

ESTABLISHING THE AUTHENTICITY OF A WINE USING LOCAL CHARTS BASED ON PHYSIC-CHEMICAL ANALYSIS AND STATISTICAL METHODS, MEANS TO PREVENT ITS COUNTERFEIT

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Abstract

The research aims to combat forgery of wines from vineyards with clearly defined characteristics, by establishing database of basic physic-chemical analysis (acidity, degree alcohol, extract, etc.), statistically measured and recorded during several years. These data are recorded in "standard datasheet", which are characterizing the quality of wine, and then can be used by comparison for the detection of counterfeits wines of the same type from current production, suspected to be forged by determination of sensory quality of wine or check required by clients. Only approved laboratories, using standardized methods, should perform determinations. In our case we used for analysis the local wines from neighbors of Targoviste (Răzvad and Priseaca area), from red and white grapes that after being examined, have been subjected to deliberate falsification in order to check the veracity of the scientific conclusions obtained. In order to be applied, an in-depth research has to be performed and the results to be approved by official standards.

Keywords: wine, counterfeiting, chemical characteristics, correlation

1. INTRODUCTION

Keeping the development of wines' production worldwide at a high level is a problem of all oenologists from all the major producer countries in the world, among which Romania. Statistics show that there is a tendency to reduce the area planted with vines, but also growing and maintaining production on account of increased production per hectare. It should be noted that stocks of wine on the market have increased as a result of stagnation in consumption, blamed on global crisis affecting the purchasing power of people. In these circumstances, logically, it is increased the competitiveness of wine producer, and issues relating to quality assurance and authenticity of wines, along with the discovery and suppression of counterfeiting, are some of the highest concerns of the producers, traders and institutions empowered to controls. In our country, recently integrated into EU structures, with legal framework adjusted to the criteria required by EU, the issues raised by research theme content is very actual. IT has to be mentioned that Romania is one of the major wine producing, 5th ranking among European countries and 9th place in the world, with an

estimated production of 6 million hectoliters of wine in 2009 (PNNV, [1]).

This paper is part of the efforts made by European and national competent bodies, regarding the food security. The research aims to combat counterfeiting of wines from vineyards from Razvad and Priseaca area, with clearly defined characteristics, by establishing a database of basic physic-chemical analysis (acidity, degree alcohol, extract, etc.), statistically measured and recorded during several years. These are recorded in "standard datasheet" that characterizes the quality of wine and then can be used by comparison for the detection of counterfeits wines of the same type of current production, suspected to be forged by determination of sensory quality of wine or check required by clients.

Research work aims to establish basic indicators of the authenticity of some types of local wine called „Strawberries” and „Răzvad hills”, from the vineyard of Priseaca and vineyard of Răzvad, which can be used in order to control the quality and authenticity of these types, and the possibility of highlighting illegal interference of wines falsification.

2. MATERIALS AND METHODS

There were taken for analysis 2 types of authentic local wines, an white wine called "Răzvad Hills" from local vineyards Răzvad and a red wine called "Strawberries" from vineyards of Dragomirești. The experiment was based on and have taken into account the research carried out by Ghe. Ghimicescu and his associates in the interpretation of correlations of the chemical characteristics of wines, with support of diagrams and nomograms (Țârdea c., [2]).

Determinations were carried out in stages, as follows:

- ◆ Prior to beginning of basic research, it have been performed sensory tests in order to set out the main features of assessment of limpidity, color, taste and determination of flavor and bouquet, which actually characterizes quality of a wine.
- *Limpidity appreciation* in transparent light on a scale calibrated values (the crystal clear, clear as gloss, very clear, clear enough, less clear);
- *Color appreciation* within the meaning of color intensity and reported also to a standard scale (light red, red ruby, etc.);
- *Determination of flavor and bouquet*. Total aroma is the sum of primary and secondary flavors depending on the age of wine and the bouquet is a mixture of complex flavors specific to mature and aged wine;
- *Taste appreciation* is the key element to define the wine quality and is the result of taste sensations, smell and touch.
- ◆ After this stage, there were conducted basic research activities, which are object of the present paper, in which have been followed the existing correlations between the basic components of wine, resulted from analysis:
 - The amount of real alcohol (g%) and fixed acidity (g / l);
 - Ratio of real alcohol (g%) and fixed acidity (g / l);
 - Correlation between real alcohol (g%) and total dry extract.

As samples there were used from each type three categories of wines: normal authentic wine, counterfeit wines by adding vodka and counterfeit wine by adding water, in order to highlight the counterfeits made deliberately.

Practically three samples were analyzed for white wine (one normal and two counterfeit) and three of red wine (one normal and two counterfeit). Components determined by analysis are: real alcohol g%, fixed acidity g/l and total dry extract g/l.

The working methods were the following:

- Determination of alcohol was performed by the **ebulliometry method** (Tardea [2], Segal [3], Ghimicescu [4], Doholici [5]) based on the principle of determining the wine's boiling point, which is found between the boiling point of water (100 ° C) and ethyl alcohol (78.3 ° C), the wine being a hydro-alcoholic mixture (Tardea C., [2]). Alcohol concentrations of wine is higher as the boiling point is lower than that of water. It was used an ebulliometer type Dujardin-Salleron and a special ruler slider for alcohol concentration reading.
- To determine the fixed acidity it was used **titration method** whose principle is the neutralization of organic acids and their acid salts with an alkaline solution, using as an indicator blue brom-timol or other indicator (phenol red in our case) which turns at pH = 7 . A preliminary test allows to determine the color calibration of the pH indicator to 7.
Reagent used:
 - sodium hydroxide 0.1 N;
 - Indicator phenol red,
 - Buffer pH 7.
- To determine the total dry extract was used **direct method** which has the principle of evaporation of a volume of wine to the temperature of boiling water, in specified conditions and weighting the dry residue obtained (Tardea C., [2]). The equipment used includes a vacuum oven, a platinum capsule with a flat bottom and lid, a water bath.

3. RESULTS AND DISCUSSIONS

The experiment followed the correlation between some main components of wine in its content, chemically analyzed, as follows:

a) Correlation between alcohol degree and acidity

→ The correlation between real alcohol g% and sum: real alcohol (g%) + fixed acidity (g/l);

Chemical analysis were conducted by applying the methods indicated above for the six samples taken in the analysis (three of red wine and three of white wine), including two normal and the other intentionally counterfeit.

Table 1

Analysis	Wine type	Normal wine	Wine with 20% vodka	Wine with 10% distilled water
Real alcohol g%	Red wine	14,3	18,3	12,4
		16,5		
		12,9		
	White wine	16,0	16,9	11,6
		15,3		
		16,8		
Sum:real alcohol g% + fixed acidity g/l	Red wine	13,4	21,3	16,7
		15,1		
		13,6		
	White wine	15,7	21,4	16
		13,0		
		15,35		

Research by the romanian oenologists on several romanian wines evidence that it was not found a direct link between alcoholic degree by volume of wine and total acidity (Tardea C., [2]). In contrast there were detected the existence of linear correlations (almost linear) and constant, between the amount of real alcohol g% + fixed acidity g/l.

In order to interpret and to use them to verify the authenticity of wines and detect fraud attempts by their falsification were built several diagrams starting from the model chart below for the two types of wine taken in the analysis (one red and one white):

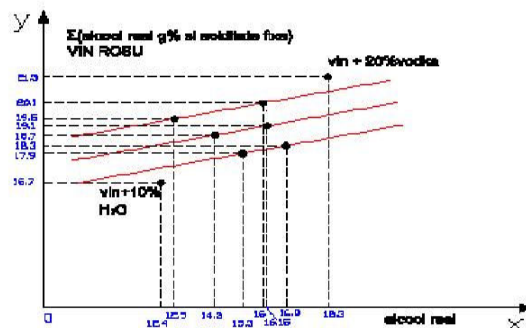


Fig. 1. Variation in amount: real alcohol (g%) + fixed acidity (g/l) compared with alcoholic concentration (g alcohol real %) in red wine

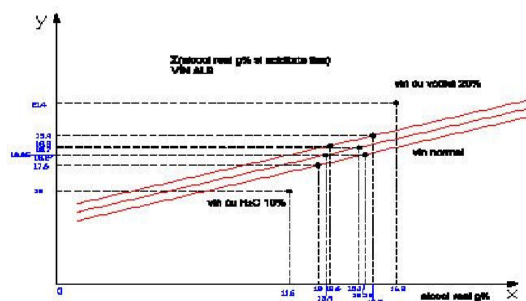


Fig. 2. Variation in amount: real alcohol (g%) + fixed acidity (g/l) compared with alcoholic concentration (g alcohol real %) in white wine

In these diagrams, specific only for these sorts of wine used in the experiment, on the abscissa have been entered the results for real alcohol component (g%) and on the ordinate the amount of sum (g real alcohol % + g fixed acidity). Graphically were obtained three linear curve (three straight) including the area within which the content of these components varies between an upper and a lower limit, for the normal wines.

At the same time we can see that for intentionally falsified wines, the recorded values are out of the values associated to normally wine, respectively over the upper limit for counterfeit wine with vodka and under

the lower limit for the wine diluted with water. This is very important because the chart shows that the wine counterfeited can be revealed by analyzing the relationship between alcoholic degree and acidity.

→ The correlation between real alcohol concentration g% and the ratio real alcohol g% / fixed acidity g/l

Results of analysis for components real alcohol g% and fixed acidity are listed in Table 2 below:

Table 2

Analysis	Wine type	Normal wine	Wine with 20% vodka	Wine with 10% distilled water
Real alcohol g%	Red wine	14,1	18,3	12,4
		15,9		
		14,6		
		15,5		
White wine	14,84	16,9	11,6	
	16,2			
	13,4			
	15,1			
	13,6			
Red wine	White wine	15,7	3,9	1,83
		13,0		
		15,35		
		2,9		
		3,2		
The ratio real alcohol g% + fixed acidity g/l	Red wine	3,15	6,1	2,0
		3,35		
		3,5		
		3,7		
		2,65		
White wine	White wine	2,44	3,9	1,83
		2,8		
		3,03		
		2,9		
		3,22		

There were scratched diagrams in Figure 3 and Figure 4 by the same principles as in the preceding except that on the ordinate were included data from the existing ratio between g real alcohol % and g fixed acidity.

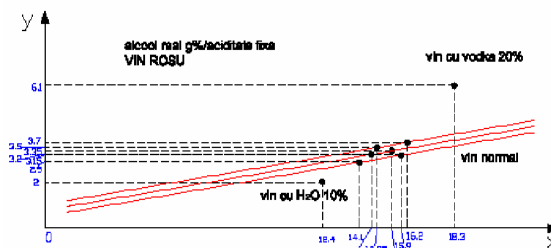


Fig.3. Variation of the ratio between real alcohol (g%) / fixed acidity (g/l) and the alcoholic concentration of wine for red wine

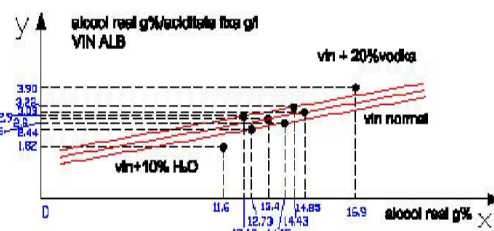


Fig.4. Variation of the ratio between real alcohol (g%) / fixed acidity (g/l) and the alcoholic concentration of wine for white wine

Interpretation of graphic performance indicates that normal authentic wines have values of the alcoholic degree and of ratio g real alcohol % and g fixed acidity correlated almost linearly, these values being present in an area bounded above and below. The values recorded for counterfeit wines came out of this area (over the upper limit for vodka counterfeit wine and under the lower limit for the wine diluted with water). The conclusion is that this type of forgery can be detected using diagrams presented.

b) The correlation between alcohol and extract
→ The correlation between real alcohol g% and ratio real alcohol g% / low extract g/l
The analysis results are listed in Table attached.

Table 3

Analysis	Wine type	Normal wine	Wine with 20% vodka	Wine with 10% distilled water
Real alcohol	Red wine	14,22	18,38	12,43
		15,69		
		14,61		
		13,9		
		17,67		
		16,14		

g%		13,08 14,58 13,48 12,78 15,55 15,09		
	White wine		16,97	11,60
The ratio real alcohol g% + fixed acidity g/l	Red wine	1,23	2,53	2,99
		1,44		
		1,49		
		1,59		
		1,80		
	1,91			
White wine	1,51	0,8	1,0	
	1,74			
	1,78			
	1,87			
	2,09			
	2,22			

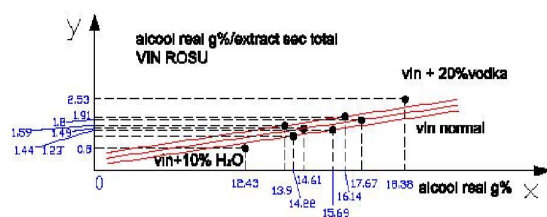


Fig.5. Variation of the ratio between real alcohol (g%) / total dry extract (g/l) and alcohol concentration in red wine.

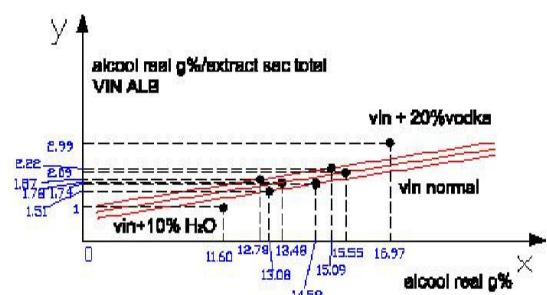


Fig.6. Variation of the ratio between real alcohol (g%) / total dry extract (g/l) and alcohol concentration in white wine.

Graphical representation of the experimental values recorded shows correlation between these components and the possibility of detecting forgery which may affect the authenticity of wine.

4. CONCLUSIONS

The conclusions that results from the experiment can be summarized as:

- wine produced from specific authentic vineyard can be made a "Standard datasheet of characteristics" including the average of chemical analysis results presented above, conducted over several years (minimum three), as diagrams and nomograms, which can be used as the standard of comparison for other wine produced or claimed to be produced in that range and vineyard, thus establishing the authenticity of that range or any of forgery
- Research shows that it is possible to measure the degree of falsification by dilution with water or addition of foreign substances (alcohol, sugar, etc.)
- The research clearly showed the existence of correlations between physical-chemical indicators specific to each type of wine and the sensorial characteristics and composition of wine;
- The extension and verification of such research is necessary in order to standardize these methods used to authenticate different type of wine and to detect counterfeiting wine.

5. REFERENCES

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