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Study of physical and chemical parameters in relationship to plant–grapes–wine romanian varieties cultivated in vineyard Iaşi

ABSTRACT

In the grapevine and in grapes there are, in different concentrations, chemical components that reach in wine, following alcoholic fermentation. The present study aims to determine and foresee the evolution of these physical-chemical parameters by using advanced analytical techniques and technologies, the analyses of the evolution of these parameters within the plant-grape-wine relationship is performed through proficient physical –chemical devices: atomic absorption spectrophotometer Shimadzu AA-6300, Shimadzu LC-20, Shimadzu GC-MS 2010 and pH meter WTW inoLab 740.

In the wine-making process, of great importance is the alcoholic fermentation, maceration of marc and malolactic fermentation. The way in which these processes are stimulated, activated, stopped, discontinued or even avoided, as is sometimes the case with the last two can largely influence the quality of wine.

Being aware of the variation of physical-chemical parameters during alcoholic fermentation facilitates the theoretical understanding of phenomena occurring during maceration-fermentation processes, concerning the multiplication of yeast, dynamics of sugars' metabolism by yeast, evolution of compounds responsible for the colour of red wines, ionization of the main acids present in wine, the total solutes, electrical conductivity, redox equilibrium processes, insolubility of the tartaric compounds.

Given the importance of these issues, the main aim of the study was to obtain data on the dynamics of values of physical-chemical parameters during the course of fermentation processes and their correlation in the plant-grape-wine relation, useful for greater control of the fermentation maceration phase of the must, using Romanian grape varieties from Iaşi vineyard.

The studied grape varieties were: Armaş, Băbească gri, Blasius, Cioinic, Creaţă de Banat, Cruciuliţă, Fetească albă, Fetească regală, Frâncuşă, Furmint de Miniş, Galbenă de Odobeşti, Gordan, Gordin, Grasă de Cotnari, Mioriţa, Mustoasă de Maderat, Selena, Şarbă, Tămâioasă românească, Zghihară de Huşi, Amurg, Arcaş, Balada, Băbească neagră, Bătută neagră,

Busuioacă de Bohotin, Codană, Fetească neagră, Negru aromat, Negru de Căuşani, Negru de Drăgăşani, Negru vârtos, Negru moale, Novac, Roz de Miniş, Vulpe.

The objectives in this study were:

- Analysis and correlation of the variation of climatic parameters during veraison with the grapes' compositional characteristics, factors that have a decisive influence on the quality of produced wines;
- Analysis of parameters involved in the evolution of phenolic ripeness of the above mentioned grape varieties and their correlation to characteristics of phenolic compounds of red wines;
- Establishing the influence of the mineral composition on the main characteristics of wines obtained by classical maceration without added yeasts and enzymes;
- Correlations between térroir and composition of phenolic compounds responsible for the colour by quantitative measurements and anthocyanins profile in wines;
- Formulating and testing statistical hypotheses concerning the influence exerted by climatic characteristics of the particular vintage years and grape varieties on participation rates of chlorophyll in wine;
- Analysis of wines' chromatic parameters, computer simulation and calculation of sensorial color differences (Δ E);
- Obtaining the aromatic profile of wines by sensorial analysis as to identify and quantify the main olfactory and gustatory characteristics;

The material used is represented by both vine leaves and grapes. It was harvested from the Ampelographic Collection of the University of Agricultural Sciences and Veterinary Medicine "Ion Ionescu de la Brad", located in Iaşi-Copou vineyard (in May the leaves, at the beginning of September the grapes). AT the same time, comparatively, wines from Odobeşti vineyard were chosen for chromatic parameters analysis. The degree of sugars accumulation in various studied grape species was typical for the harvest period. The evaluation of wines by their alcoholic strength showed that not all varieties have been able to generate superior wines or, in some cases, even table wines. The need for evaluating these varieties has been linked to a possible use of these grapes as blending partners (increased acidity).

In this study, 72 wines were obtained from native grapes varieties (as mentioned above), harvested in 2008 and 2009. The physical-chemical changes that occur during alcoholic fermentation of must were studied: Su - soluble dry matter, pH - real acidity, IPT - total polyphenolic index, χ - electrical conductivity, TDS - total dissolved substances, Eh - redox potential, rH - parameter quantifying the redox potential. The evolution of the main characteristics of composition, namely alcoholic strength, density, total acidity, volatile acidity,

non-reductive sugar content, non-reductive extract, content of phenolic compounds was also analysed.

Wine contains, in addition to organic compounds, many minerals, which come mostly from grapes, the rest having its origin in the dust on grapes, tools and equipment for wine production, storage, conditioning and stabilization of wine, and the oenological materials used in producing wine.

In the present research activities concerning white wines, the concentrations of potassium, sodium and calcium and their standard deviations were determined and the studied grape varieties were divided into groups that have common genitors, as follows:

- group I, consisting of Galbenă de Odobeşti, Zghihară de Huşi and Cruciuliţă (Galbenă de Odobeşti was genitor for Zghihară de Huşi and Cruciuliţă);
- group II, with the following grape varieties Fetească albă, Grasă de Cotnari, Fetească regală, Furmint and Armaş (Fetească regală seems to be a natural hybrid between Fetească albă and Grasă de Cotnari; acad. Valeriu D. Cotea thinks that Armaş grape variety is related to Grasă de Cotnari, who acts as genetic base via bud variation; proof of phyllogenteic kinship between Grasă de Cotnari variety and Furmint, proving thus the common genetic origin of the two varieties);
- group III, of Şarbă and Tămâioasă românească (Şarbă is a grape variety recently obtained by specialists at the Viticultural Research Station Odobeşti by crossing Tămâioasă românească with Riesling).

In order to obtain as many details about the studied grape varieties, the colour of the wines was determined by CIE Lab76 method, the chromatic parameters were obtained by plotting absorption spectra for some samples of red wine.

Comparing the absorption spectra of the wine of the same species, but different vineyards shows that: in the case of the variety Fetească neagră, the highest value of absorbance is shown by Fetească neagră -Iaşi. Băbească neagră, on the contrary, has the highest value in the wine from Odobeşti vineyard, the same situation being analysed for the wine obtained from Codană variety.

Noteworthy is that the classification of wines according to their digital colour is similar to that given by their absorption spectra.

The study regarding the characterization and classification of wines according to the parameters of colour, structure and content of phenolic compounds as assessment of the authenticity of grape varieties was performed on wine samples obtained by maceration-fermentation (classical system) of three varieties of black grapes from the Odobeşti and Iaşi vineyards, from the 2008 harvest.

The chromatic parameters of wine samples were calculated with the CIE Lab 76 methods, according to the absorption spectrum registered fort each sample. The spectra were processed using a computer program specifically created by the research staff in order to obtain chromatic parameters (L, a, b, C, H°), colour intensity (I) and hue (N).

The chromatic characteristics and the computerised simulation of wine colour using DIGITAL COLOUR ATLAS 3.0 software allowed an objective visual differentiation in wine colour and their sensorial classification.

Using the chromatic characteristics L, a, b, C and H^o one can calculate the colour differences by using the ΔE 1976 and ΔE 2000 formulae, to observe if the wines obtained from the same variety or different varieties can be distinguished with a naked eye.

The data presented, correlated with the organoleptic features, lead to the following conclusion: some of the analysed red wines can be registered in three quality categories DOC-CMD (Fetească neagră-Iaşi, Băbească neagră-Iaşi, Codană-Odobeşti), DOC-CT (Fetească neagră-Odobeşti, Băbească neagră-Odobeşti), IG (Codană-Iaşi).

Due to the modern technology present in the Enology Laboratory, the anthocyan profile was obtained, and these analyses can be used to distinguish the different grape varieties. Furthermore, data interpretation can be made by taking into consideration the possibility of a variation in anthocyan participation percentages and relative content due to the origin.

The analyses were made by using a HPLC method, where the anthocyanic compounds re determined by using a UV detector. For each chromatogram, the relative proportions of each anthocyan were calculated and identified: delfinidine-3-monoglicoside (Del-3-gl), cyanidine-3-monoglicoside (Cya-3-gl), petunidine-3-monoglicoside (Pt-3-gl), peonidine-3-monoglicoside (Po-3-gl), malvidine-3-monoglicoside (Mv-3-gl), peonidine-3-monoglicoside acetylated (Po-3-gl-acet), malvidine-3-monoglicoside acetylated (Mv-3-gl-acet), peonidine-3-monoglicoside cumarilated (Po-3-gl-cum), malvidine-3-monoglicoside cumarilated (Mv-3-gl-cum).

From the above mentioned chromatograms one calculated, according top the peak areas, the proportions of the main anthocyans, represented in area percentages, with a standard deviation, obtained after five consecutive determinations; the fact that the area percentage ratios of the most common anthocyans in wines are indicators for the used grape variety, was confirmed by the obtained data analysis, with the conclusion that the red wines can be distinguished also based on the values of area percentages of each main anthocyans.

In the study regarding the physical-chemical parameters involved in the plant-grape-wine relationship at the Romanian grape varieties harvested from Iaşi vineyard, the mean values of chlorophyll a (Ca), chlorophyll b (Cb) and carotenoids vary according to the harvest year.

Three types of questions arise:

- are there significant differences between the mean values of chlorophyll a (Ca) concentrations, in regard to harvest year?
- are there significant differences between the mean values of chlorophyll b (Cb) concentrations, in regard to harvest year?
- are there significant differences between the mean values of carotenoids concentrations, in regard to harvest year?

To sum it up, does the harvest year significantly influence the mean values of chlorophyll a (Ca), chlorophyll b (Cb) and carotenoids and in which degree?

From the ANOVA statistical analysis applied to the mean values of chlorophyll a, chlorophyll b and carotenoids concentrations found in the leaf samples in 2008 and 2009, the following conclusions can be drawn:

- for Armaş, Fetească albă, Fetească regală, Furmint de Miniş and Grasă de Cotnari, the harvest year significantly influences the mean values of chlorophyll a, chlorophyll b and carotenoids. The F crit = 11,26 < F = 14,53 shows that the harvest from the compared years differ significantly in respect to the mean values of carotenoids concentrations, the test being distinctly significant at 99,0% coverage probability (trust level) (P-value = 0,005 < p = 0,01).
- For the Galbenă de Odobeşti, Zghihară de Huşi and Cruciuliţă variety group, the harvest year significantly influences the mean values for chlorophyll a, chlorophyll b and carotenoids. The equation F crit = 21,19 < F (53,60, 46,69, 51,93) shows that the harvest from the compared years significantly differs in respect to the mean values of chlorophyll a, chlorophyll b and carotenoids, the test being distinctly significant at 99,0% coverage probability (trust level) (P-value = 0,002 < p = 0,01).
- For the Tămâioasă românească and Şarbă aromatic grape varieties, the harvest year does not influence the mean values of chlorophyll a, chlorophyll b and carotenoids. The equation F crit = 18,51 > F (3,59, 2,82, 1,39) shows that in the case of the compared harvest years, no significant statistical influence on the mean values of chlorophyll a, chlorophyll b and carotenoids concentrations exists, the test being insignificant at 95,0 coverage probability (trust level) (P-value = 0,19 > p = 0,05).
- For the grape varieties group with no common genitors, the harvest year influences very significantly the mean values of chlorophyll a, chlorophyll b and carotenoids concentrations. The equation F crit = 16,12 < F (36,38, 28,81, 21,59) shows that the compared harvest years differ very significantly, thus influencing the mean values of chlorophyll a, chlorophyll b and carotenoids concentrations, the test being very significant at 99,9% coverage probability (trust level) (P-value = 0,00002 (0,00006; 0,0003) < p = 0,001).

The organoleptic analysis of wines obtained from Romanian grape varieties harvested from Iaşi vineyard was conducted during a wine tasting session, by 13 wine-tasting specialists. In general, the wine analysis and grading can be made by many methods, but for this study the evaluation method used was that of the International Enology Union (UIO). This methods was performed on 26 wine samples from the conducted experiments, 10 white wines and 16 red and was based on attributing points according to the organoleptic properties of the wines.

The purpose of this method consists in realising a sensorial determined aromatic profile according to specific olphactory and taste aromas on the same grouping criteria in respect to the genitors.

The aroma characteristics of the 10 white wines are slightly different from the ones specific to red wines.