

Evaluation of the wines adulteration from Cotesti vineyard

Constanta Vicol^{a*}, Gabriela Râpeanu^b, Gabriela Bahrin^b

^aLaboratory of wine control, 61 Stefan cel Mare street, Odobesti, Romania

^bDunarea de Jos University of Galați, Faculty of Food Science and Engineering, 111 Domneasca Str.,
800201, Galati, Romania

Abstract

The adulteration of wine usually refers to alcohol and glycerol addition, dilution with water, and change of aroma and color by using different substitutes. In this situation the final product consumption can be an unsafe product for human health, because the added ingredients are not well controlled by authorities before processing. The purpose of the study was to find the adulterated wine samples produced in Cotesti vineyard (Vrancea County) by several wineries during the period of time of 3 years (2007, 2008 and 2009). A number of 219 wine samples were analyzed and it was found that the low quality wines are usually adulterated. It was found a decreasing in adulterated wine samples provided by Cotesti vineyard from 88.3% adulterated samples in 2007 to 48.5% adulterated in 2009. The decreasing trend of the adulterated wines during the period of three years (2007, 2008 and 2009) can be explained by the application of Romanian legislative regulations on wine quality level.

Keywords: wines, adulteration, sugar addition, water dilution.

1. Introduction

According to the European regulations wine is the product obtained exclusively by the total or partial alcoholic fermentation of fresh grapes, whether or not crushed, or of grape must. Its alcoholic content may not be less than 8.5% (v/v). Because of its economic value, wines are classified as wines with protected designation of origin (PDO), wines with controlled denomination of origin (CDO), wines with protected geographic indication (PGI). For this reason, in order to protect the trade-mark of quality wines and to prevent their illegal adulteration some analytical techniques have been developed [1].

Given the wide range of wines and large variations of their chemical composition and sensory properties caused by the influence of biological, ecological and technological factors, wines have been the subject of adulteration for a long ago.

If at the beginning the wines adulteration was empirical and consisted mainly in diluting with water and adding plant extracts to correct some defects, today the adulteration are more

diversified and sophisticated, being more difficult to identify them. Currently, the most common fraudulent operations on wines refer to the authenticity of the raw grape variety and the production area, but also to the addition of natural or synthetic sweeteners, flavoring substances etc. [2]

The wines adulteration consists in the alcohols (mostly ethanol) addition in order to increase the alcoholic content of final wine. This increase in alcoholic content will conduce to the increasing of the cost of the adulterated product, because the alcoholic content is not the result of the anaerobic fermentation of sugar grapes [2].

Another important adulteration of wine is the addition of sugar (from beet or cane) or rectified sweet grape must during fermentation. This will increase the alcoholic content of the final wine and the cost of the wine on the market will be higher. The Romanian Law allows in only unfavorable climatic years, with the approval of authorized agency, the addition of a maximum amount of 35g/l sugar, which will

* Corresponding author: e-mail address: constantavicol@yahoo.com

increase of alcoholic content of 2% (v/v) [2,3].

Glycerol is a compound that naturally occurs in wine, being present as a result of sugar fermentation in the presence of yeasts. This compound is involved in the sugar-free extract of wine. Also, it contributes to improve sensorial characteristics of wine, being responsible of velvety character. For this reason, some disloyal wine producers practice the glycerol addition not permitted by the Romanian law [2].

The normal ratio glycerol and ethanol is from 6 to 10% depending on the several factors, such as: composition of grape must, used yeast strain, fermentation temperature, pH etc. To prove the fraudulent addition of glycerol in wines some analytical methods can be used. Researchers tried to develop new techniques able to measure the content of glycerol from wines [4,5].

Different methods can be used to evaluate the wines authenticity. Beside classical methods already known, some other new methods, such as stable isotope analysis, HPLC-MS, GS-MS, evaluation of mineral content, DNA fingerprinting are developed.

The wines authenticity is adjusted by some rules described below. Commission Regulation (EC) [No 753/2002] established some rules for application of Council Regulation (EC) No 1493/1999 regarding the description, designation, presentation, and protection of certain wine sector products. Regulation EC 753/2002 governing the designation, naming and protection of wines has been amended by regulation [No 316/2004] and by Commission Regulation (EC) [No 1429/2004].

The main purpose of this research was to establish the presence of adulterated wines from Cotesti vineyard present on the market during the period of 2006-2008.

2. Materials and Method

Materials. A number of 219 wine samples were provided from local winemakers during the period of time (2007-2009). All the wine samples were processed in the Cotesti vineyard, Vrancea County.

During the year 2007 only a number of 34 samples were collected and further analysed. For the years 2008 and 2009, a higher number of samples were studied, 78 and 107 samples, respectively.

Methods. In order to characterize wine samples, the alcoholic content (expressed as %, v/v) (pycnometer method STAS 184/2-87), total and volatile acidity (expressed in g/l H₂SO₄) (SR184-5:1997), free and total SO₂ (mg/l) (STAS 6182-12:2009), total sugar content (g/l) (STAS 6182-18:2009), sugar free extract (g/l) (STAS 6182-25:2009), glycerol content (g/l) (enzymatic method E 0148270, Darmstadt, Germany), citric acid content (g/l) (STAS 6182-26:2009), presence of natural and synthetic colorants or flavors by using official methods (OIV) have been performed.

Some oenological indices are usually used to express correlations between some wine chemical parameters. They can be used to asses at least some general and more known wine adulterations. Some of these correlations were described in our previous work [2] and are briefly described below.

The correlation between alcohol content and acidity is expressed by the calculation of the three indices:

Gautier sum - Alcohol (% , v/v) + Total Acidity (g/l), with values (13-17); [2]

If the wines are diluted with water when this indicator is below 13, the degree of wine dilution can be estimated by using the following relationship:

$$\text{Water, \%} = \frac{13 - (A + T)}{13} \cdot 100$$

where: A – fixed acidity of wine, (g/l); T – alcoholic content of wine, (%v/v).

Blarez rules - Alcohol (%v/v) + Fixed acidity (g/L), ranging from (11-17); [2]

Alcohol (%v/v)/Fixed acidity (g/L), having values between 1.75-1.65 (for an alcoholic content of 7-14% v/v).

Halphen ratio - Total acidity (g/l)/Alcohol content (%v/v), with values (0.2 - 0.8). [2]

The correlation between alcohol content and extract

The correlation between the alcoholic content and sugar free extract is expressed as the ratio R:

$R = \text{Total alcohol (g/l) / sugar free extract (g/l)}$ with values (3.6 - 5.5).

Higher values of R indicate the wine adulteration by alcohol addition.

The correlation between alcohol content and glycerol

Between the glycerol content and the alcoholic content of wine a linear correlation has been found. In this situation, the amount of glycerol is increasing with the increasing of the alcohol degree. As state earlier, the amount of glycerol is 6.5-10% by weight of ethanol. If the values calculated for samples are not in these limits, an ethanol or glycerol fraudulent addition is found.

The value of ratio $\frac{\text{glycerol (g/l)} \cdot 10}{\text{alcohol (g\%)}}$ for the

wines produced in Romania varies between 5.5-13.5, with an average of 8.5. [2]

For wine adulteration with sugar addition, the presence of glucose and sucrose evaluation was performed. The addition of synthetic sweeteners in wines is proved when the wine sample has sweet taste and no reducing sugars are found in the wine sample tested.

All determinations from this study were carried out in triplicate, and the calculated relative standard deviations were less than $\pm 1\%$.

3. Results and Discussion

By analyzing the label conformity the wine samples, a number of 13 samples from 34 samples analyzed in 2007 were not conform to their labels. A number of 3 wine samples presented lower alcohol content (% v/v) and a higher total and volatile acidity, in the case of other 7 samples.

Samples studied in 2007 year were found to be adulterated with water addition. This was proved when a lower alcohol concentration was measured. In the case of wines diluted with water, they became more watery and have less body.

For this adulterated wine samples their color is also reduces and their flavor are not perceptible in accordance with the water percentage of substitution.

Other adulterations found for the samples collected during the 2007 year were sugar addition and presence of synthetic sweeteners for 7 samples and synthetic colorants for 9 samples.

The percentage of adulterated wines collected and analyzed in 2007 year was 88.30% as can be seen in Figure 1.

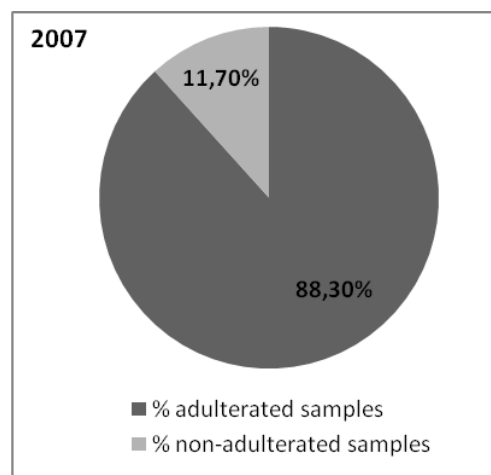


Figure 1. Adulterated wines found during the period of 2007 year

A number of 78 wine samples were analyzed for the year 2008. From the data it was observed a decreasing in the percentage of adulterated wines (50.1%) (Figure 2).

Some of the wine samples analyzed during this period were adulterated with water addition (16 samples); sugar addition (13 samples) and citric acid addition (19 samples).

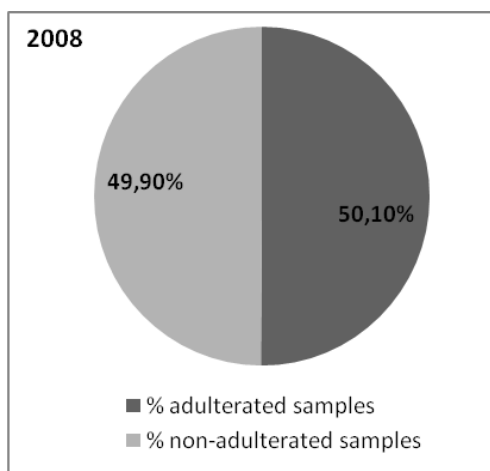


Figure 2. Adulterated wines found during the period of 2008 year

For the year 2009, only 52 wine samples were adulterated from the total 107 tested samples. A number of 12 wine samples were diluted with water. 4 wine samples were adulterated with sugar and synthetic sweeteners addition, while a number of 32 samples were adulterated with citric acid addition (Figure 3).

During this study some misleading-labeled wines were found. The reason is to be included in a superior level of quality and to commercialize them to higher prices.

For some analyzed wine samples, the information found on the label is quite different with the wine characteristics.

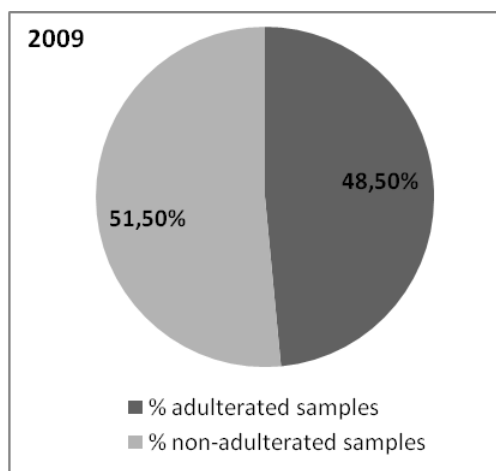


Figure 2. Adulterated wines found during the period of 2009 year

There is a requirement for a wine to have the grape variety mentioned on the label. The wine has to contain minimum 85% the required grape variety and to have a minimum alcohol content of 11% (v/v).

In some cases the controlled wines even were obtained from more than 90% of grape variety but some addition (sugar, colorants, synthetic sweeteners) were found detected, that wine samples cannot be included as wines with controlled denomination of origin (CDO) origin (CDO). Also in this situation the wine sample is misleading labeled.

On the other hand, adulteration of wines is a very long-standing concern, since these fraudulent practices affect the consumer's health and are detrimental to the quality wines, which are produced in specific regions.

There is a growing interest for the wines authentication and for the identification of analytical methods capable to find the origin of wines and accurately detect wines adulteration.

For this reason a database is need at national and international level.

4. Conclusion

A total number of 219 wine samples were collected and analyzed in order to find if some of them were adulterated. The analyses were performed during the period 2007-2009. The number of adulterated wine samples decreased from 2007 year (88.3%) to 50.10% in 2008 year and to 48.5% in 2009 year.

For all analysed wine samples it was found that mainly wines included in inferior quality level are often adulterated.

The decreasing trend in fraudulent practices can be explained by the application of Romanian legislative regulations on wines quality.

Nowadays, EU regulations are implemented with the purpose to protect specific quality wines.

For the same reason winemakers are obliged to produce wines with specific quality if they decide to commercialize them in a globalized wine market.

Export of Romanian wines is just over 3% of total local production, and much of the exported wine goes to the European single market. In 2009, Romania ranked not in the top of wine-producing countries in terms of production and exports, while Hungary exported few times more wine than Romania, at a production several times lower.

The Romanian wine market and its compact structure effectively attract other producers. Wine is generally imported to Romania from Italy, France and Spain, but also from Portugal, the United States, Australia or New Zealand. An interesting new trend is in terms of imports of South American wines from Argentina or Chile.

Acknowledgements

We gratefully acknowledge the financial support from the Regional laboratory of wine control, Odobesti, Romania and BIOALIMENTPlatform (<http://www.bioaliment.ugal.ro/>)

References

1. Penza, M., Cassano, G., 2004. Recognition of adulteration of Italian wines by thin-film multisensor array and artificial neural networks, *Anal. Chim. Acta*, **509(2, 3)**, 159-177.
2. Bulancea M., Rapeanu G., 2009. *Autenticarea si identificarea falsificarilor produselor alimentare*, Ed. Didactica si Pedagogica, Bucuresti, Romania.
3. Kosir, I. J., Kocjancic, M., Ogrinc, N., Kidric, J., 2001. Use of SNIF-NMR and IRMS in combination with chemometric methods for the determination of chaptalisation and geographical origin of wines (the example of Slovenian wines), *Anal. Chim. Acta*, **429(2)**, 195-206.
4. Roßmann, A., Schmidt, H.L., Hermann, A., Ristow, R., 1998. Multielement stable isotope ratio analysis of glycerol to determine its origin in wine, *Z Lebensm Unters Forsch A*, **207**, 237-243.
5. Da Costa R., Santos S.R.B., Almeida L.F., Nascimento E.C.L., Pontesa M.J.C., Lima R.A.C., Simoesa S.S., Araujo M.C.U., A novel strategy to verification of adulteration in alcoholic beverages based on Schlieren effect measurements and chemometric techniques, *Microchemical Journal*, **78**, 27- 33, 2004.
6. ***Commission Regulation (EC) No 753/2002 of 29 April 2002 laying down certain rules for applying Council Regulation (EC) No 1493/1999 as regards the description, designation, presentation and protection of certain wine sector products. *O J Eur Comm L* 118: p. 1-54.
7. ***Commission Regulation (EC) No 316/2004 of 20 February 2004 amending Regulation (EC) No 753/2002 laying down certain rules for applying Council Regulation (EC) No 1493/ 1999 as regards the description, designation, presentation, and protection of certain wine sector products. *Off J L* 055:p. 16-42.
8. ***Commission Regulation (EC) No 1429/2004 of 9 August 2004 amending Regulation (EC) No 753/2002 laying down certain rules for applying Council Regulation (EC) No 1493/1999 as regards the description, designation, presentation, and protection of certain wine sector products. *Off J Eur Union L* 263:p. 11-20.