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PHYSICOCHEMICAL STUDY OF RED AND WHITE WINE PROPERTIES

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Abstract: *Wine is one of the most popular alcoholic beverages. Tasting in moderation has beneficial actions on our body. The quality of the wine has been and continues to be a topic of high relevance, which is absolutely justified, since wine consumption is part of life, and the wine is drunk only if it satisfies the consumers' exigencies and preferences. The aim of this paper is to verify qualitatively through physical-chemical analysis the quality of two types of wine obtained by classic wine-making methods.*

Key words: *wine quality, alcoholic content, pH,* SO_2

1. Introduction

Wine is a complex mixture of different chemical compounds that are responsible for its color, flavor, bitterness or sourness, aroma, and a positive impact on human health [12].

Wine quality (nutritional and sensory) is affected by multiple factors like growing conditions and vinification conditions during winemaking, such as fermentation temperature, yeast strain and application form i.e. immobilization, processing enzymes and alcohol concentration [5].

The conversion of grape must to wine is a complex biochemical process involving interactions between yeasts and bacteria. It is essential to understand the composition and behavior of these microorganisms during fermentation in order to expand our understanding of fermentation problems, to improve fermentation control and to obtain final products with the desired organoleptic characteristics [11].

Today, most wine is produced using selected commercial strains of Saccharomyces sp and even small wineries select yeasts from their own environment for use as starter cultures [8].

Inoculation with this yeast has been recommended to improve wine complexity, decrease volatile acidity and acetaldehyde content, or increase dried fruit and pastry aromas [4]. Red wine-making differs from white wine-making in certain aspects that may affect the growth of yeast during must fermentation and thereby its effect on wine quality. Oxygen availability is greater in red than in white wines because the cap of skins is frequently punched down into the must [2].

The amount of initial wild microorganisms is also usually greater in red than in white wine fermentation. This is because red, but not white, wine is made in the presence of grape skins to which many bacteria remain bound, and these bacteria may promote malolactic

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fermentation. Another factor is that the presence of these grape skins results in extra nutrient availability in the must, and this may improve the yeast fermentation capacity [10].

2. Materials and Method

2.1. Vinification Process

Two different grape must varieties were used, one white and one red, Fetească Regală and Pinot Noir respectively. Both varieties were cultivated in the vineyard of the Dealu Mare, Romania region, from the 2015 vintage.

Both types of grapes were first removed from the bunch and crushed with a crusher destemmer (Enoventa Tecnologie Enologiche, Italy).

After that, the white variety was processed immediately and the red variety was left 4 days for maceration.

The next step was pressing the must and solid particles with a hydraulic press machine (LU.C.M.E. Elettromeccanica, Italy). The must fermentation was initiated by adding 0, 2 g/l yeast Saccharomyces cerevisiae Viniferm Passion. This type of yeast is used for white and red wine, for high production of aromatic compounds based on esters giving notes of compote, syrup and floral. The must fermentation was carried out at 19 ºC for 15 days. After wine fermentation, the wine supernatant was decanted and allowed to mature at 4 ºC for three months. The samples were analyzed at each stage of the production (must and wine after fermentation). Fermentations were considered to be finished when the level of reducing sugars was below 2 g/L and must density was below 1000 g/L. Sugar consumption was monitored every second day by measuring the density (g/L) of the fermenting must.

2.2. pH, Density, Total Soluble Solids, Titratable Acidity, Tartaric Acid

The pH was measured with a potentiometer (Consort C1010, Consort, Belgium). The potential difference between a glass electrode and a reference electrode (calomel - saturated KCl) introduced into the sample to be analyzed varies linearly with the pH probe.

The density (g/L) was measured with a density meter standardized at 20ºC.

The determination of density by the isometric method is based on Archimedes' law, according to which a body submerged into a liquid is pushed from the bottom up with a force proportional with the displaced volume of liquid mass. It has been observed that a body introduced into a liquid sinks more or less as the fluid density is lower or higher. Liquid density varies depending on the concentration of dissolved substances and temperature.

A soluble solid (º Brix) was determined using a refractometer (Brix/ ATC FG-113, Hangzhou Chinchan Trading Co., China).

Titratable acidity was performed on aliquots of 10 ml placed into a 250 ml beaker and titration with standardized 0.1N NaOH (Sigma-Aldrich, Dublin, Ireland) until the wine color was is changed. With a pipette, on a porcelain plate for titration, a drop of wine was removed and mixed with two drops of red phenol indicator. The titration is continued drop wise, after each addition of the hydroxide solution, until the indicator turns in pink-orange for white wine or pink for colored wines. The results are expressed as g of tartaric acid/L. Titratable acidity was calculated as follows:

$$A_T = \frac{V \cdot 0{,}0075 \cdot 1000}{10} = 0{,}75 \cdot V$$

Tartaric acid was obtained following a colorimetric sequential technique (HI83748, Hanna Instruments).

2.3. Free and Total Sulphur Dioxide Analysis

Free and total sulphur dioxide was obtained using colorimetric equipment (HI84500, Hanna Instruments).

This equipment determines the total and free SO_2 concentration of wine using the Ripper method. During this procedure, an excess of iodine is added to the wine sample and then titrated with iodine. HI 84500 uses an ORP electrode to monitor redox titration. The integrated algorithm detects when the reaction is complete (the equivalence point). The volume of titration required reaching the equivalence point; the titration concentration and the sample quantity are used to calculate the sulfur dioxide concentration of the wine sample.

2.4. Total Phenol Measurement

The total phenol was measured with an optical system of Hanna's HI 83000 series colorimeters. Photometric chemical analysis is based on the possibility to develop an absorbing compound from a specific chemical reaction between sample and reagents. Given that the absorption of a compound strictly depends on the wavelength of the incident light, a nanow spectral bandwidth should be selected as well as a proper central wavelength to optimize measurements. The optical system of Hanna's HI 83000 series colorimeters is based on special subminiature tungsten lamps and norrow-band interference filters to guarantee both high performance and reliable results.

The measurement process is carried out in two phases: first the meter is zeroed and then the actual measurement is performed.

The vat has a very important role because it is an optical element and thus requires particular attention. It is important that both the measurement and the calibration (zeroing) vat are optically identical to provide the same measurement conditions.

2.5. Determination of Alcoholic Content

The alcoholic content was measured with an electronic ebulliometer (Electronic Ebulliometer, Bulgary). The method is based on the boiling point of the wine, which is between the boiling point of water (100°C) and that of ethyl alcohol (78.4°C), the wine being a hydro alcoholic mixture. A classification of wines according to their alcoholic concentration is highlighted in Fig. 2 [13].

3. Results and Discussions

3.1. Evolution of pH, Density, Total Soluble Solids, Titratable Acidity, Tartaric Acid

The must fermentations of Fetească Regală and Pinot Noir were finished successfully in 15 days (Fig. 1). The initial pH value of the must obtained from white grapes (Fetească Regală) was 3.63 and after the fermentation process it was 3.46.

The initial pH value of the must obtained from red grapes (Pinot Noir) was 3.54 and after the fermentation process it reached 3.36. Following the fermentation process, the pH values for both varieties decreased. The initial Fetească Regală must variety had a density of 1104 g/L and after the must fermentation the density decreased to 998 g/L and the Pinot Noir must variety had the initial density of 1100 g/L and after the must fermentation the density decreased to 997 g/L. The soluble solids value changed radically before and after fermentation because a great sugar quantity had been turned into alcohol concentration.

The must values of soluble solids were 22.1 º Brix (210 g/L sugar) for Fetească Regală and 23.6 º Brix (225 g/L) for Pinot Noir.

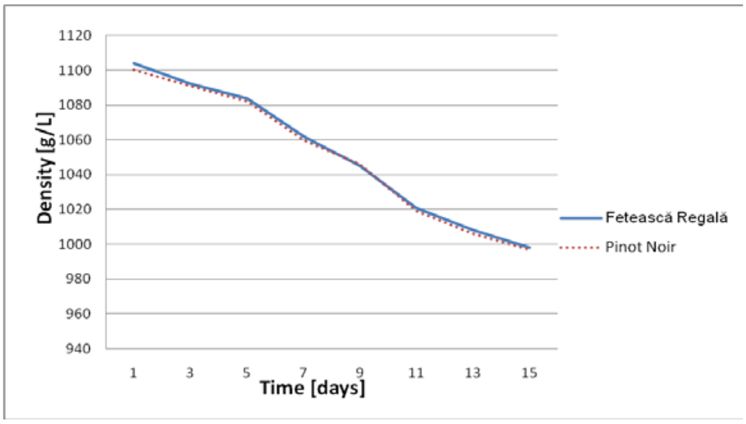

Fig. 1. *Evolution of wine fermentations of Fetească Regală and Pinot Noir grapes measured as density (g/L)*

Must total acidity (expressed as tartaric acid) was 4.21 g/L for Fetească Regală and 4.55 g/L for Pinot Noir and wine total acidity (expressed as tartaric acid) was 4.42 g/L for Fetească Regală and 5.73 g/L for Pinot Noir.

Wine tartaric acid was 3,7 g/L for Fetească Regală and 4.7 g/L for Pinot Noir.

3.2. Free and Total Sulphur Dioxide Analysis

Among the numerous oenological inputs, the protection of must and wine using sulfur dioxide (SO_2) is undoubtedly among the oldest practices. Due to a remarkably large spectrum of action, including antioxidant and antiseptic properties, an easy to use and a low cost, this additive is still considered an essential tool for many winemakers. However, in a context of societal concern about food and wine preservation, combined with an acknowledged latent toxicity of sulfites, there is a general tendency of reducing SO_2 levels in wine [2].

Monitoring total and free SO2 content in wine is critical during wine storage and processing to ensure protection from chemical and microbiological agents and to adhere to the legislation in force. The presence of even lower concentrations of SO_2 can induce severe diseases in people with allergic illnesses or food intolerance symptoms [1].

The maximum level of total and free sulfur dioxide is stipulated in the European Community by the International Organization of Vine and Wine (OIV) and it depends on the type of wine (up to 150 mg L^{-1} for red wines and up to 400 mg L^{-1} for sweet white wines). If the total sulfur dioxide content exceeds 10 mg L^{-1}, this it must be specified on the label of the wine bottle [6].

The wine free and total sulphur dioxide values were in normal parameters. The free sulphur dioxide was 29 mg L^{-1} for Fetească Regală and 20 mg L^{-1} for Pinot Noir. Total sulphur dioxide was 95 mg L^{-1} for Fetească Regală and 83 mg L^{-1} for Pinot Noir.

3.3. Total Phenol Measurement

Phenol compounds play an important role in color flavor and mouth feel attributes of wines. The acquisition of information related to phenol compounds during the winemaking process is therefore becoming a necessity. With the colorimeter described in section Materials and method the wine total phenol content was determined. For Fetească Regală the total phenol value was 0,683 g/L and for Pinot Noir variety was 5 g/L.

3.4. Alcoholic content

The alcoholic content of the wine is the content of ethyl alcohol, expressed as a percentage by volume (% vol.) at 20 ° C.

More simply, the alcoholic content is the number of milliliters of pure ethyl alcohol contained in 100 ml of wine.

Using the electronic ebulliometer it was found that the Fetească Regală variety has 12.5% vol. alcohol content and Pinot Noir 14.1% vol. alcohol content.

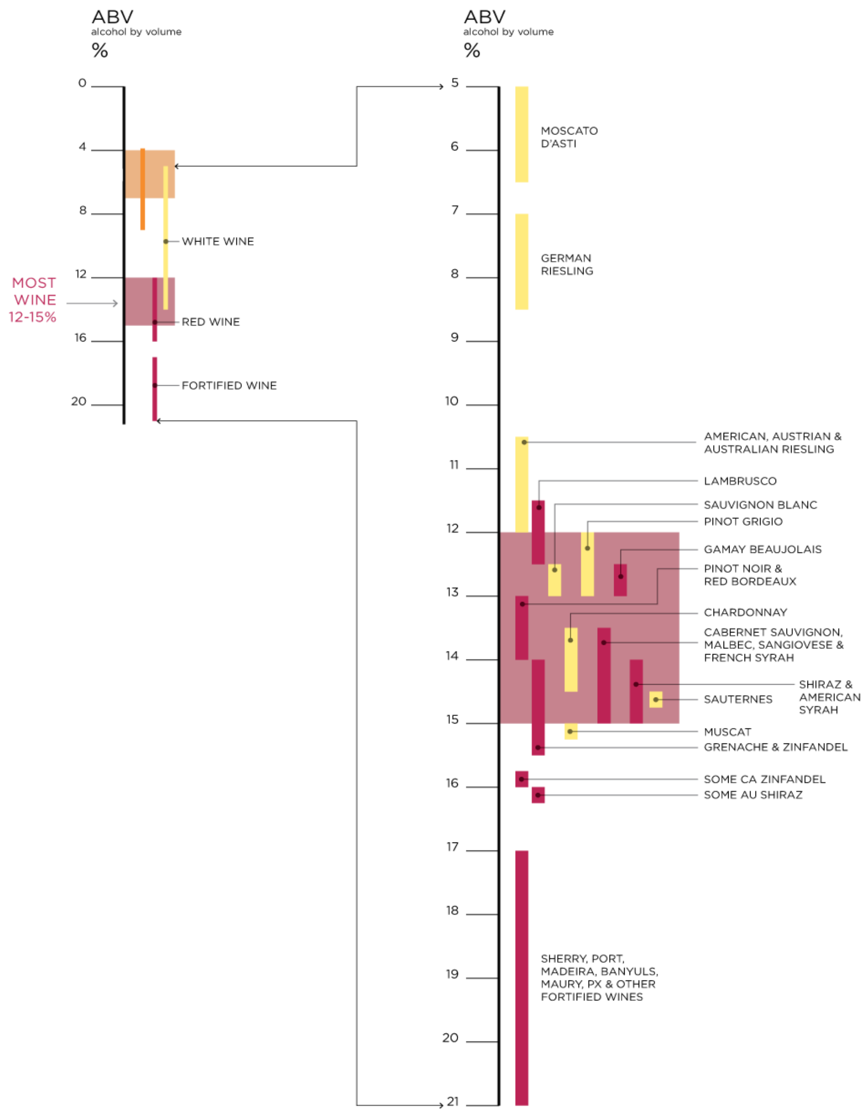

Fig. 2. *Alcohol content in wine (Infographic) [13]*

4. Conclusion

Wine quality is affected by multiple factors but knowing and monitoring these factors it is possible to control its qualitative properties.

Experimental research revealed that both types of wine studied are from a qualitative point of view within normal parameters.

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