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Ways of Must Treatment and its Effect on the Wine Quality

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Abstract

The aim of our work was to evaluate the effect of different methods of must clarification on the wine quality of variety Pinot Gris, compared traditional and modern technologies. Clarification of must is important operation performed in winemaking, which can have a major impact on the future quality of the wine. It removes components that may negatively affect hygienic and sensory quality of the wine. Four variants of wine were prepared by different treatments of must: variant 1 : spontaneous fermentation without the addition of yeast, no clarification; variant 2 : must with static decanting for 12 hours, without adding clarifying preparations, with the addition of wine yeasts; variant 3: must clarified by the clarification preparation at a dose of 100 g. 100 l^{-1} of must, representing the maximum dose of the clarification preparation. The preparation was applied directly to the must. Yeasts were applied to the clarified must after the must turbidity. Variant 4: must clarified by the clarification preparation at a dose of 30 g. 100 l^{-1} must, with the addition of yeasts. Clarification consisted of preparation of highly pure cellulose, polyvinylpolypyrrolidone, gelatin and mineral adsorbents.

Basic chemical assessment of acid, alcohol and residual sugar contents were assessed in produced variants of wines and statistical testing was performed (Multifactor Analysis of Variance). Then overall sensory quality of wines was evaluated (100 - points system, and semantic differential) and the aromatic profile (profile method). Based on acquired results we compared which of the used technologies the most significantly affect observed parameters. Content of acids in wine variants ranged from 6.4 g.l-1 to 7.5 g.l-1. The highest acidity was found in the first variant (7.5 g. l-1), while the lowest acidity was found at the third variant. Acidity (6.7 g.l-1) was detected almost the same in the second and the fourth variant. The acid contents at all samples were detected in the optimal amounts. Statistical testing by the Tukey HSD test showed that two homogeneous groups were formed, statistically differed only the first variant. Alcohol content ranged from 11.8 % to 12.1 %. Variant 1 contained 11.83 % alcohol and the same alcohol content was detected at second variant. The third variant was the lowest and the highest alcohol content was observed at the fourth variant (12.1%). Residual sugar of wines ranged from 8.5 to 17.4 g.l-1. At the first variant residual sugar was determined 11.77 g.l-1, so we can classify this wine as a semi-dry. The second variant contained 11.27 g.l-1 , so it can be classified as a semi-dry wine as well. By statistical testing by the Tukey HSD test, 3 homogeneous groups were formed, statistically insignificant were the first and the second variants. At the third variant the content of residual sugar was the highest, so the wine is semi-sweet. Residual sugar was found to be the lowest at the fourth variant (8.5 g.l-1), so the wine is in the term of acidity dry.

As top scored wine in sensory evaluation was the fourth variant, where the technology used at must clarification was with minimal dose of clarification preparation and using yeasts (85 points) and followed the third variant with 82.8 points. The worst evaluated was (79.8 point) the first variant - spontaneous fermentation without clarification. Beneficial effect of clarification on the wine preparation based on cellulose, polyvinylpolypyrrolidone, gelatin and mineral adsorbents the minimum dose was confirmed at using of clarification preparation in must treatment.

Keywords: must, wine, acid content, clarification, sensory evaluation, aroma profile

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Introduction

Wine is a natural product resulting from a number of biochemical reactions, which begin during ripening of the grapes and continue during harvesting, throughout the alcoholic fermentation, clarification and after bottling (**Torija et al., 2001**). Clarification belongs to the basic operations to obtain pure must without causing side effects in taste and smell. Must from the pressing contains undesirable substances, such as grain, husk, flesh, soil dust particles, pesticide residues and others. Various substances have been used to clarify wines for many years, and many authors reported that pesticide residues can be adsorbed and removed by fining agents (**Ruediger et al., 2004 and Fernandez et al., 2005**). These undesirable substances should be removed in any case before the start of the fermentation process to avoid its adverse effects (**Steidl, 2010**).

Porubský (2012) states on three ways of must clarification. By application of sulfur dioxide will be removed foreign particles in the wine and wild yeasts. We can also use clarifiers enzymes, at disrupting of pectin in must and particle deposition on the bottom of the container is quicker. Another way is to use a clarifiers substances (wine bentonites) that removes proteins and improves the clafication. Wine bentonites affect the fermentation, there is also strong foaming during fermentation.

Under the term of "wine", there is a diversity of quality which is quite unique among the products and determined mainly by interaction between grapes, yeasts and technology. Modern wine makers prefer to employ selected yeast strain for certain advantageous and particular characteristics so as to ensure a reproducible product, reduce the risk of wine spoilage and allow a more predictable control of fermentation and quality (**Romano et al., 2003**).

The colour and limpidity are the first sensory attributes of wines that are appreciate by consumers, predisposing their acceptance or rejection (**González-Nevesa, 2014**) Sensory analysis involves the application of human senses to the description and/or evaluation of a product for consumer use. Rigorous sensory analysis involves a panel of assessors that have been trained for a specific evaluation. For example, the determination of descriptors to characterise a wine style or to assess the impact of a processing step on the wine style is now a routine practice. (**Blackman, 2009**).

The aim of this work was to monitor the impact of modern technology on the final product compared to traditional technology. To determine which technology used (clarification, yeast addition) mostly affect the composition and aroma profile of produced wines.

Material and methods

The grapes for the production of test samples originated from Nitra wine- growing region of Radošinské vineyard turf from year 2012. At time of harvest in the grape was determined the sugar content 21 ° NM, pH was 3.27. Grape was harvested on 14. 09. 2012.

After harvesting the grapes were pressed and got rid of stems. Obtained must was divided into four equal homogeneous parts, of which were prepared own experimental samples. Four variants were prepared by different treatments of must: variant 1 : spontaneous fermentation without the addition of yeast, no clarification; variant 2 : must with static decanting for 12 hours, without adding clarifying preparations, with the addition of active dry wine yeasts; variant 3: must clarified by the clarification preparation at a dose of 100 g. 100 l^{-1} of must, representing the maximum dose of the clarification preparation. The preparation was applied directly to the must. Yeasts were applied to the clarified must after the must turbidity. Variant 4: must clarified by the clarification preparation at a dose of 30 g. 100 l^{-1} must, with the addition of yeasts. Clarification consisted of preparation of highly pure cellulose, polyvinylpolypyrrolidone, gelatin and mineral adsorbents.

The process of fermentation was performed at a standard temperature of 15 °C for 14 days. After the fermentation completion the wine was added and subsequently clarified with bentonite. After clarification was coiled up, filtered, and after thorough preparation to be bottled.

Methods

Basic chemical assessment of acid, alcohol and residual sugar contents were determined in produced variants of wines according to the International Methods of Analysis of Wines and Musts (2010). Results were tested by the Multifactor Analysis of Variance (software STATISTICA 10Cz) and subsequent the Tukey HSD test was used. In case of alcohol content the LSD test was performed.

Produced wines were then evaluated by selected sensory methods - 100-point rating system, profile and semantic differential method. The 100 point rating system assesses the appearance of wine (max. 15 points), smell (max. 30 points), taste of wine (max. 44 points) and overall impression of wine (max. 11 points).

Profile method is a special quantitative method of descriptive evaluation. It is characterized by the fact that each sample must be from a large number of descriptors defined ones that best match a given sample. Profile method results are the product of intensity scales, which are compiled either for a variety of descriptors or for individual characters.

Semantic differential is widely used technique for treatment of certain stimuli. In this method, in most cases are selected 3 factors: rating scale good - bad, activity on a scale active - passive and robustness on scale strong - weak **(Suzuki et al., 2005)**.

RESULTS AND DISCUSSION

By legislation (**Council Regulation 491/2009)** grape must shall be the liquid product obtained naturally or by physical processes from fresh grapes. An actual alcoholic strength of the grape must of not more than 1 % volume is permissible. Wine shall be the product obtained exclusively from the total or partial alcoholic fermentation of fresh grapes, whether or not crushed, or of grape must.

Clarification of must is important operation performed in winemaking, which can have a major impact on the future quality of the wine. It removes components that may negatively affect hygienic and sensory quality of the wine **(Vietoris et al., 2014).** Quality evaluation of wine is primarily based on wine tasting. Chemical analyses are however performed in addition in order to explain some sensory changes observed. The relationship between sensory evaluation and chemical composition of wine is a critical subject of research in oenology (**Chira, 2011**)

Firstly observed were three basic chemical parameters of wines (Fig.1-3) affected by the influence of different treatments of must. Content of acids in wine variants ranged from 6.4 g.l^{-1} to 7.5 g.l^{-1}. The highest acidity was found in the first variant (7.5 g. l^{-1}), while the lowest acidity was found at the third variant with the highest preparation dose used. Acidity (6.7 g.l^{-1}) was detected almost the same in the second and the fourth variant. The acid contents at all samples were detected in the optimal amounts. Statistical testing by the Tukey HSD test showed that two homogeneous groups were formed, statistically differed only the first variant (Table 1).

Table 1 The mean content of acids and homogenous groups based on Tukey's HSD test

Tukey HSD test; alfa = 0.01000			
Variant	Mean	1	2
3	6.366667	****	
4	6.666667	****	
2	6.733333	****	
1	7.500000		****

Alcohol content (Fig. 1) of wines ranged from 11.8 % to 12.1 %. Variant 1 contained 11.83 % alcohol and the same alcohol content was detected at second variant. The third variant was the lowest and the highest alcohol content was observed at the fourth variant (12.1%). Only one homogenous group was formed among all observed samples (not shown).

Fig. 1 Alcohol content (%) of wines

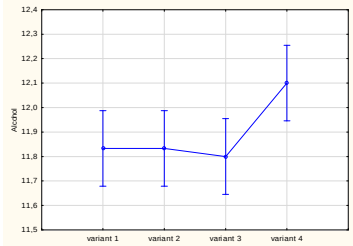
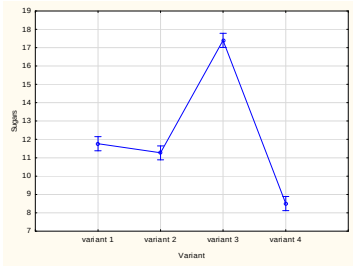


Fig. 2 Acid content (g.l^{-1}) of wines

Fig. 3 Residual sugar content (g.l^{-1}) of wines



Vertical columns represent 95% confidence intervals for mean

Residual sugar of wines ranged from 8.5 to 17.4 g.l^{-1}. At the first variant residual sugar was determined 11.77 g.l^{-1}, so we can classify this wine as a semi-dry. The second variant contained 11.27 g.l^{-1} , so it can be classified as a semi-dry wine as well. By statistical testing by the Tukey HSD test, 3 homogeneous groups were formed, statistically insignificant were the first and the second variants which were found to be at the same homogenoeus groups (table 2). At the third variant the content of residual sugar was the highest, so the wine is semi-sweet. Residual sugar was found to be the lowest at the fourth variant (8.5 g.l^{-1}), so the wine is in the term of acidity dry.

Table 2 The mean content of residual sugars and homogenous groups based on Tukey's HSD test

Tukey HSD test, alfa = 0.01000				
Variant	Mean	1	2	3
4	8.50000		****	
2	11.26667	****		
1	11.76667	****		
3	17.40000			****

Sensory evaluation was performed in properties such as appearance, evaluators observed the clarity and color of the samples, the intensity of its aroma, softness, smell and its intensity, grade, quality of taste and persistence. Results of sensory evaluation of samples were obtained by one hundred point wine rating system. As top scored wine in sensory evaluation was the fourth variant, where the technology used at must clarification was with minimal dose of clarification preparation and using yeasts (85 points) and followed the third variant with 82.8 points. The worst evaluated was (79.8 point) the first variant - spontaneous fermentation without clarification. Beneficial effect of clarification on the wine preparation based on cellulose, polyvinylpolypyrrolidone, gelatin and mineral adsorbents the minimum dose was confirmed at using of clarification preparation in must treatment.

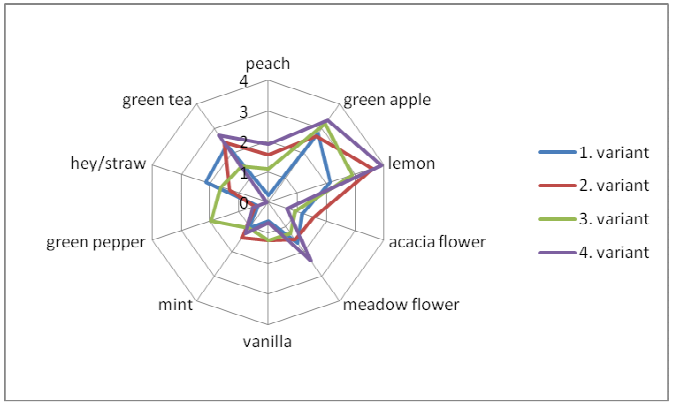
Based on results with variants of Sauvignon (Vietoris et al., 2014) sensory evaluators appreciated production technology at sample C, in which the maximum dose used was in the clarification preparation in must and must was subsequently yeasted with pure culture yeast of *Saccharomyces cerevisiae*. The second best sample was Savignon with the minimum dose of fining agents which is comparable to our variant. Fining agents, which are all adsorptive compounds, commonly used in winemaking are grouped according to their general nature; arths (montmorillonite, bentonite, kaolin), animal proteins (gelatin, isinglass, caseins), wood charcoal (carbons) and synthetic polymers (polyvinyl polypyrrolidone – PVPP) (**Sen et al. 2012**).

Table 3 Results of sensory evaluation of samples obtained by one hundred point wine rating system

Pinot Gris	**1. variant**	**2. variant**	**3. variant**	**4. variant**
Rating	79.8	80.8	82.8	85.0

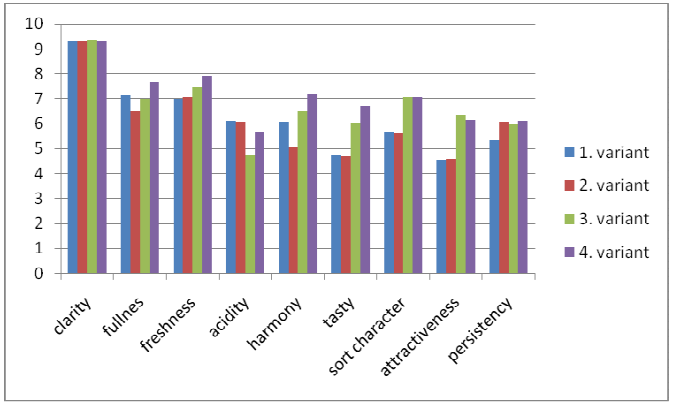
For the evaluation of the profile method we used descriptors of smell typical for the variety Pinot Gris. Peach flavor was the most significantly detected in the fourth variant, and least in the first variant. Green apple was in all variants almost in balance, but also the highest value achieved the fourth variant. Lemon / lime flavor was found to be the most significant again at the fourth variant and the least in the first variant. Acacia flowers were found to be the lowest in the fourth variant, meadow flowers were significant also at the 4.th variant and least in the third variant, vanilla was observed in the 2nd and 3rd variant (Fig. 4).

Fig. 4 The sensory profile of four wine variations



Semantic differential (Fig. 5) showed that clarity is in all varieties almost the same and wines were identified as sparkly. Freshness was evaluated as the highest at the 4.th variant. Wines are accordingly acidic. Other variants were not very different. Harmony is the lowest for the second variant, contrary the 4th variant is the most harmonious. The highest palatability was characterized by the 4.th variant. The least attractive were the 1st and the 2nd variants prepared with older traditional technologies. The most attractive is the third variant, which is followed by the fourth variant, so we can state that modern technology positively affected several important properties of wnes..

Fig. 5 Semantic differential of wine variations



Conclusion

Technology used significantly affected chemical and sensory properties of wines. The most affected was the content or residual sugar. At acid content all the wines were in the optimal range. In sensory evaluation as the best were evaluated variants produced by modern technology. The worst evaluated was the first variant - spontaneous fermentation without clarification.

Beneficial effect of clarification on the wine preparation based on cellulose, polyvinylpolypyrrolidone, gelatin and mineral adsorbents the minimum dose was confirmed at using of clarification preparation in must treatment.

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