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RESEARCH ON THE PHYSICO-CHEMICAL ANALYSIS OF WHITE AND RED GRAPES MUST FROM A WINERY IN PRAHOVA COUNTY

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Abstract

The paper proposed an analysis of the physico-chemical composition of several types of grape varieties (white and red). Their analysis was done during the years 2019-2021 at a winery in Prahova County. The determinations were made on must, and the analyzed varieties were: Sauvignon Blanc, White Feteasca and Black Feteasca. The sugar content was determined, which is an important parameter in wine-making to estimate the favorable time for harvesting, but also to decide what wine is produced (dry, sweet, semi-sweet). The total acidity of the wine was also determined, acids representing important components of the wine. Low acidity will cause a "flat" and uninteresting taste, and too much acidity will cause an overly sour and astringent taste. At the same time, the pH was analyzed, which affects the taste, sugar, acidity level and stability of the wines. The observed values were in normal limits.

Key words: *acidity, must, pH, sugar, variety.*

INTRODUCTION

Viticulture represents one of the most important traditional branches of agriculture that contributed to the formation and development of civilization, as a basic occupation, bringing economic and social and cultural benefits.

The grapevine adapts very well to sloping lands, sandy or eroded soils, which are not suitable for other crops, the lands being favorable for the planting of the grapevine, having good climatic conditions and superior quality products can be obtained (Doholici, 1981). By growing vines, sloping lands are stabilized, reducing soil slips and the continuation of its solidification. In addition, it offers us many benefits (Cabernet Sauvignon, 2012).

The cultivation of vines represents an important source of profit, the production resulting from one hectare of vines is equivalent to the production obtained from ten hectares of cereal crops. Wine products are highly appreciated on the domestic and foreign market, obtaining important profits. Cultivation of vines by people living in the hill area is sometimes the only source of income. Vineyards with varieties for table grapes are exploited very well, with large productions of grapes being achieved.

Wine-viticulture products have an important contribution to the diet. Due to the high content of organic acids, mineral salts, vitamins, pectic substances, polyphenols, etc., grapes and must have a beneficial effect on the body, having an energizing, therapeutic and mineralizing effect (Doholici, 1981). Following some recent research, it was found that wine, in moderate quantities, can have an antibiotic effect on the body, especially in the cardiovascular system, preventing the causes of risk in food, caused by the excessive consumption of fats and animal proteins, which lead to favoring cardiovascular diseases (Chiva-Blanch et al., 2013, Torres et al., 2015; Snopek et al., 2018).

In some regions where wine is the traditional drink, the longevity of the population increases surprisingly (Gambini et al., 2021). The accumulation of sugars in the grains, in the form of glucose and fructose, is achieved from the reserves of the stem, the vine and from the reserves of the leaf, created daily, through photosynthesis. In the leaves, all the compounds of plant cells are born: sugars, organic acids, tannins, etc. (Boerescu, D.S., 2007). Depending on the duration of sunlight

during grape ripening, a certain amount of sugar is formed through photosynthesis. Thus, the warm areas of the country will produce grapes richer in sugar, respectively, wines richer in alcohol. The migration of sugars from the woody part of the vine intensifies as the grapes enter the harvest period. The light influences the accumulation of sugars in the grapes uniformly, thus in the berries, in the peduncular area there is more sugar, and in the peripheral area of the berry it is sweeter and less acidic (Teodorescu et al., 1987).

MATERIALS AND METHODS

During the years 2019-2020, analyzes of the sugar level, acidity and pH were carried out. Determining the sugar content is an important parameter in winemaking in order to estimate the favorable time for harvesting, but also to decide what wine is produced (dry, sweet, semi-sweet). The sugar level determines an important parameter, this being the alcohol, it is estimated that at a content of 17 g/l, approximately 1 alcoholic strength is obtained, that it 10 ml of alcohol per 100 ml of wine. The sugar level of a wine is estimated to be 170-180 g/liter, and if it does not reach these limits before fermentation, sugar is added. The amount of sugar was determined with the refractometer for the must, and the unit of measure in which it was expressed is grams of sugars/1 liter of must.

The refractometer is an optic equipment which allows the measurement of refraction index of substances. It is made from an optic tube, with lentiles, which has in interior a graded scale and a glass refraction prisma, covered with a transparent plate, which moves. Thruough the glass prisma the light goes in the tube. The equipment is calibrated with distilated water and the readings are made at 20 ^{o}C or are made the necesarry corrections. Sugar determination in must and wine are done by harvesting a sample with a pipette and putting 2-3 drops on the refractometer's prisma. The transparent lama is added and the reading are done on the graded scale at the limit point between lighted and dark field.

The acidity was determined by: the potentiometric method, mandatory in case of litigation, as a reference method; titrimetric methods in the presence of a color indicator (bromothymol blue, phenol red), as usual (indicative) methods

Excessive absorption of nitrogen and potassium is due to strong vines, which increases the pH of the grapes and the wine, which leads to spoilage of the wine quality. The pH of the must affects the taste, sugar, acidity level and stability of the wines. It is determined by the balance between the main anions (malate and tartrate) and the presence or absence of major cations (mainly potassium). The pH may increase by up to 0.2 units between harvest and delivery. High pH values can change the color of the wine. A high pH should result in wines that taste flat and red wines with a brown color. In general, a pH higher than 3.6 has a negative effect on wine quality.

RESULTS AND DISCUSSIONS

Determining the sugar content is an important parameter in winemaking in order to estimate the favorable time for harvesting, but also to decide what wine is produced (dry, sweet, semi-sweet). Depending on the amount of sugar, the following categories can exist: dry white wine - the yeasts in the dry wine consume, during fermentation, the sugar in the must and transform it into ethyl alcohol and carbon dioxide. The amount of sugar left in the composition of the wine is small, 4 g/liter; demisec white wine - sweeter than dry wine, but not sweet enough to be considered sweet, demisec wine is obtained by finishing the fermentation process longer, so that the yeasts do not consume all the sugar, and the amount of sugar remains between 4 and 12 g/liter; sweet wine - the amount of sugar is between 12 and 50 g/liter, the wine is semi-sweet, being obtained by stopping the fermentation of the must before it is complete; sweet white wine - the sugar concentration in sweet wine is 50 g/liter.

The total acidity of the must is determined by the sum of the functions of free and semi-bound acids, which can be titrated when the pH is brought to the value of 7 by adding a titrated alkaline solution. Acids are important components of wine. Low acidity will cause a "flat" and uninteresting taste, and too high

acidity will cause a too sour and astringent taste.

The excessive absorption of nitrogen and potassium is due to strong vines, which increases the pH of the grapes, leading to the deterioration of the quality of the wine. The pH of the must affects the taste, sugar, acidity level and stability of the wines. It is determined by the balance between the main anions (malate and tartrate) and the presence or absence of major cations (mainly potassium) influences the pH of the wine, the time and management of the harvest. The pH may increase by up to 0.2 units between harvest and delivery. High pH values can change the color of the wine. A high pH should result in wines that taste flat and red wines with a brown color. In general, a pH higher than 3.6 has a negative effect on wine quality.

The White Feteasca variety is one of the most valuable Romanian grape varieties. It produces dry or semi-dry wines, with balanced alcohol content (11.5-12% strength) and acidity, characterized by great finesse, but also semi-sweet, sweet and sparkling wines. White Feteasca produces a fine, elegant, round, velvety, ample, full-bodied wine.

It has a very high sugar accumulation power, from this point of view being among the first varieties in the world. The amount of sugar accumulated in grapes is normally 180-220 g/l of must, but it can reach up to 240-250 g/l and even 270 g/l, in overripe conditions.

For white Feteasca, for the years studied (2019-2021), the sugar, acidity and pH values can be found in the Tables 1, 2 and 3.

From the analyzed of these data, it can be seen that the largest amount of sugar was accumulated towards the end of the harvest period, respectively on September 2 and 5. Also, the highest acidity reached 12.5 g/l in the first days of harvesting, decreasing during the harvest (Table 1).

Table 1. Sugar content, acidity and pH of the White Fetească variety in 2019

Analysis data	Type of analysis		
	Sugar (g/l)	Acidity (g/l)	pH
12.08	122	12.2	2.86
19.08	170	7.6	3.06
22.08	172	5.7	3.12
26.08	183	5.2	3.11
29.08	188	4.3	3.18
02.09	210	3.7	3.44
05.09	210	3.8	3.55
Average	**179.29**	**6.07**	**3.19**

Also, in 2020, the amount of sugar accumulated was towards the end of the harvest period, the highest acidity 6 g/l was recorded at the beginning of the harvest period, respectively on 6.08, the pH maintaining between values between 3.08-3.46 (Table 2).

Table 2. Sugar content, acidity and pH of the White Fetească variety in 2020

Analysis data	Type of analysis		
	Sugar (g/l)	Acidity (g/l)	pH
06.08	135	6	3.08
13.08	151	4.7	3.12
17.08	162	4.1	3.2
20.08	167	4.2	3.25
24.08	175	3.7	3.33
27.08	175	3.5	3.46
Average	160.83	4.36	3.19

In the last year of the study, regarding the White Fetească variety, the recorded sugar value was 143 g/l on August 23, reaching a maximum of 204 g/l towards the end of the harvest. Regarding the pH, the values were between 2.8-3.47 (Table 3).

Table 3. Sugar content, acidity and pH of the White Fetească variety in 2021

Analysis data	Type of analysis		
	Sugar (g/l)	Acidity (g/l)	pH
23.08	143	4.8	3.06
26.08	156	3.9	2.8
30.08	164	3.3	2.89
02.09	162	3.6	3
06.09	183	3.4	3.29
09.09	183	3.7	3.3
13.09	191	3.2	3.47
14.09	204	3.3	3.32
Average	173.25	3.62	3.14

The Sauvignon variety ranks second after Chardonnay in international trade. This is originally from Bordeaux, which is located in France and was introduced to Romania in the last part of the last century. To avoid confusion with Cabernet Sauvignon, producers write Sauvignon Blanc on the label.

The wines obtained from Sauvigon Blanc are white wines of superior quality. This variety

can be vinified to obtain dry, semi-dry or sweet wines. Sauvignon Blanc is often overlooked by experts because the wines produced from this variety are relatively simple, have strong vegetal notes and do not have great aging potential. However, Sauvignon Blanc has a much more complex and attractive character than it suggests at first sight or tasting. The variety can be subjected to various styles of winemaking, the result being wines that differ in taste, appearance and personality.

In the Sauvignon Blanc variety, the analyzed values regarding the sugar content ranged between 111 g/l in the first harvest period, reaching 217 g/l in the last period. Regarding pH, the values ranged between 2.8 and 3.25 (Table 4).

Table 4. Sugar content, acidity and pH of the Sovingnon Blanc variety in 2019

Analysis data	Type of analysis		
	Sugar (g/l)	Acidity (g/l)	pH
12.08	111	18.6	2.75
18.08	156	13	2.8
22.08	162	9.6	2.91
26.08	212	8.3	3
29.08	212	7.3	3.01
02.09	215	6	3.25
05.09	217	5.3	3.3
Average	**153.28**	**9.72**	**3.00**

In 2020, the Sauvignon Blanc variety had sugar values between 167 g/l, increasing recently to 230 g/l. Throughout the period, the acidity had an average of 5.75, and the pH 3.28.

Table 5. Sugar content, acidity and pH of the Sovingnon Blanc variety in 2020

Analysis data	Type of analysis		
	Sugar (g/l)	Acidity (g/l)	pH
20.08	167	7.8	3.06
24.08	175	6.3	3.2
27.08	215	5.9	3.29
03.09	204	6	3.3
07.09	194	4.5	3.38
10.09	230	4	3.48
Average	**197.5**	**5.75**	**3.28**

From the analysis of the data below we can see that the highest sugar content was 228 g/l recorded in September, the highest acidity was in the first period of the harvest 6.6, it will decrease until the end of the period to 4.6 g/l. The pH recorded values between 3 and a maximum of 3.27 (Table 6).

Table 6. Sugar content, acidity and pH of the Sovingnon Blanc variety in 2021

Analysis data	Type of analysis		
	Sugar (g/l)	Acidity (g/l)	pH
06.09	172 g/l	6.6 g/l	3.16
09.09	178 g/l	6.4 g/l	3
13.09	196 g/l	6.2 g/l	3.2
14.09	209 g/l	6.2 g/l	3.29
23.09	228 g/l	4.6 g/l	3.27
Average	**196.6**	**4.76**	**3.18**

The Black Fetească variety is an autochthonous variety, cultivated for a long time on large areas in the southern part of Moldova and in the eastern area of Muntenia. From this variety, you can get both special rosés and red wines that can be aged in quality wood and later in glass, resulting in high-brand wines with a pronounced typicality. Depending on the winemaking techniques, wines with varied aromas and fine tannin structure, good acidity, medium to full body and a medium to high alcohol level can be obtained. Black Fetesca offers a dry or demi-dry top quality red wine, ruby-red in color, with an alcoholic strength of 12-13% with a higher acidity, the young wine is very harsh, but once it ages, it becomes balanced. In 2019, the picking of the Back Feteasca variety took place between August and September over the course of three days. The Black Fetească variety had an average value of 242.66, acidity of 6.13 and a pH of 3.56 (Table 7).

Table 7. Sugar content, acidity and pH of the Black Fetească variety in 2019

Analysis data	Type of analysis		
	Sugar (g/l)	Acidity (g/l)	pH
26.08	236	7.2	3.24
02.09	242	6.7	3.31
05.09	250	4.5	3.52
Average	**242.66**	**6.13**	**3.56**

Table 8. Sugar content, acidity and pH of the Black Fetească variety in 2020

Analysis data	Type of analysis		
	Sugar (g/l)	Acidity (g/l)	pH
02.09	234	5.4	3.37
05.09	238	5.2	3.44
21.09	240	4	3.32
Average	**237.33**	**4.86**	**3.37**

In the last year of the study, the recorded averages were 186.6 for sugar, acidity recorded an average of 5.82, and pH 3.15 (Table 9).

Table 9. Sugar content, acidity and pH of the Black Feteasc ă variety in 2021

Analysis data	Type of analysis		
	Sugar (g/l)	Acidity (g/l)	pH
02.09	160	6.1	2.8
06.09	170	6.3	3.3
09.09	194	5.8	3.2
13.09	199	5.9	3.2
16.09	210	5	3.26
Average	**186.6**	**5.82**	**3.15**

CONCLUSIONS

Full maturity represents the moment when carbohydrates, total acidity and 1000 berry weight achieve the characteristic levels of the varieties. The evolution of the weight of the berries gives indications on the qualitative side, the variation of the content in sugars and acidity, as well as the establishment of the ratio in which they are found give indications especially on the qualitative side. So, by full maturity is meant that moment when the grape has accumulated a maximum amount of carbohydrates without its weight having decreased, and the acidity is moderate. White grapes turn yellowish and black ones turn light black. The period can be limited to two weeks, observing a sudden increase in the sugar content.

In this study, the evolution of the physico-chemical analyzes of white and red grape varieties was followed during the years 2019-2021 in a winery in Prahova county.

From the statistics, it is found that in 2019, a higher level of sugar in the red varieties, compared to the white one, and the acidity level of the pH is higher in the white grapes compared to the black ones. It was found that in 2020 the red variety was much richer in terms of the level of sucrose in the grapes, and the white variety in acidity and pH. The year 2021 also saw a very good harvest in terms of the red variety, both in terms of sugar level and acidity and pH. The white variety had normal values throughout the years of study. The accumulation of sugars in the grains, in the form of glucose and fructose, is made from the reserves of the stem, the vine and from the reserves of the leaf, created daily, through photosynthesis. All the compounds of plant cells are born in the leaves: sugars, organic acids, tannins, etc. Depending on the duration of sunlight during grape ripening, a certain amount of sugar is formed through photosynthesis. Thus, the warm areas of the country will produce grapes richer in sugar, respectively, wines richer in alcohol. The migration of sugars from the woody part of the vine intensifies as the grapes enter the fallow period. The light influences the accumulation of sugars in the grapes uniformly, thus in the berries, in the peduncular area there is more sugar, and in the peripheral area of the berry it is sweeter and less acidic. The decrease in acidity is the reverse of the process of accumulation of sugars. In green grapes, the acidity is 20 g sulfuric acid/l, so that in a few weeks it drops to 4-6 g sulfuric acid/l.

The dynamics of titratable acidity is due to the evolution of tartaric acid and malic acid. Tartaric acid undergoes minimal changes, and malic acid, because it is more labile, will quantitatively decrease faster in the first stage and then more slowly, depending on the ripening of the grapes. Varieties are differentiated by their content in malic acid, there are varieties rich in malic acid and varieties poor in malic acid. During the ripening phase of the grape, the maturity index is monitored, which represents a sugar/acidity ratio, which, depending on the pedoclimatic conditions, varies between 30 and 70.

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