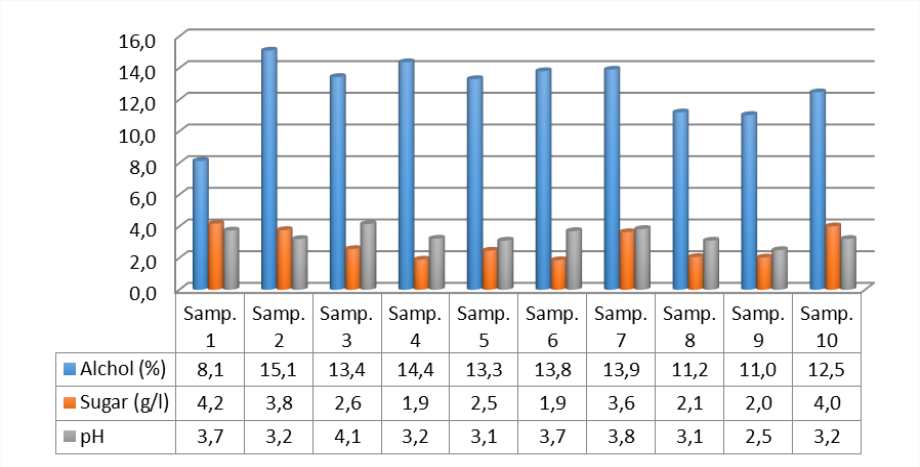
Wine Samples and Repetition	EC50			D280		
	Mea.	Std. D	Std. E	Mea.	Std. D	Std. E
Samp. 1	0,71[c]	0,00200	0,00115	28,77[c]	0,06245	0,03606
Samp. 2	0,72[c]	0,00608	0,00351	28,47[b]	0,15177	0,08762
Samp. 3	0,83[d]	0,00643	0,00371	27,97[a]	0,03215	0,01856
Samp. 4	0,46[b]	0,00153	0,00088	30,55[e]	0,11533	0,06658
Samp. 5	0,43[a]	0,00529	0,00306	30,77[e]	0,10066	0,05812
Samp. 6	0,70[c]	0,00451	0,00260	28,77[c]	0,06245	0,03606
Samp. 7	1,05[e]	0,00058	0,00033	29,12[d]	0,05686	0,03283
Samp. 8	0,73[c]	0,00100	0,00058	28,06[a]	0,07550	0,04359
Samp. 9	1,05[e]	0,00723	0,00418	28,05[a]	0,06506	0,03756
Samp. 10	0,84[d]	0,03831	0,02212	28,03[a]	0,04509	0,02603
Total	0,75	0,20006	0,03652	28,85	0,99371	0,18143
F and P value	777.150, 0.000***			449.098, 0.000***		

W. S. and Rep.: Wine Samples and Repetition

Mea: Mean, Std.D: Standard Deviation, Std. E: Standart Error; [a,e] the difference between different letters between the means in the same column is significant [***] P<0.01

3.1.3 Alcohol, Sugar, pH

Alcohol, sugar, pH values of the wine samples used in the test are given on Figure 3. In accordance with the calculations on the samples, the mean of alcohol values is 12.6733, the mean of sugar values is 2.8467, and the mean of pH values is 3.3750. The differences among alcohol, sugar, and pH means in terms of all varieties are considered statistically significant (P<0.0[1]). It was determined that the sample whose alcohol value was higher than the other ones was 2[nd] sample, 1[st] sample had the highest sugar value, and 3[rd] sample had the highest ph value (Table 4)



	Samp. 1	Samp. 2	Samp. 3	Samp. 4	Samp. 5	Samp. 6	Samp. 7	Samp. 8	Samp. 9	Samp. 10
Alchol (%)	8,1	15,1	13,4	14,4	13,3	13,8	13,9	11,2	11,0	12,5
Sugar (g/l)	4,2	3,8	2,6	1,9	2,5	1,9	3,6	2,1	2,0	4,0
pH	3,7	3,2	4,1	3,2	3,1	3,7	3,8	3,1	2,5	3,2

Figure 3. Alcohol, sugar, pH values

Table 4. Alchol, sugar and pH values

Wine Samples and Repetition	*Alcohol*			*Sugar*			*Ph*		
	Mea.	Std. D	Std. E	Mea.	Std. D	Std. E	Mea.	Std. D	Std. E
Samp. 1	8,1333[a]	0,05774	0,03333	4,1667[a]	0,05774	0,03333	3,7400[c]	0,02000	0,01155
Samp. 2	15,1000[b]	0,00000	0,00000	3,7667[b]	0,05774	0,03333	3,2000[f]	0,01000	0,00577
Samp. 3	13,4333[c]	0,05774	0,03333	2,5667[c]	0,05774	0,03333	4,1433[d]	0,04933	0,02848
Samp. 4	14,3667[d]	0,05774	0,03333	1,9000[d]	0,10000	0,05774	3,2233[b]	0,03215	0,01856
Samp. 5	13,3000[e]	0,00000	0,00000	2,4667[c]	0,05774	0,03333	3,1000[f]	0,01732	0,01000
Samp. 6	13,8000[f]	0,10000	0,05774	1,8667[d]	0,05774	0,03333	3,7033[c]	0,00577	0,00333
Samp. 7	13,9000[f]	0,10000	0,05774	3,6333[e]	0,05774	0,03333	3,8333[e]	0,05774	0,03333
Samp. 8	11,2000[g]	0,00000	0,00000	2,0667[f]	0,11547	0,06667	3,1000[f]	0,10000	0,05774
Samp. 9	11,0333[h]	0,05774	0,03333	2,0333[f]	0,05774	0,03333	2,5000[a]	0,10000	0,05774
Samp. 10	12,4667[i]	0,05774	0,03333	4,0000[g]	0,10000	0,05774	3,2067[f]	0,09018	0,05207
Total	12,6733	1,98372	0,36218	2,8467	0,90544	0,16531	3,3750	0,46209	0,08437
F and P value	3455.919, 0.000***			463.948, 0.000***			190.147, 0.000***		

W. S. and Rep.: Wine Samples and Repetition

Mea: Mean, Std.D: Standard Deviation, Std. E: Standart Error; [a,j:] the difference between different letters between the means in the same column is significant [***] P<0.01

3.1.4 Total Acidity and Volatile Acidity

Total and volatile acidity values of the wine samples are given on Figure 4. In accordance with the samples, it was determined that total acidity value was 3.7494 on average, the sample with the highest total acidity value was 6th sample, and the sample with the lowest acidity value was 10th sample. The difference between the mean total acidity value of the samples are considered statistically significant (P<0.01). The mean volatile acidity value of all the groups was calculated to be 0.3967(g/l). It was determined that the highest mean volatile acidity value was at 10th sample and the lowest one was at 5th sample. The differences between the means of volatile acidity value showed discrepancy in terms of the samples (P<0.01) (Table 5).

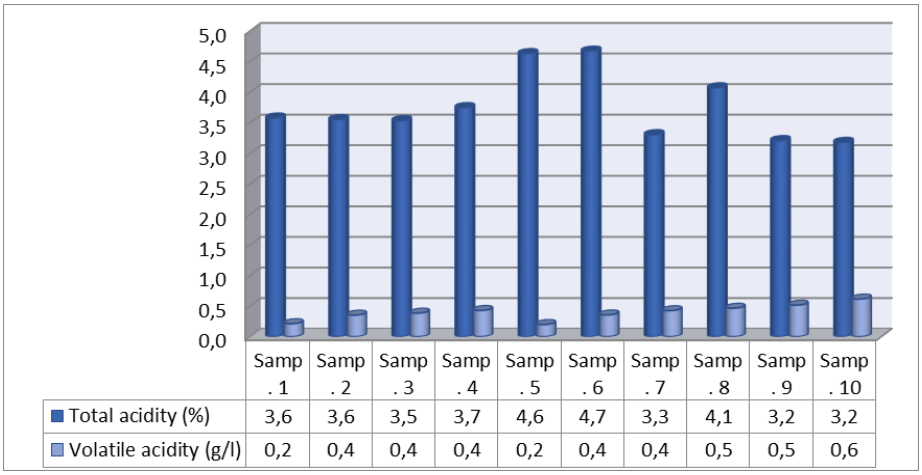


Figure 4. Total acidity and volatile acidity

Table 5. Total acidity and volatile acidity values

Wine Samples and Repetition	Total acidity			Volatile acidity		
	Mea.	Std. D	Std. E	Mea.	Std. D	Std. E
Samp. 1	3,5790[b]	0,20491	0,11831	0,2133[a]	0,01528	0,00882
Samp. 2	3,5533[b]	0,01258	0,00726	0,3533[b]	0,02082	0,01202
Samp. 3	3,5367[b]	0,03395	0,01960	0,3867[c]	0,01155	0,00667
Samp. 4	3,7493[b]	0,06664	0,03848	0,4300[d]	0,01000	0,00577
Samp. 5	4,6323[d]	0,25077	0,14478	0,2000[a]	0,01000	0,00577
Samp. 6	4,6727[d]	0,02250	0,01299	0,3567[b]	0,03215	0,01856
Samp. 7	3,3067[a]	0,12931	0,07466	0,4267[d]	0,01528	0,00882
Samp. 8	4,0733[c]	0,07342	0,04239	0,4667[e]	0,00577	0,00333
Samp. 9	3,2100[a]	0,07804	0,04506	0,5167[f]	0,00577	0,00333
Samp. 10	3,1810[a]	0,01217	0,00702	0,6167[g]	0,02082	0,01202
Total	3,7494	0,53363	0,09743	0,3967	0,12349	0,02255
F and P value	63.561, 0.000***			175.395, 0.000***		

W. S. and Rep.: Wine Samples and Repetition
Mea: Mean, Std.D: Standard Deviation, Std. E: Standart Error; [a,g:] the difference between different letters between the means in the same column is significant [***] P<0.01

3.1.5 Free sulfur and total sulfur

Free and total sulfur values are given on Figure 5. It was determined that mean free sulfur value and total sulfur value for all groups were 32.40 (mg/l) and 55.20 (mg/l) respectively. It was determined that 7th sample had the highest free sulfur value, and 2nd sample had the highest total sulfur value. The differences between free and total sulfur mean values are considered statistically significant (P<0.01) (Table 6)

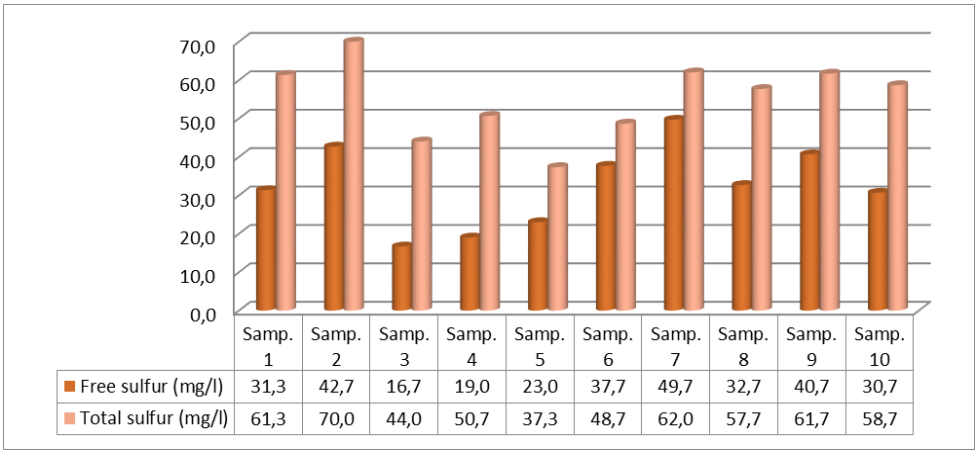


Figure 5. Free sulfur and total sulfur values

Table 6. Free sulfur and total sulfur values

Wine Samples and Repetition	Free sulfur			Total sulfur		
	Mea.	Std. D	Std. E	Mea.	Std. D	Std. E
Samp. 1	31,33[d]	1,155	0,667	61,33[f]	0,577	0,333
Samp. 2	42,67[h]	1,528	0,882	70,00[g]	0,000	0,000
Samp. 3	16,67[a]	0,577	0,333	44,00[a]	1,000	0,577
Samp. 4	19,00[b]	1,000	0,577	50,67[b]	0,577	0,333
Samp. 5	23,00[c]	1,732	1,000	37,33[c]	0,577	0,333
Samp. 6	37,67[f]	1,155	0,667	48,67[d]	0,577	0,333
Samp. 7	49,67[i]	0,577	0,333	62,00[f]	1,000	0,577
Samp. 8	32,67[e]	0,577	0,333	57,67[e]	0,577	0,333
Samp. 9	40,67[g]	0,577	0,333	61,67[f]	0,577	0,333
Samp. 10	30,67[d]	0,577	0,333	58,67[e]	0,577	0,333
Total	32,40	10,304	1,881	55,20	9,506	1,736
F and P value		318.528, 0.000			669.778, 0.000	

W. S. and Rep.: Wine Samples and Repetition

Mea: Mean, Std.D: Standard Deviation, Std. E: Standart Error; [a,i:] the difference between different letters between the means in the same column is significant [***] P<0.01

1. Discussion and Result

Total phenolic compound value of the tested wine samples is 893,77 (mg/L) on average (Table 2). The differences between total phenolic compound mean values manifested statistically significant differences in terms of the samples (P<0.01). Bayram et al., (2014) reported in their study that total phenolic compound varied between the range of 2191,53-2445,9 µg GAE/ml. Moreover, Anlı and Vural (2009), indicated that total phenolic compound amounts of the red wines produced from different grapes were in the range of 1000-2500 mg/L. Gordillo et al. (2013), determined that wines supplemented with oak chips provided total phenolic compounds of high amounts and more stabile colored wines. Macheix et al., (1991), reported that totalphenolic compund amount in young red wines was 1,30 g/l. Singleton and Noble (1976), suggested that total phenolic compounds in red dry wines were 1,40 g/l or more.

Total phenolic compound amounts in a major part of the produced wines were in concordance with literature data (Table 2).

Total phenolic compound amounts in a major part of the produced wines were in concordance with literature data (Table 2).

Total anthocyanin value was found to be 29,97 (mg/l) on average as a result of the study. The differences between total anthocyanin compound means revealed significant statistical differences in terms of wine samples (P<0.01). Bayram et al., (2014), determined as a result of the total anthocyanin capacity analysis that anthocyanin capacity was 68.21 µg mal-3-glu/mL.

The antioxidant capacity values in the produced red wines are in concordance with the study done by Spilmann et al., (1998).

It was determined that the highest EC50 value was 1.05 (ml/ml dpph) for 7th and 9th wine samples. D280 values for 7th and 9th wine samples were 30.55 and 30.77 respectively, which was higher than the other wine samples. Deryaoglu et al. (1997) found D280 index value between 35-82 in their study.

Mean alcohol value was found to be 12,67 (%) in our study. The differences among alcohol, sugar and pH means of all wine samples are considered statistically significant (P<0.01).

Bayram et al., (2014), reported that alcohol amounts of the produced wines varied between %11.97 and %13.17. Akman et al. (1971), Topaloglu (1984) reported in their study that alcohol percentage was %12. Similarly, in another study on Bogazkere wines, alcohol amount was determined to be % 10.90- 13.2 (% 12.2 on average). (Canbas et al. 2001). In the study made by Deryaoglu et al., (1997), it was reported that alcohol amount varied between %12,2 and % 13,0. Furthermore, it was stated that alcohol percentage depended on sugar percentage, alcohol percentage could vary between &8-17 in volume, this percentage could be between %11-14 in red wines, and alcohol percentage in the wines must not be lower than %10

for durability (Ough and Amerine 1988). Accordingly, it is clear that alcohol values obtained in the study are in concordance with literature data. It was stated according to Turkish Food Codex Wine Notice (Anonymous 2009) that alcohol percentage in the wines must not be lower that %9 (v/v). It is obvious that alcohol percentages of all wine samples used in the test except 1st sample are in concordance with the other studies.

It was determined as a result of our study that mean sugar value in the wine samples was 2,84 (g/l). Deryaoglu et al., (1997) reported that sugar value varied between 2,39 (g/L) and 3,58 (g/L) in their study. Turkish Food Codex Wine Notice Anonymous, (2009) defines the wines containing 4 g/L or less sugar as dry wines. Accordingly, the wines produced in this way are in dry wines category.

It is obvious that mean pH value (3,37) obtained as a result of the study is in concordance with Kelebek et al., (2011), (pH 3,2), Göktürk Baydar et al., (2000) (pH 3,68), Bayram et al. (2014) (pH 3.3) ve Deryaoglu et al., (1997) (3,5) studies.

The differences between total acidity (3.75) and mean volatile acid (0,39) values of the wine samples are considered statistically significant ($P<0.01$).

Bayram et al., (2014) found out that total acidity varied between 4.4-6.4 g/L (5.9 g/L on average) in their study. In the wine notice published by Turkish Food Codex in 2009, it was stated that total acidity amount in the wines must be at least 3.5 g/L or 46.6 meq/L in terms of tartaric acid (Anonymous, 2009).

According to Turkish Food Codex Wine Notice (Anonymous 2009), the highest volatile acid amount permitted for the red wines is 1.20 g/L (acetic acid). Volatile acid amount of the produced wines was determined to be 0.39 g/L in the study, and it is in concordance with the values stated in Turkish Food Codex Wine Notice (Anonymous 2009).

The differences between the mean values of mean free sulfur (32,40) and mean total sulfur (55,20) are statistically significant ($P<0.01$).

Bayram et al., (2014) determined that total sulfur amounts of the wines produced by implementing oak chipped maceration and classical maceration after fermentation were 18.5-19.0 mg/L respectively. They stated that free sulfur values of the wines produced by implementing classical maceration and oak chipped maceration after fermentation were 4.5-7.5 mg/L respectively. Deryaoglu et al., (1997) reported that total sulfur and free sulfur amounts were 48,00 mg/l and 9,7 mg/l respectively.

Sulfur plays an important role in wine production, ripening, and prevention of diseases and defects. Total sulfur has an antiseptic effect on microorganisms and prevents oxidation by binding the oxygen (Cabaroglu and Canbas 1994). Anlı (2009), indicated that red wines must usually had free sulfur of 20-30 mg/L level.

It is clear that all the wine quality criterion values are usually close to the desired standards for a qualified wine. However, the family business in which wine is produced, the environment of wine production, and the mix proportions of the types used in wine production are determinative in the fact that quality criteria values of the wine samples are statistically different.

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