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STUDY OF PHYSICO-CHEMICAL AND SENSORY PROPERTIES OF RED WINES FROM BLACK GRAPES (*VITIS VINIFERA* L.) IN DIFFERENT AREAS OF ALBANIA

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Abstract

Grape vine is the most commonly grown kind of fruit worldwide. Albania belongs chronologically to the old world of wine producing countries. Many factors such as: variety, soil, climate, growing conditions and winemaking techniques influence the fruit composition and therefore, the style of wine that can be produced. Wine is an alcoholic beverage produced through the partial or total fermentation of grapes. Wine is characterized by color: white, rose and red. Albania can be separated into four wine regions, which are mainly defined by their altitude. Varieties from the *Vitis vinifera* group are most widely used for winemaking. Wine can be classified by human experts or by physicochemical laboratory experiments. Physicochemical and sensory analyses of wine are important in establishing their quality and authenticity. The aim of the study was to investigate physico-chemical and sensory properties between red wines from black grapes (*Vitisvinifera* L.) produced in different regions of Albania (Tirana, Durres, Berat, Korca).

The sensory properties like: colour, taste and aroma were first examined. Shade and intensity of wine colour were calculated using optical methods. Then, different physicochemical parameters were determined: dry matter, ash, density, total acidity, and volatile acidity, alcohol content, reduced sugars, free and total SO_2, pH and polyphenol index following the analytical methods described in Albanian standard. The content of alcohol in wine was determined by SSH 1446-1:1987 method [19]. The concentration of reduced sugars was determined with Fehling method SSH 1446-2:1987. Total and free acidity were determined by analytical methods according to, SSH 1446-3:1987, and SSH 1446-4:1987. Free and total SO_2 were determined by titration of the standard solution of iodine, SSH 1446-7:1987 and SSH 1446-6:1987 respectively.

The content of alcohol in the red wine ranges between 10 and 13% vol. Wines with alcohol content from 12 to 14% vol are marked as strong. Total acidity values were observed at about 5 to 7 g/L tartaric acid range. The values of pH ranging between 3 and 4 were considered as optimal for red wine. Sulphur dioxide affect human health, hence the maximum limit for red wine 180 mg/L must not be exceeded. The values of total sulphur did not exceed the maximum limit. Phenolic composition of the finished wines depends on the grape and winemaking practices, and polyphenol index ranges from 60 to 90.

Physicochemical and sensory parameters of red wines can be influenced by the plant's environment, different areas, varieties, viticulture and enological practicesand can be used as a way of characterizing the wine quality. The values of physicochemical and sensory parameters in red wine produced in different regions of Albania were in accordance to the national law of the Albanian Food Law and EU Food legislation.

Key words: *Red wine, Physicochemical, Sensory, Quality.*

1. Introduction

Albania belongs chronologically to the old world of wine producing countries. The ancient Roman writer Elder described Illyrian wine as being very sweet or luscious and refers to it as taking the third rank among all the wines [8]. Albania is a mountains Mediterranean country and extends with the Mediterranean Sea in the west. Favorable climate and fertile soil of the mountainous areas of the country are well suited to viticulture. The wine production is associated mainly with countries of moderate climate with long, hot summers. However, the vineyards are located also in countries of cooler climate [10, 17]. The country can be separated into four wine regions, which are mainly defined by their altitude: Western lowland that rises to 300 m (Tirana, Durresi, Shkodra, Lezha, Lushnja, Fier, Vlora, and Delvina); Central hilly region which varies between 300 and 600 m altitude (Elbasan, Kruje, Gramsh, Berat, Permet, Librazhd, and Mirdita); Eastern sub-mountainous region which lies between 600 and 800 m (Pogradec, Korca, Leskovic, and Peshkopi); and (4) Mountains wines are also grown as high as 1,000 m [6]. Many factors such as: variety, soil, climate, growing conditions and winemaking techniques influence the fruit composition and therefore, the style of wine that can be produced. Varieties from the *Vinifera* group are most widely used for winemaking. Approximately 5,000 types' of varieties are recognized, but only fifteen types of grape-varieties are able to produce excellent wines (Cabernet sauvignon, Merlot, Pinot noir). Wine is an alcoholic beverage produced through the partial or total fermentation of grapes. Fermentation processes are done by the yeast *Saccharomyces*, whereby the sugars in the fruit juice are metabolized into alcohol and dioxide carbon, that later react to form organic acid, aldehydes, esters and other chemical components [1, 3]. Wine is characterized by the following colors: white, rose and red. Wine can be classified by human experts or by physicochemical laboratory experiments. Physicochemical and sensory analyses of wine are important in establishing their quality and authenticity. Evaluation prevents illegal adulteration and assures quality for the wine market [18].

The aim of the study was to investigate physico-chemical and sensory properties between red wines from black grapes (*Vitis vinifera* L.) produced in different regions of Albania (Tirana, Durres, Berat, Korca, and Librazhd).

2. Materials and Methods

Red wines from black grapes (*Vitis vinifera* L.) available in Albanian market were characterized for physicochemical and sensory properties produced in different regions of Albania (Tirana, Durres, Berat, and Korca). Following red wines were purchased: No. 1 - Cabernet Souvignon from Librazhd; No. 2 - Merlot from Korca; No. 3 - Shesh i zi from Durres; No. 4 - Mixed varieties Cabernet Souvignon, Shesh i Zi and Merlot from Berat; and No. 5 - Mixed varieties Merlot and Cabernet Sauvignon from Tirana.

We started wine analysis with the sensory properties like color, taste and aroma. Color intensity and hue of wines were calculated using optical methods. Physically, the color is a light characteristic, measurable in terms of intensity and wavelength. The intensity and hue of color in tested red wines were determined spectrophotometrically by measuring the absorbance at: 420, 520 and 620 nm [11].

Polyphenol index was determined by measuring the absorbance at 280 nm [12]. For spectrophotometric measurements, spectrophotometer UV-2100C was used.

Then different physicochemical parameters for each wine were determined: dry matter, ash, density, total acidity, and volatile acidity, alcohol content, reduced sugars, free and total SO_2, pH, and polyphenol index following the analytical methods described in Albanian standard [19]. Tests were performed in triplicate for each sample. For the determination of the density, the pycnometric method was used. For this purpose, pycnometers with a volume of 50 mL and an analytical balance with an accuracy of 0.0001 g were used. Based on the determination of the density of wine and distillate, the extract was determined (g/L). Ash content of wines was determined by gravimetric method. Content of alcohol in wine was determined by SSH 1446-1:1987 method [19]. The pH measurement of red wine was obtained with a pH meter (PHS-3CW microprocessor pH meter) was calibrated with standard solutions buffered. Total and free acidity were determined by analytical methods according to, SSH 1446-3:1987 [21], and SSH 1446-4:1987 [22]. All titrated acids in the wine are the sum of compounds titratable by standard alkaline solution to pH 7. Carbonic acid is not included in total acidity. The amount of acetic acid in wine, which at too high of levels can lead to an unpleasant, vinegar taste. Sweetness of the wine is determined by the amount of residual sugar in the wine after fermentation, relative to the acidity present in the wine. Concentration of reduced sugars was determined with Fehling method SSH 1446-2:1987 [20]. Free and total SO_2 were determined by titration of the standard solution of iodine, SSH 1446-7:1987 [23], and SSH 1446-6:1987 [24] respectively. Free form of SO_2 prevents microbial growth and the oxidation of wine.

3. Results and Discussion

The red wine quality and behavior can be influenced by the plant's environment, species and varieties, viticulture and enological practices [20]. Several physicochemical and sensory properties of red wines were investigated. We started the wine analysis with the sensory properties like color, and taste and aroma were first examined. The red color in brownish shades of all samples was observed. Wines produced form different varieties were rich with flavor: light oak wood flavor - No. 1; and dry fruit flavor - No. 2. All the samples were with fruit taste: apple taste - No. 1; dried plums - No. 2; blue plum, black berries - No. 3. No. 4 and No. 5 samples, mixed different varieties were observed that Cabernet Sauvignon taste and Merlot flavor prevails.

Color intensity and polyphenol index are presented in Figures 1 and 2.

Color intensity and hue of red wines were 0.715 to 0.867 and 1.0849 to 1.211, respectively (Figure 1). In contrast to the intensity, the value for the color hue (T) slightly increased with the process of the wine ageing [14, 15, and 16]. According to standard value color hue is < 1 for young wines (0.5 - 0.7) and > 1 when older (max 1.2 - 1.3). The experimental results indicated that all samples were ageing wines. As red wine age, a dark color will eventually lose its depth of color and begin to appear orange at the edges, and then later eventually turning brown. These changes occur due to the complex chemical reactions of the phenolic compounds of the wine. Also, the phenolic composition of the finished wines depends on the type of grape and winemaking practices. Polyphenol index ranges from 40 to 90 (Figure 2).

The physicochemical experimental dates of red wines are presented in Figure 3.

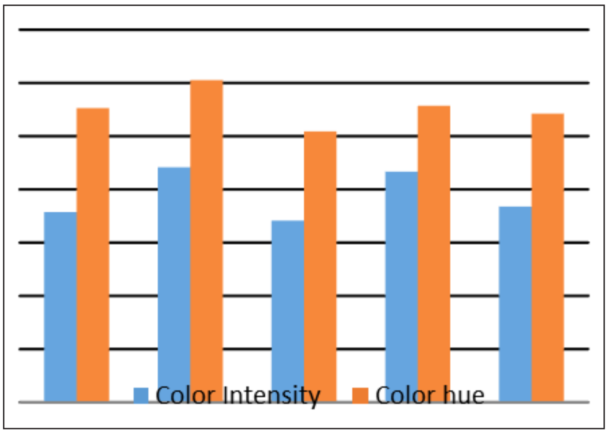

Figure 1. Color intensity and hue of different red wines

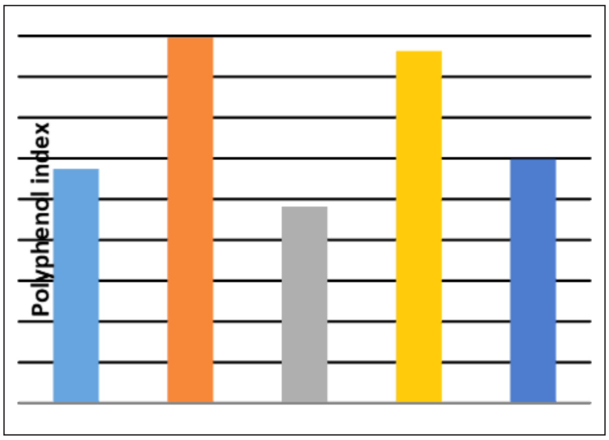

Figure 2. Polyphenol index of different red wines

Ethyl alcohol is the predominant constituent of alcoholic fermentation. Variation in the alcohol content of wine in different varieties of grape might be due to the variation in amounts of sugar present in berries [7]. Content of alcohol in wine is affected by many factors, such as ripeness of the grapes at the time of harvest, grape processing technology, and fermentation technology [3]. Experimental data for alcohol content of red wines, is presented in Figure 3 (a). Wines ranging from 10 - 13% are usually produced when less-sweet grapes are used to make wine. Alcohol content was maximum in No. 4 (12.59%), while No. 1 has recorded minimum content (10.9%).

Percentage of dry matter and ash determined by the classical way are presented in Figure 3 (b). Dry matter values ranging from 15.8 to 20% while ash values ranging from 0.5985 to 1.55%. Ash content into wine lie normally between 0.5 and 3.5 %. All relevant substances are absorbed during grape ripeness through the soil, whereby minerals are the biggest part of ash.

On Figure 3 (c) is presented pH values for each wine analyzed. Typical pH levels in wine normally range from 3 to 4 and can be measured using a pH meter. Care should be taken during pH measurement to ensure accurate results as there are various components in wine that can affect the performance of the pH electrode; these include proteins, sulfides, tannins, and polyphenols [2]. Maximum pH value was found in No. 2 and minimum value in No. 1. However, pH values ranges from 3.25 to 3.74, according to standard range.

Acidity provides physico-chemical stability of wine, gives colour, brightness and freshness of taste. A wine contains manly organic acids like tartaric, malic and citric acids. Acidity plays a crucial role in protecting the wine from spoilage [9]. The acids are important in maintaining pH low enough to inhibit the growth of many undesirable bacteria, thus giving advantage to wine yeasts [7]. Total acidity, volatile acidity and fixed acidity experimental values are presented in Figure 3 (d). The total acidity in different samples ranges from 3.9 to 6 g/L tartaric acid. Total acidity was highest in No. 4 (6 g/L), while No. 1 has recorded lowest content (3.9 g/L). According to Ribéreau and Traduction, [5], content of acids in wine ranges between 5 and 7.5 g x L^{-1}. There is a relation between the value of pH and acids contained in wine. When the content of acids is higher, the pH value is lower [4]. Among the samples, No. 1 was observed maximum volatile acidity and minimum fixed acidity, while No. 5 minimum value for volatile acidity and maximum fixed acidity. Volatile acidity is expressed in terms of g/L acetic acidity.

Sugars are converted into alcohol and carbon dioxide in the process of fermentation. Reducing sugar and extract are presented in Figure 3 (e). Reducing sugar content of wine was maximum in No. 4 (3.6 g/L),

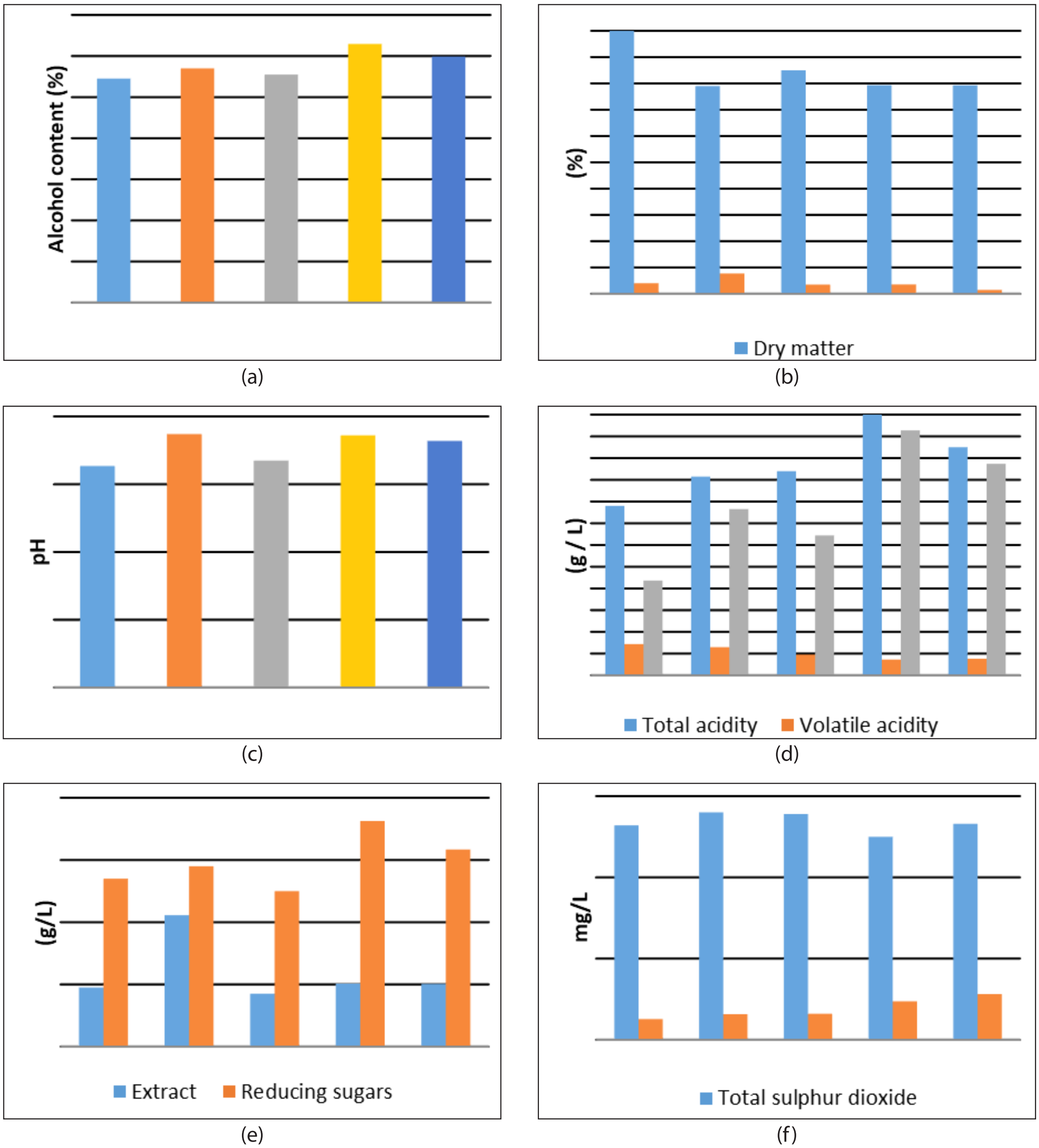

Figure 3. Physicochemical properties of different red wines: (a) dry matter and ash, (b) alcohol content, (c) pH, (d) total acidity, volatile acidity and fixed acidity, (f) extract and reducing sugars, and (e) total sulphur dioxide and free sulphur dioxide

while No. 3 has recorded minimum content (2.5 g/L). A decrease in the reducing sugar content happened due to conversion of sugars amount into various by products like aldehydes, acetyls, esters, tartaric acid and malic acids [13]. According to the grams per liter residual sugar in a wine, can determined the product type: dry, medium dry, medium sweet and sweet. In accordance with Europe wine regulations is not higher than 4 g/L, so red wine can be classified into the category of dry wines.

Sulphur dioxide is the only antiseptic allowed in wine conservation, a chemical antioxidant and inhibitor of microbial activity. The determination of total sulphur dioxide and free sulphur dioxide is rapidly made by using iodometric oxidation. The total sulphur dioxide ranging from 125 to 140mg/L, are presented in Figure 3 (f). No. 4 minimum value and No. 2 maximum value were observed. None of the evaluated samples exceeded the maximum allowable limit, 160 mg x L^{-1}. The free dioxide ranging from

12.8 (No. 1) to 28.6 (No. 5), indicated that values were under 30 mg/L. The limit values of physicochemical properties in wines available on the market comply with the national law of the Albanian Republic and the European Union law. The results indicated that all the samples possessing good quality of sensory properties.

4. Conclusions

- The physicochemical and sensory parameters of red wines can be influenced by the plant's environment, different areas, varieties, viticulture and enological practices and can be used as a way of characterizing the wine quality.

- Wines produced in different regions of Albania (Tirana, Durres, Berat, Korca, and Librazhd) were in accordance with the limits recommended by the national law of the Albanian Republic and the European Union law. The red wines differed in dry matter, ash, alcohol content, total acidity, volatile acidity, fixed acidity, reduced sugars, free and total sulphur dioxide, pH and polyphenol index, due to differences in the wine-making processes and by the use of different grape varieties for wine production.

- Based on the results we noted that all the samples can be consumed without affecting the health.

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