

Study on the foaming ability of varietal wines produced in the conditions of various terroirs of the Krasnodar region

V I Koshevaya^{1*}, *I V Oseledtseva*¹, *L I Stribizheva*¹, *N U Kachaeva*¹, and *M A Nazarenko*¹

¹Kuban State Technological University, Krasnodar, Russian Federation

Abstract. This study was devoted to the issue of the ability of varietal base wines to form foam and the correlation of this indicator with terroir and the level of concentration of surfactants. The work used samples from the grape varieties Pinot Blanc, Rhein Riesling and Chardonnay, grown and processed in the village of Abrau-Durso and the Temryuk region of the Krasnodar Territory of the Russian Federation. As a result of the study, a correlation was established between the ability to make foam and the composition of the main surfactants. It was found that the samples obtained during the 2023 processing season in the Temryuk region of the Krasnodar Territory of the Russian Federation - Pinot Blanc-2 and Rhein Riesling-2 - had the greatest ability to make foam (22.4 and 22.3 s, respectively).

1 Introduction

The formation of pronounced sparkling and foamy properties of wines saturated with carbon dioxide is one of the main tasks in the implementation of sparkling wine technology. One of the indicators of the finished sparkling wine is the formation of persistent foam and the formation of bubbles in the glass, which in turn depend on the ability of the original wine to foam.

It is known that one of the main indicators of base wines for the production of sparkling wines is the presence of surfactants in the wine. Wine is a complex model containing many types of molecules that can enhance or impair foam formation and stability. A number of studies have confirmed that foam properties are related to the chemical composition of wine [1-3]. Many researchers note the positive influence of such surfactants as proteins, amino acids, phenolic substances and polysaccharides on the quality of the foam formed and the ability of wine materials to form it [2-7].

The purpose of this work was to study the foaming ability of varietal base wines produced in the conditions of various terroirs of the Krasnodar region of the Russian Federation, and to establish the relationship between the level of concentration of amino acids, proteins, phenolic substances and the ability of wine materials to foam.

* Corresponding author: koshevaya.vita@gmail.com

2 Materials and methods

For the study, 6 groups of samples were selected from the grape varieties Pinot Blanc, Rhein Riesling and Chardonnay, grown and processed in 2023 in the village of Abrau-Durso (option 1) and Temryuk district (option 2) of the Krasnodar Territory of the Russian Federation. Processing and fermentation were carried out under identical conditions. For each group of samples, 3 options were used, developed separately; Data are presented based on average values.

The study of the component composition of the samples was carried out according to standard methods using modern equipment.

To determine the foaming ability of the samples, the "Foaming Analyzer" installation was used, developed at the Department of Winemaking and Fermentation Technologies named after. Professor A.A. Merzhanian Kuban State Technological University [8-9]. The method allows you to evaluate the potential of wine for champagne, that is, its ability to be saturated with carbon dioxide, form and retain foam.

The resulting base wines had standard values of physical and chemical parameters for wines sent for secondary fermentation.

3 Results and Discussion

To assess the correlation of foaming ability with the level of concentration of surfactants in base wines, we determined the foaming ability of test samples and analyzed the composition according to the level of concentration of proteins, proline, phenolic substances and polysaccharides. The study took into account only data on the mass concentration of proline, as the main amino acid in wines [10]. This is due to the fact that this amino acid is poorly absorbed by yeast cells during the fermentation process [11]. The results of the study are presented in Table 1.

Table 1. Results of analysis of foaming ability and mass concentration of proteins, proline, phenolic substances and polysaccharides in test samples.

Name of sample groups	Foaming ability, F, s	Mass concentration, mg/dm ³			
		proteins	proline	Phenolic substances	polysaccharides
Pinot Blanc-1	15.2	19.0	380.2	176.4	500.0
Pinot Blanc-2	22.4	42.0	705.0	170.2	650.0
Chardonnay-1	15.5	22.0	396.0	154.4	550.0
Chardonnay-2	16.5	54.0	1831.0	156.2	568.0
Rhein Riesling-1	17.4	26.0	555.7	159.8	855.0
Rhein Riesling-2	22.3	41.0	644.1	165.0	800.0

It was experimentally established that the value of the foaming ability index (F) in the test samples varied from 15.2 to 22.4 s. The study revealed a correlation between the value of foaming ability and the Chardonnay grape variety (15.2 and 16.5 s) despite the fact that the grapes were grown and processed in two different terroirs of the Krasnodar region. There was no correlation between the Pinot Blanc and Rhein Riesling grape varieties. However, it is worth noting that in samples from the Pinot Blanc and Rhein Riesling varieties, a higher level of foaming ability was observed in wines from the Temryuk region of the Krasnodar Territory.

It was found that the highest level of concentration of proteins and proline is characteristic of the group of Chardonnay-2 samples (54.0 mg/dm³ and 1831.0 mg/dm³, respectively), while the group of Chardonnay-1 samples had a lower indicator (22.0 and

396.0 mg/dm³, respectively). It should be noted that the difference in the value of foaming ability in these groups of samples differed slightly (16.5 and 15.5 s). It is also worth noting that the lowest values of mass concentrations of proteins and proline were found in the group of Pinot Blanc-1 samples (19.0 and 380.2 mg/dm³). At the same time, this sample had the lowest value of the foam-forming ability indicator - 15.2 s.

When analyzing experimental data on phenolic substances and polysaccharides, a characteristic correlation with the variety was revealed. The highest level of phenolic substances was found in the pair of Pinot Blanc 1 and 2 – 176.4 and 170.2 mg/dm³, respectively; the maximum level of polysaccharides was recorded in the pair Riesling Rhine 1 and 2 (855.0 and 800.0 mg/dm³, respectively).

The experimental data obtained indicate that the accumulation of surfactants is certainly influenced not only by the grape variety (clone), but also by the terroir and cultivation conditions and agricultural technology.

In order to establish a correlation between the value of foaming ability and the quantitative composition of surfactants in base wines, experimental data were systematized and analyzed separately for each group of components (Figures 1-4).

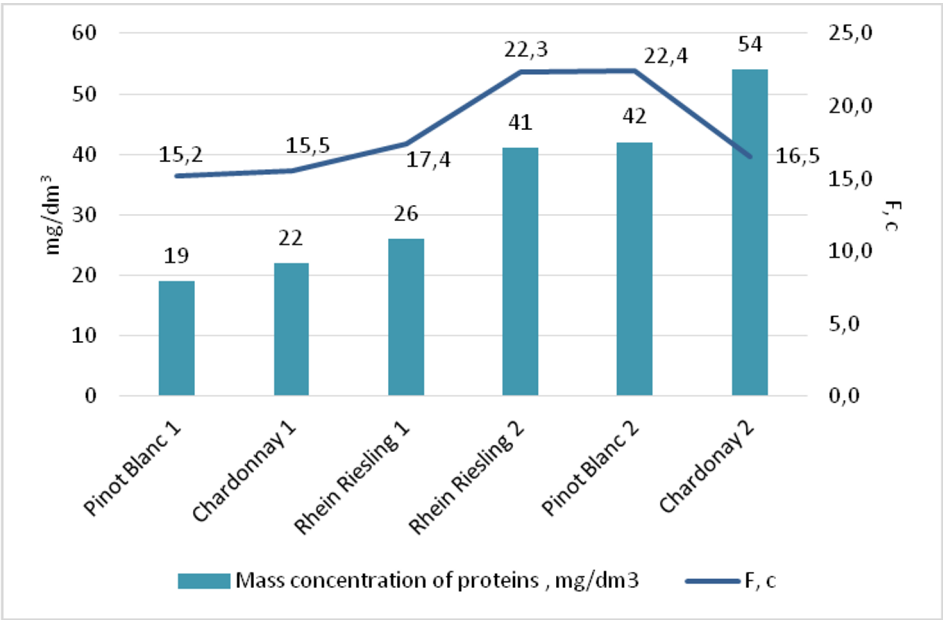


Fig. 1. Correlation between the value of the foaming ability parameter (F, c) and the mass concentration of proteins, mg/dm³.

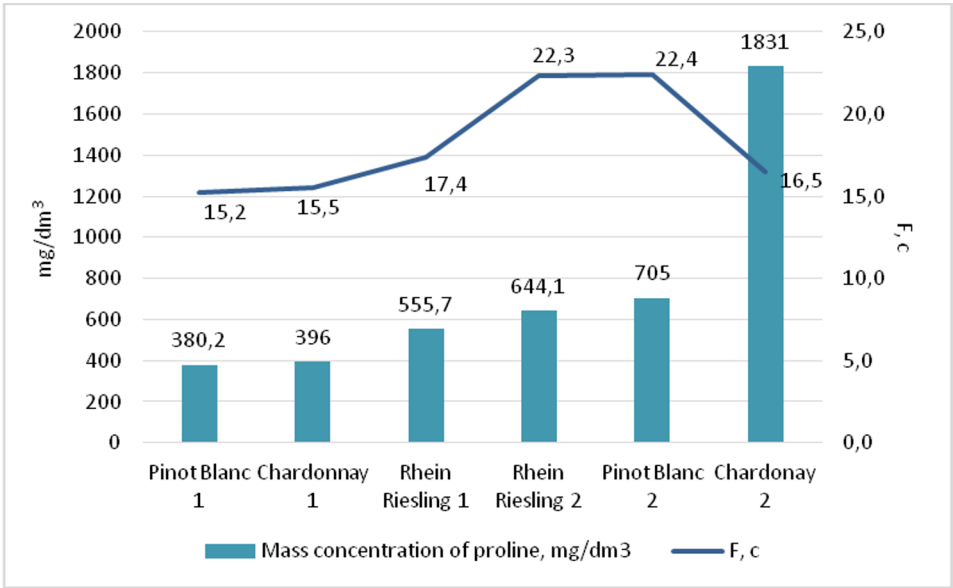


Fig. 2. Correlation between the value of the foaming ability parameter (F, c) and the mass concentration of proline, mg/dm³.

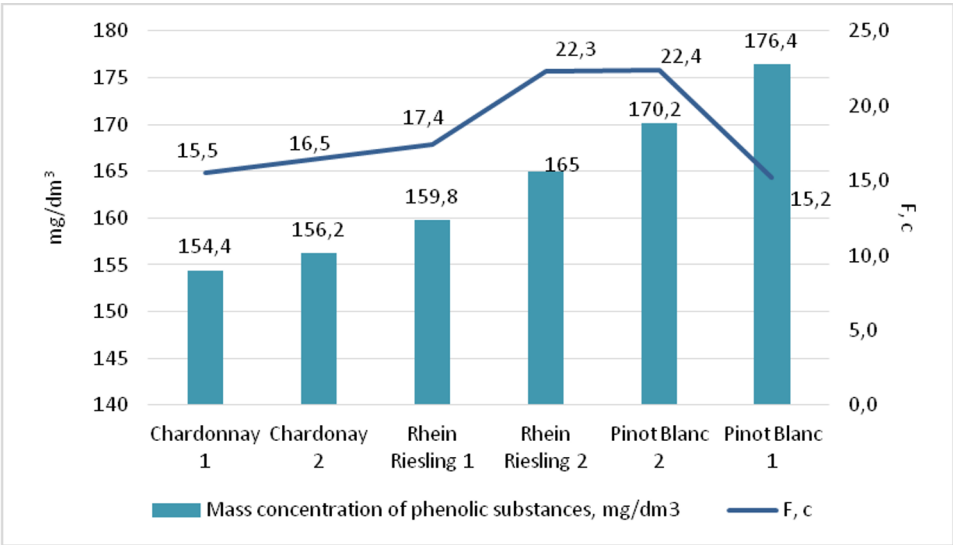


Fig. 3. Correlation between the value of the foaming ability parameter (F, c) and the mass concentration of phenolic substances, mg/dm³.

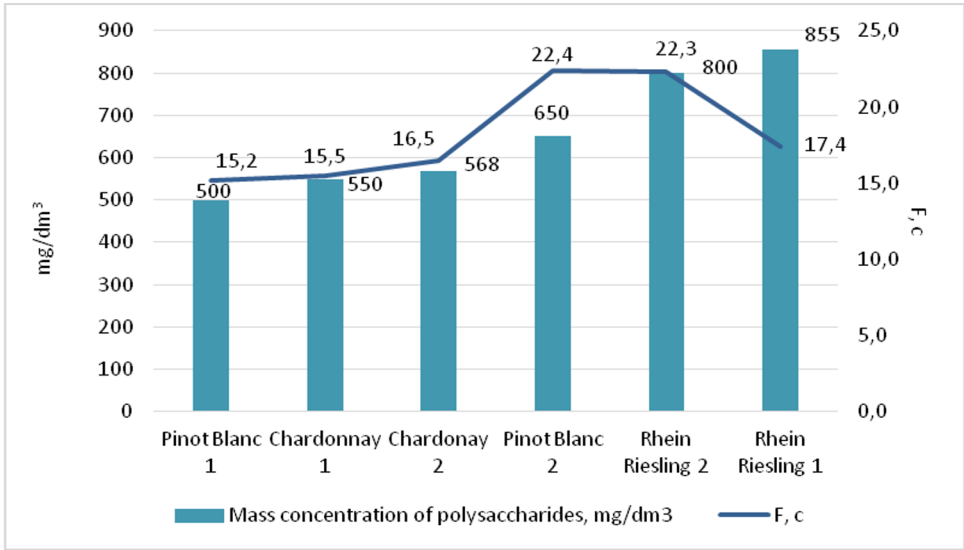


Fig. 4. Correlation between the value of the foaming ability parameter (F, c) and the mass concentration of polysaccharides, mg/dm³.

An obvious correlation between the mass concentration of surfactants and the variety was detected only for wines from the Chardonnay variety (with the exception of data on proline).

It should be noted that the foaming potential of experimental wine samples as a direct correlation with the level of surfactants is not absolutely linear, but changes when a certain concentration of surfactants is reached. At the same time, the dependences on the concentration of proteins, proline and phenolic substances are most pronounced - in the range:

- From 19.0 to 42.0 mg/dm³ for proteins.
- From 380.2 to 705.0 mg/dm³ for proline.
- From 154.4 to 170.2 mg/dm³ for phenolic substances.

With a subsequent increase in the concentration level of these surfactants, a decrease in the ability of base wines to foam was established.

When analyzing the dynamics of changes in foaming ability depending on the mass concentration of polysaccharides, an almost similar dependence was established.

4 Conclusion

Thus, according to the data obtained, in the 2023 grape processing season, base wines from Pinot Blanc, Chardonnay and Rhine Riesling varieties grown in the Krasnodar region of the Russian Federation were characterized by a generally high foaming potential. This allows the use of these varieties in the production of high-quality sparkling wines without the use of additives that stimulate foaming properties. The samples obtained in the Temryuk region of the Krasnodar Territory had the greatest ability to foam. From said varieties, the samples of the Pinot Blanc-2 and Rhein Riesling-2 group had the greatest potential for foam formation - 22.4 and 22.3 s. respectively.

Wine samples from the village of Abrau-Durso were characterized by a lower foaming ability, which may be due to a lower level of surfactants. This in turn may be due to the characteristics of the terroir and the clones used.

Thus, the foaming ability indicator is a mandatory parameter for monitoring base wines used in the production of sparkling wines. Moreover, its value can vary significantly depending on various factors (grape variety, terroir, agrotechnological methods and harvest year).

When forming assemblages, it is advisable to annually pre-assess the level of foaming ability of wines. According to the data obtained in the Krasnodar region of the Russian Federation, when forming assemblages, it is advisable to use base wines from the Pinot Blanc and Rhein Riesling varieties.

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