# STUDIES REGARDING THE CONTROL OF THE MAIN QUALITY PARAMETERS OF NEGRU DE DRĂGĂȘANI WINE

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**Abstract**

*In a global landscape where competition is increasingly intense, quality has become an essential standard in all sectors, including the wine industry. This evolution is amplified by the growing expectations of consumers who, endowed with access to a wide range of options and information, are becoming increasingly demanding in their choices. For wine producers, this context imposes not only a struggle to differentiate themselves, but also the need to continuously improve the quality of their products in order to remain relevant and competitive.*

*Negru de Drăgășani is an autochthonous grape variety from Romania, cultivated predominantly in the Drăgășani region in the southwest. This variety was obtained by crossing the Negru Vârtos and Saperavi varieties, thus combining their qualities to produce a wine with unique characteristics. The wines produced from the Negru de Drăgășani variety are valued for their complex aromatic profile and aging potential.*

*This variety produces wines with a rich and complex bouquet. Aromatic notes include black and red fruits such as blackcurrants, blackberries and cherries, complemented by hints of spices, dark chocolate, coffee and vanilla, especially when the wine has been matured in wooden barrels.*

***Key words**: **quality, typicality, red wines technology, Negru de Drăgășani grapes***

## INTRODUCTION

Grape maturity at harvest strongly affects wine quality and, therefore, an adequate strategy of berry selection based on objective quality indicators is a key issue to produce high-quality and premium wines. In red wine technology, phenolic composition, aromatic profile, chromatic characteristics, mechanical properties, reducing sugars content, and acidity contribute most to grape quality (Muntean C., 2012).

Also, climate is a key consideration for winegrowers, so information regarding projected climate change and the relative global impacts are of great interest (Băducă Cîmpeanu C., et al., 2016).

However, intra- and intercluster variability in berry quality can be only solved in the winery. In this case, postharvest strategies are used such as manual sorting tables or automatic selection based on berry density and optical measurements (near-infrared/visible spectrometry) combined with multi- and hyperspectral imaging (Rio Segade S. et al., 2019).

Red grape fermentation is a complex process in which the fermentation of sugars occurs at the same time as skin maceration together with seeds and eventually stems. Fermentation is a biological process produced by yeast, and maceration is a physicochemical process which requires the extraction of anthocyanins and tannins to obtain the color and structure typical of red wine (Muntean C., et al., 2018; Vaquero C. et al.,2022). Control parameters of both processes are different, so it is necessary to optimize the compatible conditions to manage each of them. Temperature, mechanical operations, and aeration are useful to increase extraction and improve the final balance of phenolic compounds. The main drawback of conventional red wine making processes is the requirement to work with solids (skins and seeds). Emerging technologies not only facilitate

the separation of solids with suitable extraction techniques, but at the same time reduce wild microorganisms (Morata A. et al., 2019). Aging in oak barrels is a common practice to improve the wine quality because of its beneficial effects on flavor, aromatic complexity, color stabilization, and astringency modulation. Different phenomena take place during barrel aging (Zamora F.,2019). First, oak wood releases several volatile substances, making the wine aroma more intense and complex. Second, oak wood also releases ellagitannins, which contribute to texture sensations such as astringency and mouthfeel. Third, the moderate diffusion of oxygen through the wood causes different reactions between anthocyanins and proanthocyanidins which stabilize the color and smooth the astringency. Finally, the repose of the wine inside the barrels allows the natural sedimentation of unstable colloidal matter, leaving the wine limpid and stable. All these phenomena depend on several factors including the botanical and geographic origin of the wood, seasoning, the toasting degree, and the number of times the barrel was previously used (Carpena M. et al., 2020).

Recent studies have shown the effect of barrel aging on the wine aroma composition not only depend on the wood specie but also on the geographical origin of the wood. Barrel aging is a common practice in the production of high-quality red wines as it improves wine aroma, colour, flavor and stability (Zhao Feng et al., 2023)

## MATERIALS AND METHODS

The study was designed to explore the combined influence of grape maturity and biotechnological techniques applied in the modern primary vinification process on the characteristics and quality of red wine produced from the Negru de Drăgășani variety, within the Venetic Winery, Drăgășani vineyard, from the 2023 harvest. In this study, two main lines of investigation were considered: the first aimed at identifying the impact that the grape ripening stage has on the quality of wine produced under standardized biotechnological conditions; the second explored how different biotechnological factors contribute to defining wine quality and composition, for the same stage of grape ripening.

The vinification process was carried out in multiple stages, based on the degree of maturity of the grapes: vinification at full maturity (MD), vinification after 5 days of over-ripening (MD5), after 10 days of over-ripening (MD10), and after 15 days of over-ripening (MD15).

Three different approaches were tested in the winemaking process:

1. Clarified and deburred must, addition of sulphur dioxide (SO2) in a quantity of 100 mg/l, fermentation with indigenous yeasts, temperature of 23-26°C.
2. Clarified and deburred must, SO2 - 100 mg/l, using selected yeasts for fermentation, temperature 23-26°C.
3. Clarified and deburred must, SO2 - 100 mg/l, fermentation with selected yeasts and maceration for 48 hours, at the fermentation-maceration temperature of 23-26°C.

The impact of different maturation levels and vinification methods on the wine was evaluated by measurements of alcohol content, acidity (total and volatile), glycerol, total extract and non-reducing extract. The quality ratio based on the glycerol x 100 / alcohol ratio was also calculated, as well as the fermentation ratio and the duration of the alcoholic fermentation (Muntean Camelia, Băducă C., Stoica Felicia, 2001).

## RESULTS AND DISCUSSIONS

As grapes ripen, they undergo a series of complex changes, both physical and biochemical. These changes include variations in size, composition, colour and texture. Monitoring the growth and ripening process of the grapes allowed the determination of the variations of carbohydrates, acidity and the weight of the berries at different stages of ripening, thus facilitating the identification of the moment of full maturity (Table 1).

The year 2023 was marked by an alternation between periods of rain and high temperatures, so that the full maturity of the grapes was reached on September 20. On this date, the grapes recorded a sugar content of 213.8 g/l and an acidity of 6.3 g/l $H_2SO_4$. After this date, the beans were allowed to overripe for another 15 days.

The wines were produced as part of an experiment, initially using grapes at full maturity, followed by three additional stages of winemaking at 5, 10 and 15 days after reaching full maturity. This approach allowed the exploration of different structural profiles of wines obtained from grapes harvested at different time intervals after full maturity.

1. Results regarding the production of Negru de Drăgășani wines, from grapes harvested at different maturation stages, clarified and deburred must, SO2 - 85 mg/l, fermentation with indigenous yeasts, fermentation temperature - 23-26$^0$ C.

In the vinification process of Negru de Drăgășani grapes, without pre-fermentative maceration and using indigenous yeasts for spontaneous fermentation, it was observed how the stages of over-ripening influence the chemical composition of the wines produced. The collected data show significant changes in the profile of the wines from full maturity (MD) to 15 days of over-ripening (SP15). (Table 2).

As the grapes overripe, the following changes were observed in the wines produced:

The alcohol content increased from 11.6% vol. at full maturity to 13.8% vol. after 15 days of over-ripening.

Volatile acidity decreased from 0.65 g/l to 0.48 g/l $H_2SO_4$, reflecting a potential improvement in wine stability and quality.

Glycerol content, an indicator of wine body, increased from 7.80 g/l to 8.40 g/l.

The non-reducing extract, which indicates the wealth of non-volatile compounds in the wine, increased significantly from 18.20 g/l to 20.90 g/l, giving a more complex structure to the wine.

Fermentation time extended from 14 days to 19 days, which could indicate a better extraction of aromas and phenolic compounds from the grapes.

Total acidity decreased from 6.25 g/l to 4.98 g/l, indicating an advanced ripening and a possible sensory improvement of the wine.

Also, under spontaneous fermentation conditions, the residual sugar in the wines varied significantly, from 4.50 g/l after 5 days of over-ripening to 16.00 g/l after 15 days, indicating variations in the ability of indigenous yeasts to complete fermentation.

Fermentation ratios observed between full maturity and 15 days of over-ripening, from 0.34 to 0.27, suggest an altered dynamics of the fermentation process during over-ripening. These changes are essential to understanding the impact of winemaking practices on the final characteristics of the wine.

2. Results regarding the production of Negru de Drăgășani wines, from grapes harvested at different stages of ripening, clarified and deburred must, SO2 sulphitation dose - 85 mg/l, fermentation with yeasts selected from the Impression G.A Rouge range 20g/hl, Fermactive A Complexe nutrient, fermentation temperature - 23-26$^0$ C.

Under the same conditions regarding the processing of the must, the sulfiting dose and the fermentation temperature, but by fermentation with selected LSA yeasts, the characteristics of the wines whose sizes are listed in table 3.

The use of selected yeasts in the winemaking process brings specific advantages in the efficient transformation of the carbohydrates in the must into alcohol, thus contributing to the increase in the alcoholic strength of the wine as the grapes reach different stages of ripening. This alcoholic strength of the yeasts is reflected by the different increases in the percentage of alcohol in the successive stages of maturation: an increase of 3.9% vol. at full maturity (MD), 0.7% vol. after 5 days of over-ripening (SP5), 0.6% vol. after 10 days (SP10) and 0.9% vol. after 15

days (SP15). These variations in alcohol growth at the same initial carbohydrate contents show the increased efficiency of the selected yeasts in metabolizing sugars, even as conditions become less favourable during over-ripening.

In addition to producing alcohol, the activity of these selected yeasts also plays an important role in the generation of glycerol, a compound that contributes to the wine's body and texture.

Higher glycerol contents in wines fermented with selected yeasts - by 1.45 g/l at MD, 1.40 g/l at SP5, 1.45 g/l at SP10, and 1.4 g/l at SP15, compared to those obtained by spontaneous fermentation, underlines once again their efficiency in various fermentation conditions. This consistent increase in glycerol not only improves the wine's sensory properties, but also demonstrates the adaptability of the selected yeasts to operate optimally under different conditions of grape maturity. This specific contribution of selected yeasts adds value to winemaking by optimizing the physical and taste characteristics of the resulting wine.

In this winemaking experiment with selected yeasts (LSA), we observe that total and volatile acidities do not show significant changes during the different stages of over-ripening, suggesting a stability regarding the acid profile of the wine despite the different stages of grape ripening. This constancy may indicate good management of the fermentation process, where controlled conditions limit variations in acid production.

However, a notable aspect of the experiment is the influence of the over-ripening stage on the non-reducing extract of the wines. A consistent increase in the non-reducing extract is found, with 9.0 g/l at 5 days after full maturity (SP5), 8.95 g/l at 10 days (SP10) and 9.9 g/l at 15 days (SP15). These growths indicate an increased concentration of non-volatile compounds in the wine, such as minerals, tannins, pigments and other phenols, which are essential for the structure, colour and taste complexity of the wine. The increase in the non-reducing extract can be attributed to the partial dehydration of the grapes during the overripe phase, which concentrates these valuable compounds.

Another point of interest is the impact of the strong alcoholic potential of LSA on residual sugar. We observe a significant decrease in residual sugar, from 3.15 g/l at full maturity (MD) to 2.5 g/l, and from 16.0 g/l to 3.4 g/l at 15 days of over-ripeness (SP15). This efficiency in fermentation, with better conversion of sugars to alcohol, can be attributed to the robust activity of selected yeasts, which metabolize sugars even under less than ideal conditions, resulting in low residual sugar content. This not only increases the alcohol content, but also contributes to a drier and possibly more pleasant taste profile, reducing the risk of producing an overly sweet or unbalanced wine. These observations emphasize the importance of yeast selection in creating the desired wine characteristics.

3. Results regarding the production of Negru de Drăgășani wine, from grapes harvested at different stages of ripening, clarified and deburred must, SO2 sulphitation dose - 85 mg/l, fermentation with yeasts selected from the range, Impression G.A Rouge 20g/hl, Fermactive A nutrient Complex, fermentation temperature - 23-26$^0$ C, maceration 48 hours. (Table 4).

The implementation of maceration for 48 hours, in combination with the use of selected yeasts, has a significant impact in the winemaking of Negru de Drăgășani grapes, significantly improving the biochemical and biophysical processes that characterize fermentation and maceration. This technique contributes to a more efficient extraction of compounds from the skin and seeds of the grapes, resulting in a noticeable increase in the non-reducing extract in the wines, an indicator of their richness and complexity.

Prolonged maceration allows a better solubilisation of tannins, pigments and other phenols, which not only enrich the structure and colour of the wine, but also influence the aromatic and taste profile. These compounds are crucial for the

wine's long-term stability and its ability to evolve and mature over time.

The enhancement of the non-reducing extract was as follows: an increase of 11.0 g/l at full maturity (MD), 10.15 g/l after 5 days of over-ripening (SP5), 9.05 g/l after 10 days (SP10) and 10.3 g/l after 15 days (SP15). These increases demonstrate the ability of maceration to positively influence extract content throughout the different overripe stages, reflecting improved extractability even as compounds become less accessible.

Slight increases in glycerol content are also observed, which contribute to the 'body' and velvety feel of the wine. Glycerol in relation to alcohol (calculated as glycerol×100/alcohol) indicates an improved quality, suggesting that the wines obtained are more balanced, offering a more pleasant and rounded taste experience.

Thus, the maceration combined with the selected yeasts significantly improves the quality of Negru de Drăgășani wines, increasing not only their extractivity, but also their organoleptic characteristics, which are fundamental in the appreciation and classification of high quality wines.

The results of the vinification experiment of the Negru de Drăgășani variety highlight the clear benefits of over-ripening the grapes for a period of 10-15 days after reaching full maturity. This practice, combined with the use of selected yeasts and maceration techniques, contributes significantly to improving the quality of the final wine.

Over-ripening the grapes allows for an additional accumulation of sugars and a concentration of phenolic compounds such as tannins and anthocyanins due to the natural dehydration of the grape berries. This process not only intensifies the flavour and colour of the wine, but also helps create a more complex structure and richer taste profile.

The use of selected yeasts in this context is essential, as they are adapted to efficiently ferment musts with higher concentrations of sugars, converting them into alcohol and other valuable compounds, such as glycerol, which improve the body and texture of the wine. These yeasts can also better handle the acidity levels and increased osmotic stress that occur in concentrated musts.

Maceration, the process of extracting solid compounds from grape skins and seeds, is enhanced by the overripe state of the grapes, which makes the skins more permeable and the seeds potentially more brittle. This allows a more efficient release of tannins and pigments, which are crucial for the wine's stability and longevity, as well as its sensory complexity.

In conclusion, the over-ripening of grapes, in combination with the use of selected yeasts and the application of maceration techniques, results in the production of wines from the Negru de Drăgășani variety of superior quality, characterized by greater aromatic and structural complexity, ideal for wine lovers with rich and expressive profiles. These biotechnological practices are therefore essential to optimize the phenolic and aromatic potential of the variety.

## CONCLUSIONS

In the winemaking process of the Negru de Drăgășani grape variety, the methodical application of essential biotechnological factors, such as short-duration maceration and the use of selected yeasts, significantly influences the final quality of the wine. These biotechnological methods, in combination with grape overripening, contribute to a positive evolution of wine composition, with notable improvements in terms of alcohol content, glycerol, and non-reducing extract. The use of selected yeasts results in a more efficient fermentation, leading to a higher alcohol content. This effect is amplified by the overripening of the grapes, which increases the availability of sugars for fermentation.

**Table 1. Evolution of the 2023 ripening process of the Negru de Drăgășani grape variety**

| Variety | Characteristics | Calendar dates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 26.08 | 01.09 | 05.09 | 10.09 | 15.09 | 20.09 | 25.09 | 01.10 | 05.10 |
| Negru de Drăgășani | Glucides g/l | 155.4 | 177.2 | 190.5 | 197.3 | 209.4 | **213.8** | 222.5 | 235.0 | 254.0 |
| | Acidity g/l | 8.2 | 7.6 | 7.2 | 6,9 | 6.5 | **6.3** | 6.1 | 5.8 | 5.6 |
| | Weight 100 grains g | 142.2 | 155.5 | 155.4 | 162.5 | 178.2 | **171.4** | 166.2 | 153.0 | 148.5 |

**Table 2. The influence of primary vinification conditions and the stage of grape maturity on the basic chemical composition of Negru de Drăgășani wines - Experiment** 1

| The physico-chemical composition characteristics | Phenophases of grape ripening | | | |
|---|---|---|---|---|
| | MD | SP5 | SP 10 | SP 15 |
| Alcohol %vol. | 11.6 | 13,2 | 13.6 | 13.8 |
| Total acidity g/l $H_2SO_4$ | 6.25 | 5.92 | 5.30 | 4.98 |
| Volatile acidity g/l $H_2SO_4$ | 0.65 | 0.58 | 0.50 | 0,48 |
| Glycerol g/l | 7.80 | 8.00 | 8.25 | 8.40 |
| Total extract g/l | 19.50 | 25.65 | 26.40 | 28.50 |
| Residual sugar g/l | 3.15 | 4.50 | 4.80 | 16.00 |
| Non-reducing extract g/l | 18.20 | 19.20 | 20.35 | 20.90 |
| Ratio: glycerol x 100 / dosed alcohol | 6.72 | 8.06 | 8.60 | 9.00 |
| Fermentation ratio | 0.34 | 0.30 | 0.29 | 0.27 |
| Duration of fermentation - days | 14 | 16 | 17 | 19 |

**Table 3. The influence of the primary vinification conditions, the stage of maturity of the grapes and the selected yeasts on the basic chemical composition of Negru de Drăgășani wines Experiment 2**

| The physico-chemical composition characteristics | Phenophases of grape ripening | | | |
|---|---|---|---|---|
| | MD | SP5 | SP 10 | SP 15 |
| Alcohol %vol. | 13.50 | 13.90 | 14.20 | 14.70 |
| Total acidity g/l $H_2SO_4$ | 6.20 | 5.90 | 5.10 | 4.95 |
| Volatile acidity g/l $H_2SO_4$ | 0.60 | 0.52 | 0.50 | 0,48 |
| Glycerol g/l | 9.25 | 9.40 | 9.65 | 9.80 |
| Total extract g/l | 33.70 | 34.00 | 34.60 | 35.30 |
| Residual sugar g/l | 2.50 | 2.75 | 3.20 | 3.40 |
| Non-reducing extract g/l | 28.10 | 28.20 | 29.30 | 30.80 |
| Ratio: glycerol x 100 / dosed alcohol | 8.60 | 8.75 | 8.80 | 9.10 |
| Fermentation ratio | 0.32 | 0.31 | 0.30 | 0.29 |
| Duration of fermentation - days | 12 | 12 | 13 | 13 |

**Table 4. The influence of the primary vinification conditions, the stage of maturity of the grapes and the selected yeasts on the basic chemical composition of Negru de Drăgășani wines Experiment 3**

| The physico-chemical composition characteristics | Phenophases of grape ripening | | | |
|---|---|---|---|---|
| | MD | SP5 | SP 10 | SP 15 |
| Alcohol %vol. | 13.50 | 13.90 | 14.20 | 14.70 |
| Total acidity g/l $H_2SO_4$ | 6.20 | 5.90 | 5.10 | 4.95 |
| Volatile acidity g/l $H_2SO_4$ | 0.60 | 0.52 | 0.50 | 0,48 |
| Glycerol g/l | 9.27 | 9.42 | 9.66 | 9.81 |
| Total extract g/l | 34.95 | 35.60 | 36.30 | 36.50 |
| Residual sugar g/l | 2.50 | 2.75 | 3.20 | 3.40 |
| Non-reducing extract g/l | 29.20 | 29.35 | 29.40 | 31.20 |
| Ratio: glycerol x 100 / dosed alcohol | 8.60 | 8.77 | 8.80 | 9.10 |
| Fermentation ratio | 0.32 | 0.31 | 0.30 | 0.29 |
| Duration of fermentation - days | 12 | 12 | 13 | 13 |

Thus, as grapes go through the phases of overripening, the sugar content available for conversion into alcohol rises, resulting in a higher alcohol degree.

Glycerol, a secondary alcohol produced during fermentation, contributes to the body and texture of the wine. The longer the over ripening period, the more glycerol is formed, as the selected yeasts are better able to metabolize sugars under high osmotic stress conditions, such as those found in concentrated musts.

The content of non-reducing extract reflects the concentration of soluble organic and mineral substances in the wine, such as tannins, anthocyanins, and minerals.

The over ripening process concentrates these compounds within the grape berries, facilitating deeper extraction during maceration. Consequently, wines produced from over ripened grapes tend to have a richer non-reducing extract, enhancing the wine's complexity, colour, and structure. Through these methods, winemaking under controlled biotechnological conditions-tailored to the specific characteristics of each grape maturation stage-maximizes the potential of the Negru de Drăgășani variety. This yields wines with higher alcohol profiles, improved texture due to increased glycerol content, and superior aromatic and gustatory complexity owing to a richer extract. These outcomes underscore the importance of integrating biotechnological knowledge into winemaking to produce high-quality wines.

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