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Comparative examination between traditional and worldwide-known red wine grapes and vines based on their qualitative and quantitative characteristics

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Abstract: The tradition of drinking wine has a very old history. Romania has a very good geographical location and a favourable climate for grapes; it is ideal for growing vines and producing quality wines. In our research, we analysed quantitative and qualitative parameters of four varieties of grapes in the Miniş-Măderat Vineyard. The objective was to look for differences between traditional varieties (Cadarcă/Kadarka and Fetască Neagră/Fekete Leányka) and world varieties (Cabernet Sauvignon and Merlot). From the data, it could be concluded that the worldwide-known varieties yielded better results, but for a new plantation in the Miniş-Măderat Vineyard, we recommend the use of traditional varieties, as they have a better history in the area.

Keywords: vine, productivity, must sugar, must acidity, alcohol

1. Introduction

Wine is a beverage that plays a very important role in the present as well as in the past. However, we should not forget that wine could not exist without viticulture [1]. According to some studies, the grape was the first horticultural crop [2, 3]. The harvest of grapes can be used in the form of fruit, must, and wine; however, the most important one is winemaking.

Since ancient times, red wines have been more important than white wines. If we look back at any ancient myth, red wine is always mentioned, for example: "God turned water into red wine." Although white and rosé wines are catching up more and more nowadays, a true wine lover still swears by red wine.

Among the crops processed worldwide, including all foods and agricultural products, wine is one of the most important products in the world [4]. Grapes can be cultivated on five continents, between the parallels of 30° and 50°, on both the Northern and Southern hemisphere [5].

The conditions for wine production in Romania are favourable, as the conditions for growing grapes are given, both in terms of climate and soil properties [6, 7]. Two of the most important elements of viticulture are soil and land exposure [8] in addition to the climate factors, for example, temperature and precipitation [9]. Besides this, grapes that come from vines are the raw material for winemaking; from grapes, we can obtain jams, raisins, compotes, juice, concentrated must, etc. [10].

Romania can be divided into eight grape-growing regions, within which there are 37 wine regions [11]. On the territory that our country occupies now, wild vine (*Vitis vinifera* ssp. Sylvestris) dates back to the 7000s BC. From this wild vine derived the varieties that are now cultivated such as Fetească Neagră/Fekete Leányka [12, 13].

Based on data from 2017, the world population's wine consumption is 243 million hL/year, while in Romania this is 4.1 million hL/year. So, it could be said that the greatest significance of growing grapes is the wine culture tour. At the same time, grapes are a landscape element, as well as an aesthetic and mood-influencing factor due to changes in the terrain and cellars. As a culture linked to a place, the wine made from it withstands the climate, soil, location of the area, and even the difference between vintages, the characteristics of that particular year [14]. In addition to all this, grape and winemaking provide a livelihood for countless people, as well as a supplement to earnings. All of the above are true for the world and for Romania.

The world's total vineyard area was 7.5 million ha in 2004 [15]. According to a 2017 survey, wine grapes are grown on approximately 191,000 hectares in Romania, which accounts for 6% of the wine grapes grown in EU countries [16, 17]. The largest grape-growing country in the EU is Spain (941,000 ha), followed by France (803,000 ha), Italy (610,000 ha), and Portugal (199,000 ha). Approximately 77.2 million tons of grapes are produced across the world, while approximately 828 thousand tons are produced in Romania.

In the present experiment, we compared the quantitative and qualitative parameters of Cadarcă/Kadarka, Fetească Neagră/Fekete Léányka (traditional, local varieties) and Cabernet Sauvignon, Merlot (worldwide varieties). The aim was to determine which variety is more appropriate to plant in the newly planted vineyards in terms of climate and natural conditions.

2. Materials and methods

The site of the experiment was provided by the Balla Géza winery located in Păuliş (Ópálos), 26 km from Arad, and the Miniş (Ménes) Viticulture and Winery

Research Institute. The Miniş (Ménes) wine region is located in the western part of Romania, near the city of Arad. The region is known as a good grape-growing region.

Considering the area of the wine region, we encountered a very diverse soil composition. Among the bedrocks, there could be found: granite, crystal slate, mica slate, sandstone, limestone, etc. 70% of the soils are slightly acidic (5.57–6.45 pH), while the remaining 30% are neutral, slightly alkaline (7.05–7.10 pH) [18]. Examining the humus content of the soil, it could be observed that the area has 32% optimal, 40% medium, and 28% low humus, the P content is between 111 and 155 ppm, and the K content is between 67 and 145 ppm.

Based on the metrological measurements of the Miniş (Ménes) research station, it could be mentioned that comparing the 60-year data: the average temperature is 11.2°C, the average amount of precipitation is 626.6 mm, the vegetation period of the grapes is 212.8 days on average, the number of hours of sunshine in these days is 1,955 hours, and the prevailing south and southwest wind has an average speed of 10-12 km/h. The region has an eastern sub-Mediterranean climate, so it is suitable for growing quality grapes.

Observing the topography, it could be determined that the highest area used for grape growing around Păuliş (Ópálos) is located at 150 m above sea level. However, most of the vineyards in the wine region are located at an altitude of 180–300 metres above sea level [19]. The wine region has an excellent geographical location, perfect weather and soil properties for red wines, and a suitable microclimate because of the River Mureş.

The winery has a vineyard of 120 hectares, of which 80% are blue grapes and 20% white grapes. Some of the more important grape varieties appearing in the plantation are: Fetească Neagră (Fekete Leányka), Cadarcă (Kadarka), Burgund Mare (Kékfrankos), Cabernet Sauvignon, Merlot, Cabernet Franc, Fetească Regală (Királyleányka), Mustoasă de Măderat (Mustos Fehér), Riesling, Furmint, and Sauvignon Blanc. In addition to the plantation, the winery has a fully equipped processing plant, where all the necessary equipment for red, white, and rosé wine technology can be found. The winery's storage capacity is around 10,000 hL.

The experiment started in mid-August 2017 by marking the selected vines, and then with the start of the harvest we continued with the examination of the parameters of the grapes.

During our experiment, we made measurements with these four grape varieties: Cadarcă (Kadarka), Fetească Neagră (Fekete Leányka), Cabernet Sauvignon, and Merlot. To examine vine productivity, we also examined the amount harvested from 30 vines for each variety. 3,600 kg of grapes were used to determine the amount of grape must.

3. Examination of grape parameters

Vine productivity

In order to determine vine productivity, we selected 30 vines from each variety, which were marked with a red ribbon, collected the harvest from these vines every year, measured them, and then calculated the average productivity. We removed the grape bunches from the stems with pruning shears and collected them in plastic boxes.

Yield per hectare

All trailers arriving at the winery were weighed using a bridge scale, and we calculated the average yield per hectare from the quantities received from the following vineyards:

Cadarcă/Kadarka – Hotarul Kövi (Kövi dűlő) (6.7 ha),
Fetească Neagră/Fekete Leányka – Hotarul Ghioroc (Gyoroki dűlő) (5.5 ha),
Cabernet Sauvignon – Hotarul Tei (Hársfa dűlő) (10.2 ha),
Merlot – Hotarul Groapa vulpii (Rókagödör dűlő) (4 ha).
Grape must quantity: L/10 kg grapes.

For the experiment, we selected ten, 10-kg samples from the received grape varieties in three repetitions and then separated the amount of juice from the solid part by manual pressing.

Grape must sugar content

The sugar content of the must was measured with a refractometer.

Grape must acidity

To determine the acid content, we titrated with a strong alkaline-measuring solution using a bromothymol blue indicator until the equivalence point (pH 7) was reached.

3. Results and discussions

Vine productivity of the tested grape varieties

From the data, it could be concluded that Merlot reached better results in all three years, the highest vine productivity in the case of Merlot being in the year 2019 (1.97 kg/vine). The lowest vine productivity in 2017 could be observed in the

case of Cadarcă/Kadarka, where the average vine productivity was only 1.52 kg/vine (*Fig. 1*).

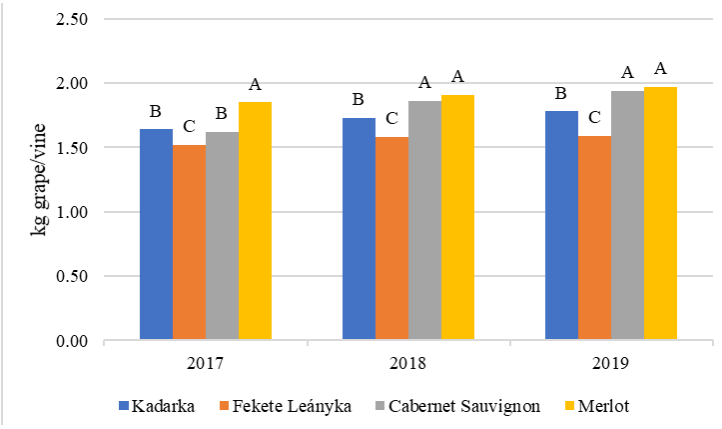

Figure 1. Vine productivity

The hectare-based yield of the examined grapes

It is important to mention that in viticulture technology yield is regulated since the quality of the grapes is prioritized, not the quantity. Under our experimental conditions, the highest yield was determined for the Merlot variety in 2019 with a value of 8.82 t/ha and the lowest for Fetească Neagră/Fekete Léányka in 2017 with a value of 6.81 t/ha (*Fig. 2*).

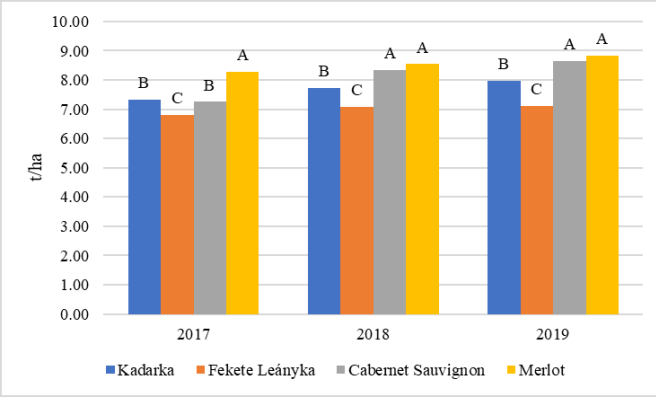

Figure 2. Hectare-based yield

The amount of must obtained from the tested blue grape varieties

In 2017, Fetească Neagră/Fekete Léányka and Merlot yielded equal results: 6.72 L/10 kg of grapes – in the case of Cadarcă/Kadarka, 6.70 L/10 kg of must was obtained from the grapes, and the lowest amount of must was extracted from Cabernet Sauvignon in 2017: 6.54 L/10 kg.

Regarding 2018, the highest amount of must was obtained for Merlot (6.94 L/10 kg of grapes) and Cadarcă/Kadarka (6.93 L/10 kg of grapes), followed by Fetească Neagră/Fekete Léányka with 6.87 L/10 kg of grapes and then by Cabernet Sauvignon with an amount of 6.67 L/10 kg of grapes.

In the last year of the experiment (2019), Cadarcă/Kadarka provided the largest amount of grape must, 7.14 L/10 kg of grapes, while Cabernet Sauvignon provided the lowest amount, of only 6.78 L/10 kg of grapes (*Fig. 3*).

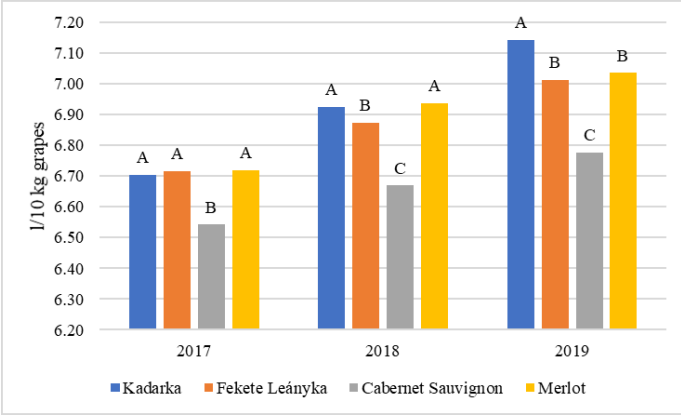

Figure 3. Must quantity

The sugar content of the grape must obtained from the blue grape varieties examined in the experiment

In 2017, Cabernet Sauvignon recorded the highest sugar content at 237.32 g/L, while Cadarcă/Kadarka the lowest at 221.68 g/L, and Fetească Neagră/Fekete Leányka and Merlot produced almost the same amount. Considering 2018, Fetească Neagră/Fekete Leányka and Cabernet Sauvignon obtained similar sugar content (Fetească Neagră/Fekete Leányka 233.92 g/L, Cabernet Sauvignon 232.90 g/L), and the must derivate from Cadarcă/Kadarka had the lowest sugar content: 218.62 g/L. Regarding 2019, the must extracted from all four grape varieties had a slightly lower sugar content compared to previous years: Fetească Neagră/Fekete Leányka 228.48 g/L, Cabernet Sauvignon 223.89 g/L, Merlot 218.45 g/L, and, finally, Cadarcă/Kadarka with 214.88 g/L (*Fig. 4*).

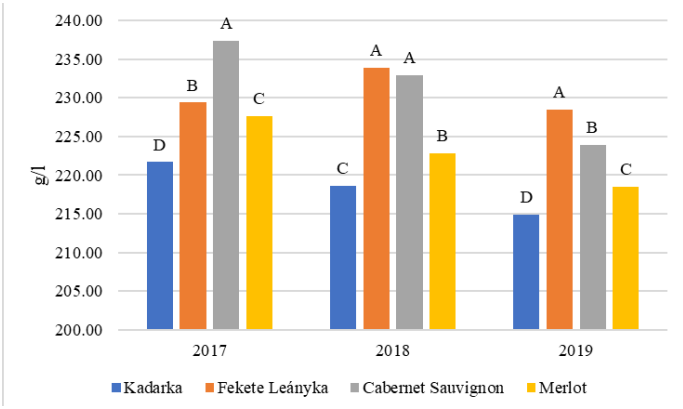

Figure 4. Must sugar content

The acidity of the must extracted from the blue grape varieties examined in the experiment

Under our experimental conditions, we have noticed that in 2017 the highest acid content was determined for Fetească Neagră/Fekete Leányka, 7.25 g/L, and the lowest one for Cadarcă/Kadarka, 6.22 g/L. Cabernet Sauvignon slightly exceeded the acidity of Cadarcă/Kadarka, the result of the measurements being 6.25 g/L, while Merlot showed a value of 6.59 g/L. In 2018, Cabernet Sauvignon produced the highest result with 7.67 g/L, Fetească Neagră/Fekete Leányka had 6.98 g/L, Cadarcă/Kadarka had 6.81 g/L, while Merlot yielded the lowest results, 6.77 g/L. Regarding 2019, the acidity content was as follows: Cabernet Sauvignon 7.37 g/L, Fetească Neagră/Fekete Leányka 7.13 g/L, Merlot 7.11 g/L, and Cadarcă/Kadarka 6.55g/L. The tests proved that the ranking was not the same every year.

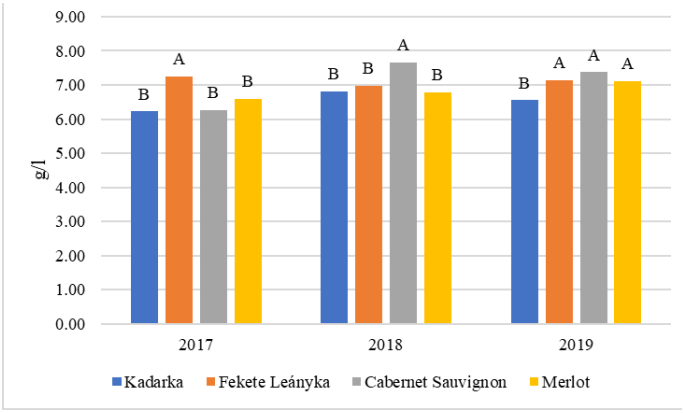

Figure 5. Must acidity

The expected alcohol content of wines made from blue grape varieties tested in the experiment

In this study, the expected alcohol content was the highest for Cabernet Sauvignon, 14.02%, and the lowest for the Cadarcă/Kadarka variety, 13.06%, in the year 2017. As for alcohol content in 2018, the highest score was recorded for the Fetească Neagră/Fekete Leányka (13.80%) and Cabernet Sauvignon (13.75%) varieties, followed by Merlot (13.14%), and the lowest alcohol content was observed for Cadarcă/Kadarka (12.91%). In 2019, our data showed that the highest alcohol content for the Fetească Neagră/Fekete Leányka variety was 13.49% and the lowest for the Cadarcă/Kadarka variety was 12.69% (*Fig. 6*).

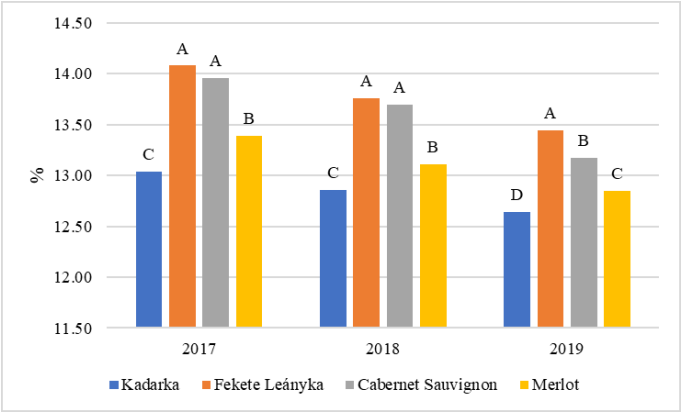

Figure 6. Expected alcohol content

4. Conclusions

From the present study, it could be concluded that in terms of average yield (t/ha), Merlot (2019, 8.82 t/ha) and Cabernet Sauvignon (2019, 8.66 t/ha), whereas in terms of vine productivity Merlot (2019, 1.97 kg/vine) and Cabernet Sauvignon (2019, 1.94 kg/stock) recorded the highest parameters. In the case of must quality parameters, Cabernet Sauvignon had the highest sugar content in 2017 at 237.32 g/L, and in terms of acidity Cabernet Sauvignon (7.64 g/L) yielded the highest result in 2018.

Based on the tests, it is clear that both worldwide-known and traditional varieties are capable of producing good-quality grapes, which is the basis of good-quality wines. In the case of planting new blue grape varieties, we could recommend opting for the traditional Cadarcă/Kadarka and Fetească Neagră/Fekete Leányka, as they are decisive in the history and uniqueness of the wine region.

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