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# The impact of Merlot grapes harvesting time on berry composition

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## Abstract:
The study conducted from 2020 to 2022 aimed to analyze and compare the physical and chemical characteristics of Merlot grapes from three vineyards in western Romania: Miniș, Recaș, and Buziaș. Using comparable vineyard management techniques, twenty-five vines were randomly selected at each site. The research, with a randomised experimental layout, investigated three phases of berry growth, examining changes in berry weight, seed and skin weight, soluble solids, total acidity, tannins, and pH. Results indicated significant physico-chemical changes from veraison to pre-harvest, including increased soluble solids, skin and berry weight, and pH, alongside decreased seed weight and total acidity. These findings highlight the critical role of harvest timing in determining grape quality, influenced by vineyard location and management, and suggest the need for further research to identify the factors contributing to quality compounds in grapes.

## • Introduction

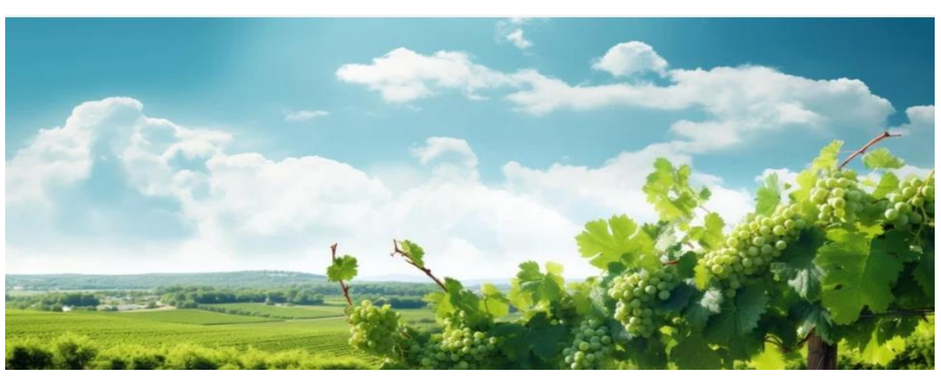
From veraison to harvest, grape ripening includes a range of intricate physiological transformations, with a specific emphasis on the build-up of sugars in the berry. The main process of sugar build-up in berries is the movement of glucose and fructose from the leaves to the berries through the phloem. The sugars are moved from the leaves and stored carbohydrates in the vine to the berry, which raises the overall content of total soluble solids (TSS). Different enzymes, like invertase, are involved in transforming sucrose (brought from the leaves) into glucose and fructose, which build up in the berries. As these enzymes become more active during ripening, it becomes easier for sugar to accumulate. As the berries mature, they experience metabolic transformations, including the decomposition of organic acids (like malic and tartaric acids) and a simultaneous rise in sugars. The aim of this paper is to evaluate the quality components and physical characteristics of Merlot grape berries and clusters during the ripening process in three vineyards from west of Romania: Recaș, Miniș and Buziaș-Silagiu. Specifically, the study focuses on assessing the changes in sugar, titratable acidity (TA), and pH levels in the berries, as well as examining berry weight, and cluster characteristics such as length and weight. Additionally, the study aims to investigate seed weight and its potential influence on grape quality. Through a comprehensive analysis of these parameters, the paper seeks to understand the ripening dynamics of Merlot grapes and provide insights that could contribute to optimizing vineyard management practices for improved grape quality and winemaking outcomes.

## • Material and method

**Experimental location and sampling**

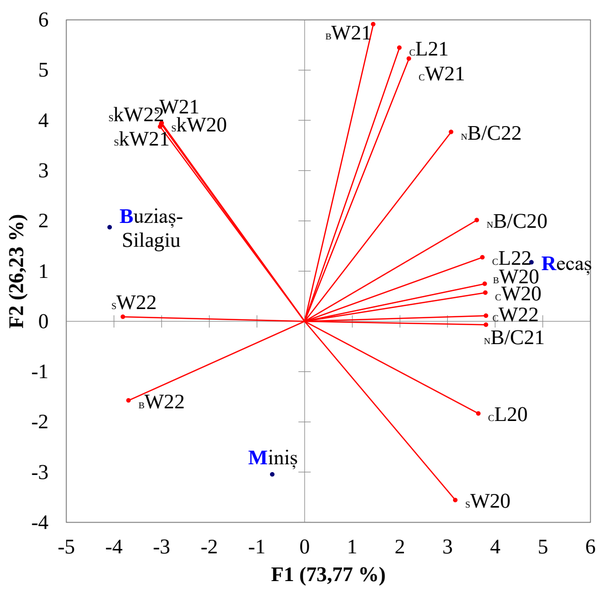
The research took place from 2020 to 2022 in three vineyards located in the western areas of Romania. Recaș is located at 45°48'5.00"N; 21°30'48.00"E, Miniș at 46° 8'6.0678"N; 21°36'16.275"E, and Buziaș-Silagiu at 45°37' 00''N; 21°37' 00''E. The Merlot vines were 9 years old in Miniș, 12 years old in Recaș, and 8 years old in Buziaș –Silagiu. The vines were planted with a spacing of 2 m between rows and 1.2 m within rows, totalling 4,169 vines per hectare. Vines were trained in espalier and pruned using the Guyot method. Random samples were collected from 25 vines in each location with comparable vineyard management techniques. The experimental setup was randomized with three replications for each independent trial. The research assessed the Merlot berries development and the biochemical alterations from veraison to harvest. Four hundred berries were randomly selected from clusters on each vine in every replication. Different sampling dates were used to harvest grapes for basic analyses, including cluster length and weight, berry weight, seed and skin weight, soluble solids, total acidity, and pH.

Sugar level was measured at weekly intervals, beginning at veraison and continuing until final harvest. The berries sugar content was determined with a Hanna Instruments portable digital refractometer, ranging from 0 to 85% Brix (HI96801). Berry samples' pH was assessed using an Automated Titration Equipment and Multi-Parameter Analyzers – MT Series (MANTECH). The identical automated titration system was utilized to measure titratable acidity by titrate 5 mL berry juice sample to a pH endpoint of 8.2 using a 0.1 N NaOH solution. The acidity measured was expressed in terms of tartaric acid equivalents. The weight of each grape cluster was measured using a digital scale (SBS-PW-60/50) to determine grape production.

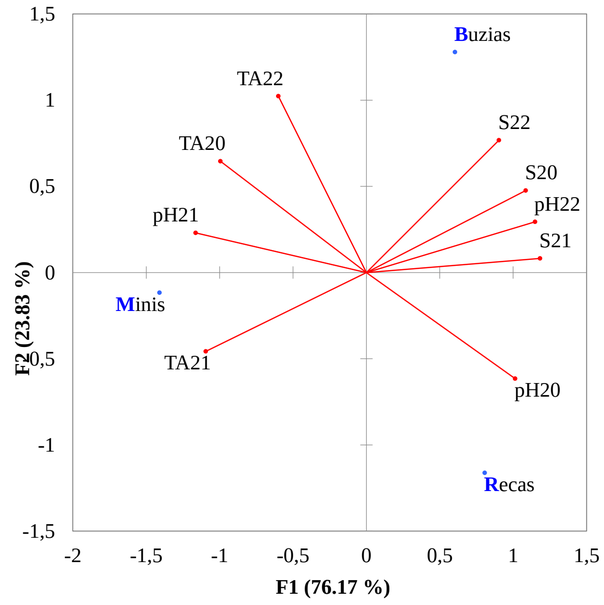


## • Results and discussions

In the Principal Component Analysis (PCA) diagram (Figure 2), PC1 explain 73.77% of variance and PC2 26.23%) representing the two primary dimensions that capture most of the variability in the data among the following variables: cluster length (CL), cluster weight (CW), number of berries in the cluster (NB/C), berry weight (BW), skin weight (SkW), and seeds weight (SW) in the grapes and berries from Recaș, Miniș, and Buziaș vineyards, during the 2020-2022 growing seasons. Among variables, cluster weight had the highest influence on variability of PC1.




1. Principal Component Analysis (PCA) diagram for cluster and berry characteristics in Recaș, Miniș and Buziaș-Silagiu vineyards, during 2020-2022 growing seasons




2. Principal Component Analysis (PCA) diagram for sugars, titratable acidity and pH, in Recaș, Miniș and Buziaș-Silagiu vineyards, during 2020-2022 growing seasons (S – sugar; TA – titratable acidity)

In 2022, the berries were the smallest and lightest compared to other seasons, though cluster length remained notably positive in 2020. This suggests changes in growing conditions or management practices affecting berry development.

In the vineyards of Buziaș-Silagiu, grapes with thicker skins had higher skin weight and larger, heavier seeds, influencing the texture and taste of the grapes and resulting wines.

The PCA diagram effectively highlights the relationships and differences among the three vineyards over three growing seasons, emphasizing the complex interplay between environmental factors, vineyard practices, and grape quality attributes such as cluster traits, berry size, skin thickness, and seed weight.

The first principal component (F1) accounted for 76.17% of the variability in the data, with pH being the most influential factor in driving this variability. The second principal component (F2) explained 23.83% of the variability, with titratable acidity having the highest influence within this component.

The PCA diagram reveals that in Recaș, the highest pH level was observed in 2020 (with rainy May, June and July), while in Miniș, the highest pH was recorded in 2021. This occurred against a backdrop of consistently high titratable acidity across all three years of the study.

## • Conclusions

Identifying the key factors affecting grape juice quality can lead to improved quality control measures and targeted interventions to optimize wine production. Data analysis for data collected from the three vineyards, demonstrates the impact of vineyard location and growing season on the quality components of wine grape juice, showcasing how cluster weight, berry weight, skin weight, and seed weight influence the overall grape quality. PCA allows for the exploration of the relationships between the variables and their interactions across vineyards and seasons. This can lead to a better understanding of the terroir and climate influence on grape juice quality. Strong correlations provide valuable insights into the interactions between different grape and juice characteristics. Understanding these relationships can help in making informed decisions in vineyard management and winemaking practices to optimize the quality of the grape juice and the resulting wine. By understanding the key factors that influence grape juice quality in different vineyards and growing seasons, winemakers and viticulturists can make informed decisions about vineyard management and winemaking practices.