MINISTRY OF EDUCATION, RESEARCH AND YOUTH
"LUCIAN BLAGA" UNIVERSITY OF SIBIU
FACULTY OF AGRICULTURE, FOOD ENGINEERING AND ENVIRONMENTAL PROTECTION

ABSTRACT OF PHD THESIS

RESEARCH ON THE OPTIMIZATION OF THE TECHNOLOGY FOR OBTAINING THE RED WINES IN DRĂGĂŞANI VINEYARD

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FOREWARD

PhD thesis " Research on the optimization of the technology for obtaining the red wines in Drăgăşani vineyard " was developed under the leadership of highly competent and professional integrity of the scientific leader Prof.PhD Eng. **Ovidiu Tița.**

I would like to bring special thanks to all those who helped me to complete what I have started in 2008. First I thank to my coordinating teacher, PhD Eng. Ovidiu Tița who during these three years directed and supported me in finding the best solutions and opportunities to achieve the proposed goals.

Many thanks to the staff of the *Research Station for Viticulture and Winemaking Dragasani Development*, to Mr. Director **Florea Valentin**, to PhD student eng. **Dinu Daniel Grigorie** and especially to PhD eng. **Gheorghe Condei**, who gave me full support in carrying out this research.

In order to complete the research objectives from the production process my gratitude goes to Mr. Eng Iordache Gheorghe the owner of the *Drăgăşani Iordache House Wines.*

Many thanks for the team of researchers from Research - Development National Institute for Cryogenic and Isotopic Technologies- Rm.Vâlcea ICSI, especially Prof.PhD Eng. **Ioan Stefanescu** and ladies: PhD eng. **Roxana Ionete**, Dr. phys. **Diana Costinel** and PhD student Chim. **Birăruţi Irina**, who helped me to analysis.

Thank the committee for evaluation and support the PhD Thesis.

More than simple gratitude, am address I especially to for my husband, my children and my parents, who raised my morale and supported me whenever it was needed.

I cannot end without addressing sincere my thanks to all who directly or indirectly supported me in making and completing the study.

Eng. Axenia Rădulescu

CONTENT

INTRODUCTION[1]

Wine is a drink produced exclusively by alcoholic fermentation complete or partial of the fresh grapes or in the must of fresh grapes ("Law on Vine and Wine", 244/2002).

Red wines are quality wines which are produced from black grapes and have special sensory characteristics compared to other wines.

A general phenomenon observed in recent years worldwide, is the gradual orientation the preference of the consumers of the current wine consumer to high quality red wines.

In the *Drăgăşani vineyard*, now, plantations vine are cultivated in the proportion of ¾ grape varieties for *white wines* and only ¼ grape varieties for *red wines* and is necessary to increase production of *high quality red wines*.

Manufacturing technology of red wine is different from the manufacturing technology of white wine in that the grape must is not quickly separated of the solid parts, but is maintained as defined in contact with them, in order to extract dye substances (phenolic compounds) located in the solid parts of the grains and especially the skin. For this technology provides a binding operation called maceration - fermentation on the pomace.

Particular attention should be given to optimal the timing of harvesting black grapes - to *phenolic maturity* - and the *operation of maceration*, aiming to intensify of this process, which leads to more rapid enrichment the must of the grapes in compounds belonging to the solid phase.

These few considerations highlight the opportunity and importance of research related production of quality red wines at superior quality parameters

The study was conducted in 2008-2010, and was aimed mainly to the optimization of the technology to obtain red wine in Drăgăşani vineyard. In the context of current research, the thesis has the following specific scientific objectives:

1. The study of the natural factors that determine quality red wine Drăgăşani
2. The study of the evolution of the physico-chemical characteristics and anthocyanin content of grapes Cabernet Sauvignon and Merlot in Drăgăşani vineyard, in 2008-2010;
3. The study of factors what influence the operation of maceration-fermentation
4. The study of the process of maturation of red wine in Drăgăşani vineyard
5. The study of the anthocyanin fingerprint of red wine the Drăgăşani vineyard
6. The study of isotopic fingerprinting of red wines the Drăgăşani vineyard

The PhD thesis is structured in two parts:

I) Documentary study

II) Experimental part

[1] *The numbering of chapters, tables, figures, appendices and bibliographical indications of this summary is the same numbering of thesis*

The documents study, structured in three chapters (1, 2 and 3) presents data from the literature with reference to the situation of the sector the vine and wine, the Drăgăşani Vineyard presentation, the history Dragasani vineyard,the technology to obtain quality red wine, the phenolic composition of grapes, musts and wines and their implications for red wine color

The experimental part, which includes the results of the research made the PhD student during the doctoral internship, is structured in five chapters, as follows:

Chapters 4, *Experimental conditions,* presents data on the natural factors that determine quality Drăgăşani red wines as well: geographical location, relief, vicinities, soil, climate indicators year on year in the vegetation period and in the period maturing: average temperature, minimum, maximum, global thermal balance , active, useful, the hours of effective brightness of the sun, of precipitation amount, relative air humidity.

Chapters 5, called *Experimental Results* includes five chapters:

5.1. The study of the evolution of the black grapes in Drăgăşani vineyard, which describe the materials and methods of analysis used to the assessment of the evolution the physico-chemical indices during the maturation of the grapes, to determine 5the moment of the full maturity and of the phenolic maturity at grapes destined to obtain high quality red wines in the vineyard Drăgăşani.

5.2. The study of the process of maceration - fermentation presents the results of investigations which aimed the evaluation of the influence of factors such as regime sulphitation, thermal regime, mode mixing and the sowing regime with enzymes, active yeast or addition of alcohol in wine distillate in marc, over

the content of anthocyanins, the intensity of colors, tints and content of total polyphenols.

5.3. The study of the maturation of the red wine in vineyard Drăgăşani presents the evolution of the intensity of colors, the tints, the total polyphenols content and in the extract content, during the wine maturing in oak barrels and aging in bottle.

5.4. The study of the anthocyanin fingerprint of red wine in Drăgăşani vineyard presents the percentage of free and acyl anthocyans which reflects anthocyanins specrul of the grapes from which comes the wine.

5.5. The study of the isotopic fingerprint of red wines in Drăgăşani vineyard presents isotopic ratios $\delta\ ^{13}C/\ ^{12}C$ and $\delta\ ^{18}O/\ ^{16}O$ of ethanol extracted from wines studied and isotopic ratios $\delta\ ^{2}H/\ ^{1}H$ and $\delta\ ^{18}O/\ ^{16}O$ of water from Drăgăşani vineyard (the groundwater and precipitation).

Chapters 6, *Conclusions,* summarizes the results of theoretical and experimental research in this the PhD thesis.

Chapters 7, *Personal contributions and perspectives of further research,* specifies the author's personal contributions and suggests directions that research can continue on this theme

Chapters 8, *Dissemination of the research performed*, presents the list of the papers published in the field addressed in the doctoral studies. Are mentioned 16 titles of papers published in journals of international research or in volumes of internationally recognized scientific, of which eleven as first author.

References, includes a bibliographical list of 245 titles, of which 45% are publications of the last 10 years.

The paper includes 42 tables and 105 figures.

II. EXPERIMENTAL PART

CHAPTER 4. EXPERIMENTAL CONDITIONS

4.1. The study of natural factors that determine the quality of the Drăgăşani red wine

Quality and typicity of wines is determined by several factors such as: the geographic location, the relief, the vicinities, the soil, the climate, the vinifera varieties to which is added the technology for obtaining the wines.Dragasani vineyard is geographically situated between 44^0 27'-45^0 14' north latitude and 23^0 47' – 24^0 26' longitude. The altitude rises from south (140 m in Oporelu) to north (463m in Scundu). Drăgăşani Vineyard is the oldest and most famous vineyard of Oltenia, called "podgoria Banilor Craioveşti". It is located in the center of Getic Plateau, it includes lands lying between the rivers Olt, Olteţ, Cerna and Vedea. Vineyard includes the seven rows of hills parallel to the river Olt, and extends over a length of 60 km on the right Olt. Vineyard is located on lands whose elevation is between 137m (terrace Olt) and 463m (Hilly Scundu), distributed 70% on slope, 20% on set and 10% on plain.

Figure 4.1.1. *Satellite images of Getic Plateau and the Olt Valley (Processing site Google)*

Figure 4.1.3: *Satellite images of the terraces on the Olt Hilly (Processing site Google)*

Figure 4.1.11. *Vineyards on the Olt Hilly and luster water (Archive SC AGRICOLA STIRBEY SRL)*

In Drăgăşani vineyard, the fragmentation of the Getic Plateau by rivers led to the formation of a hilly relief, with aspect platform predominantly at eastern and the hills at north. Slopes are arranged in terraces with cross slope of 5-7%. The presence in the vicinity of the vine forests, rivers and of dams the accumulation on the Olt River, influencing favorable the quality of the grapes and the wines obtained.

The Drăgăşani vineyard disposes the necessary conditions for cultivation the black grape varieties from which it can be obtained a high quality of red wines and with designation of controlled origin

4.2. Study climate conditions during the research

All vegetative processes of the vine - trees bud formation, shoot growth, flowering, growth and ripening grapes ripen wood, frost - resistance are closely related to thermal regime.

There were us to characterize ecoclimatice conditions during experimentation several ecoclimatice indicators: annual average temperature, sums global monthly temperatures (ΣTg) sums of active monthly temperatures (ΣTa), sums of useful monthly temperatures (ΣTu), the global thermal balance (BTG), the active thermal balance (BTA), the useful thermal balance (BTU), absolute minimum air temperature, absolute maximum air temperature, sunstroke real (Ir), the amount rainfall of annual, during vegetation and during maturation.

Annual average temperature values are of 11.96^{0}C (2008), the 12.22^{0}C (2009) and 12.68^0 C (2010).

Global thermal balance resulting from summing average temperatures above 0^{0}C. In 2008, in ecoclimatice terms of "Dragasani" vineyard global heat balance was 4562^{0}C in 2009 value of 4735.2^{0}C and 2010 respectively 3922.7^{0}C.

Active thermal balance was obtained by summing the average daytime temperatures above 10^{0}C, considered as a biological threshold of vine growth. Active thermal balance in 2008 has value of 4000.4^0 C, of which in the vegetation period was 3736.7^{0}C. In 2009 the active thermal balance has value of 4336.6^{0}C which in the vegetation was 4001.4^{0}C. In 2010 the active thermal balance has value of 3695.7^{0}C , of which in the vegetation was 3555.2^{0}C.

Useful thermal balance (effective) is calculated by summing the average daytime temperatures in which have decreased the temperature of the biological threshold of 10^{0}C (t-10^{0}C). In 2008 useful thermal balance has registered annual value of 1800.4 ° C, and during the vegetation had a value of 1756.7^{0}C. In 2009 useful thermal balance has registered annual value of 1988.1^{0}C and during the vegetation had a value of 1960.5^{0}C.
In 2010 useful thermal balance has registered annual value of 1675.7^{0}C and during the vegetation had a value of 1655.2^{0}C.

The average temperature of the warmest months (July and August) is an indicative criterion for assessing of the conditions of quality of the grapes. Average temperature in July has been of 22.5^{0}C in 2008, of 23.3^{0}C in 2009 and respectively 22.7^{0}C in 2010.

Average temperature in August was of 24.3^{0}C in 2008, of 22.9^{0}C in 2009 and of 24.3^{0}C in 2010 .

The average temperatures during vegetative had values of 18.03^{0}C (in 2008), the 18.33^{0}C (in 2009) and 17. 49^0 C (in 2010).

The average temperatures during maturation had values of 17.900C (in 2008), to 17.83 0 C (in 2009) and 17.000C (in 2010).

Absolute maximum temperature in August is restrictive when it exceeds 42^{0}C value measured in the shade . Absolute maximum temperature had value of 36^{0}C(August 14, 2008), of 35.1^{0}C (April 8, 2009) and 36.4^0 C (August 15, 2010).

Absolute minimum temperatures harmful to vines are temperatures below -20^{0}C. Temperatures lowest in years of study were recorded on January 12, 2008 (-13.90 C), on December 21, 2009 (-15.50 C) and January 25, 2010 (-17.3^{0}C).

Number of days during vegetation between the date when the average temperature has stabilized over 10^{0}C (spring) and autumn until the first frost varies between 191 days (in 2008) and 193 days (in 2009 and 2010).

Light expressed by luminous energy flow is estimated after the sum of the hours of brilliance the sun during one year and in the vegetation period. Real sunstroke result by summing the effective hours of brilliance of the sun. Duration of brilliance the sun in the vegetation period was of 1769.4 hours (in 2008) of 1758.4 hours (in 2009) and 1722 hours (2010). Annual duration of brilliance the sun was 2387.8 hours (in 2008) of 2283.2 hours (in 2009) and 2257.2 hours (in 2010).

Precipitation. In our country the cultivation of vines without irrigation is possible in the conditions some rainfall ranging between 400-700 mm of which 250 mm during the vegetation period. In (2008) rainfall in the period vegetation has been of 481.9 mm, in (2009) of 462.8 mm, and (2010) of 351mm. Pluviometric dates indicates average annual amounts of precipitation of 592.2 mm (2008), of 673.7 mm (2009) and 708.1 mm (2010).

Relative air humidity. The vine develops very well to the content atmospheric humidity between 70 ÷ 80%. In the years of the study, atmospheric humidity has varied between 53% (March 2008) 90% (in January 2010).

CHAPTER 5. EXPERIMENTAL RESULTS

5.1. The study of the evolution of the black grapes in Drăgăşani vineyard

The purpose of the undertaken research was to study the evolution of the physico-chemical indices and anthocyanin content during maturation of the grapes Cabernet Sauvignon and Merlot, in the Drăgăşani vineyard, in the period 2008-2010 and establishing the harvest date, depending on the variety and the climatic conditions of the year of harvesting.

The date of full maturation of the grapes was determined analyzing the dynamic of the main indicators in sugar content, total acidity and weight of 100 grains.

In the three years of study, the full maturity was observed to occur between 05.X and 15.X for Cabernet Sauvignon, and between 01.X and 10.x for Merlot.

To obtain superior quality red wines, the analyze the sugar content and the acidity are not sufficient to express the quality of the harvest. Analysis of phenolic maturation by following the evolution of the anthocyanin content of berries with monitoring glucoacidimetric index (ratio of sugar concentration and total acidity), is the only way to properly assess the optimal date of harvest a black grapes.

In figures 5.1.20 ÷ 5.1.25 are presented the evolutions of the phenolic maturation at Cabernet Sauvignon and Merlot grapes in the three years of study: 2008, 2009,2010.

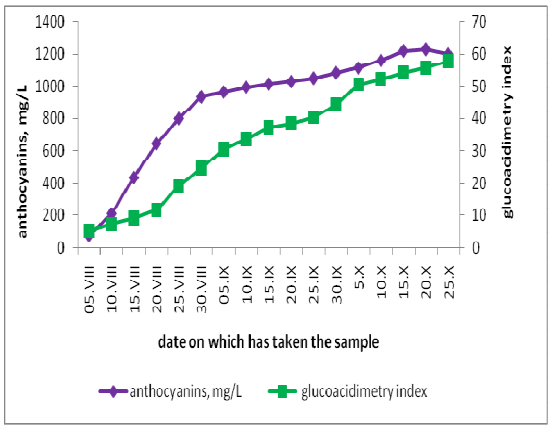

Figure 5.1.20. *Evolution of phenolic maturation at Cabernet Sauvignon 2008 (personal archive)*

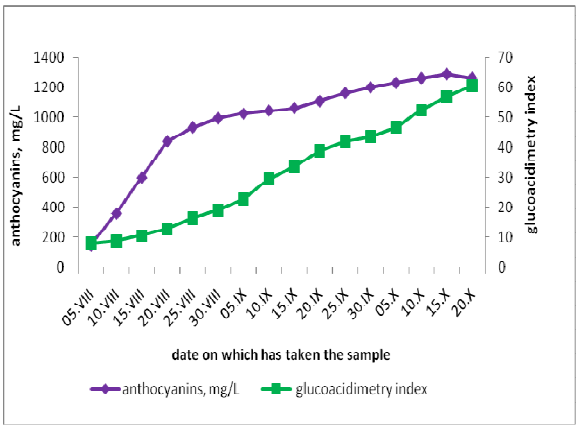

Figure 5.1.21. *Evolution of phenolic maturation at Cabernet Sauvignon 2009 (personal archive)*

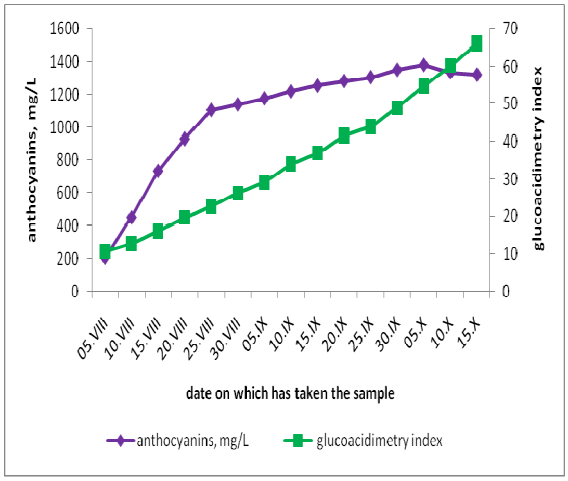

Figure 5.1.22. *Evolution of phenolic maturation at Cabernet Sauvignon 2010 (personal archive)*

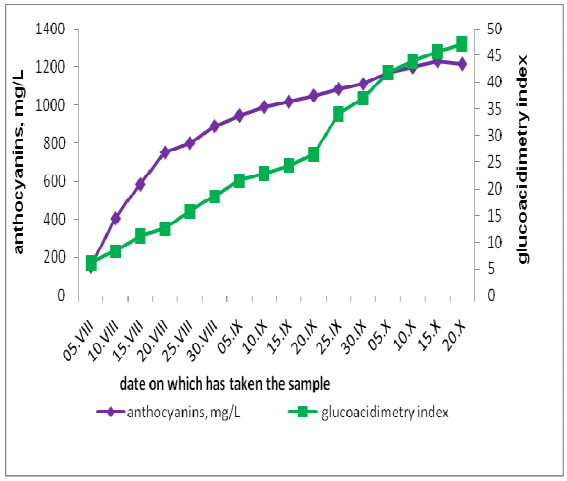

Figure 5.1.23. *Evolution of phenolic maturation at Merlot 2008 (personal archive)*

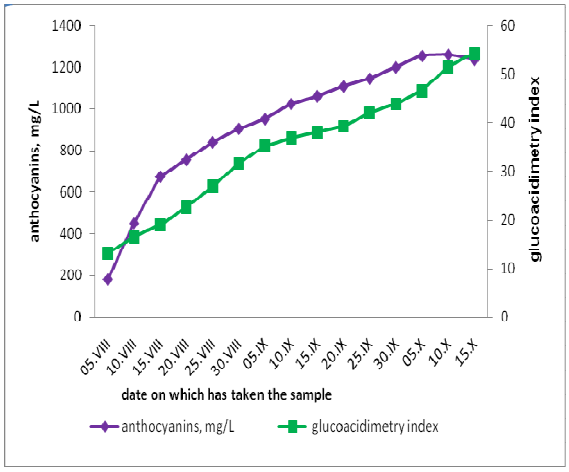

Figure 5.1.24. *Evolution of phenolic maturation at Merlot 2009 (personal archive)*

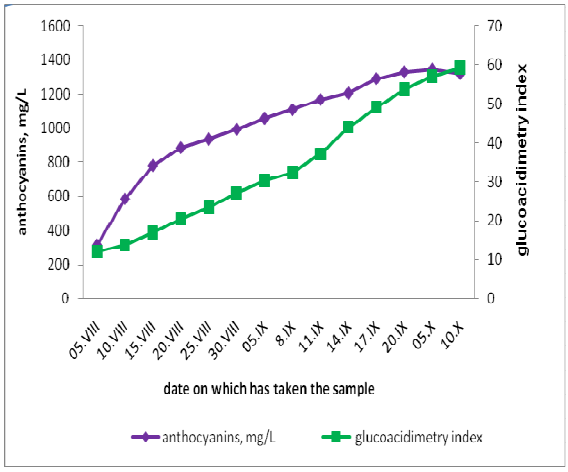

Figure 5.1.25. *Evolution of phenolic maturation at Merlot 2010 (personal archive)*

In the three years of study, it is found that phenolic maturity is achieved at varieties studied after full maturity at about 10 days, between 15.X and 25.X for Cabernet Sauvignon, between 10.X and 20.X for Merlot.

Maximum anthocyanin content of grapes does not correspond to maximum anthocyanin content in the wines. Correlated with phenolic maturity, the phenomenon is explained by the increase the extraction of the anthocyans in the skin at maturing over grapes. At super maturing, content of the anthocyanin of grapes is lower, but the wine has a higher content of the anthocyanin

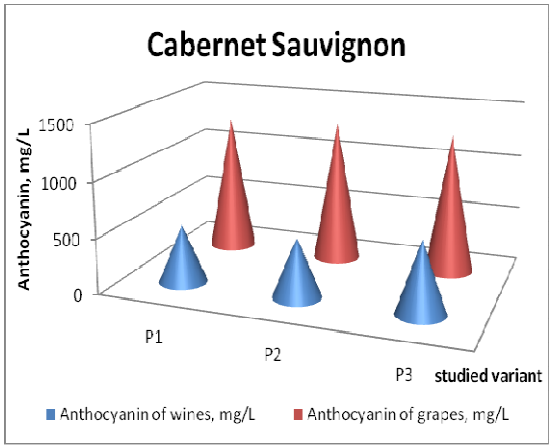

Fig. 5.1.26*: The content of anthocyanins in grapes and in wine at different times of harvesting of the grapes (personal archive)*

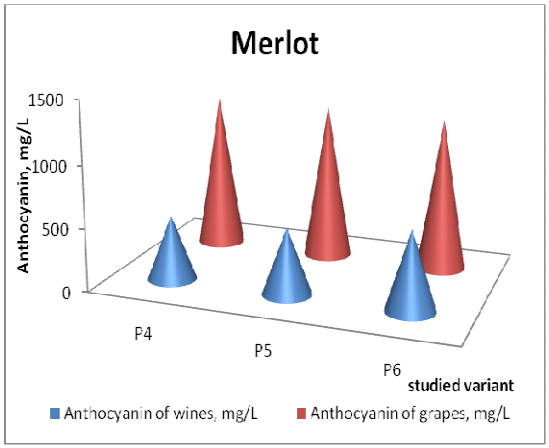

Fig. 5.1.27: *The content of anthocyanins in grapes and in wine at different times of harvesting of the grapes (personal archive)*

5. 2. The study of the process of maceration – fermentation

The quality of red wines does not only depend on their quality, but also on the vinification process. By the application of technology corresponding of work can obtained red wines with a deep red color, fresh bouquet, personality, typical of the variety , harmonious taste, lack of toughness and bitter, rich in components with beneficial effects the consumer. Choosing adequately for wine production system, the working parameters and treatments applied can improve the quality red wines in Drăgăşani vineyard .

During maceration process - fermentation of the grape must on the marc, the extraction of phenolic compounds in the skin of the grapes can be improved through the optimization of the dose of SO_2 used for sulphited the marc, through the maceration temperature optimization, through optimal mixing of the marc, by the addition of alcohol in wine or selected enzymes and yeasts, and by determining the optimum maceration period. Type of processing of black grapes influenced the anthocyanin content, the coloring intensity , the tint, the polyphenol content, and the quality of the wines which were obtained.

Purpose of the research was to study the influence of factors (sulphitation regime, temperature, mixing regime, enzymes, yeast) on the operation of maceration - fermentation in order to obtain the high-quality red wines in Dragasani vineyard.

To analyze the process of maceration - fermentation in rotating thermostat tank was used as raw material for experimentation the black grape of the variety Cabernet Sauvignon 2009 from Vineyard Drăgăşani harvest.

Based on the obtained results there were established the optimal conditions of maceration – fermentation for obtaining high quality of red wines from the "Drăgăşani" vineyard: the total sulfur dioxide content of 80 to 100 mg / L, temperature 25 ° C, mixing regime: 2x5min / day, duration the maceration - fermentation of the marc: 7 days.

5.3. The study of the maturation of the red wine in vineyard Drăgăşani

Best red wines evolves by maintaining them in oak vessels. The term of *'Wine matured in barique* " on the bottle label can be made only if the wine was stored in oak vessels at least 6 months.

In phase of aging of the wines takes place reactions with reducing character (at a low oxidation-reduction potential), since is cut off the contact the oxygen with the wine.

The bouquet of the bottled wines is amplified, particularly on the basis of processes of esterification and acetilization. A contribution in this sense bring slow oxidations of certain substances under the action the oxygen incorporated during bottling into the wine or the oxygen permeated through the pores of oak.

Obtained results at analysis during the maturation and the aging of wine Cabernet Sauvignon are presented in Figures 5.3.2-5.3.5: in Fig. 5.3.2 - the evolution of the coloring intensity, in Fig. 5.3.3- the evolution of the coloring tint, in Fig. 5.3.4-the evolution of the total polyphenol content, and in Fig. 5.3.5-the evolution of the extract.

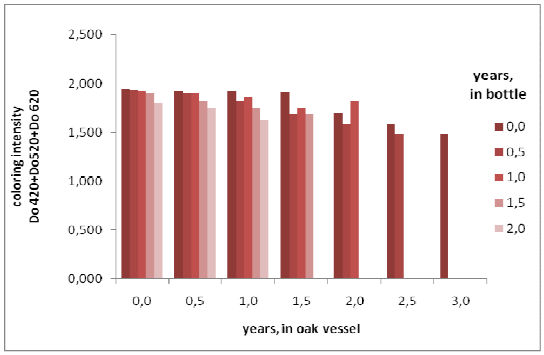

Fig.5.3.2.: *The Evolution of the coloring intensity (personal archive)*

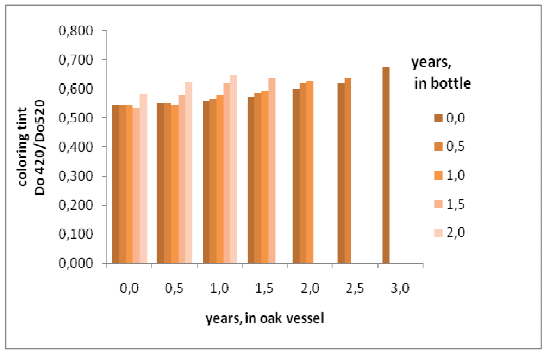

Fig.5.3.3.: *The Evolution of the coloring tint (personal archive)*

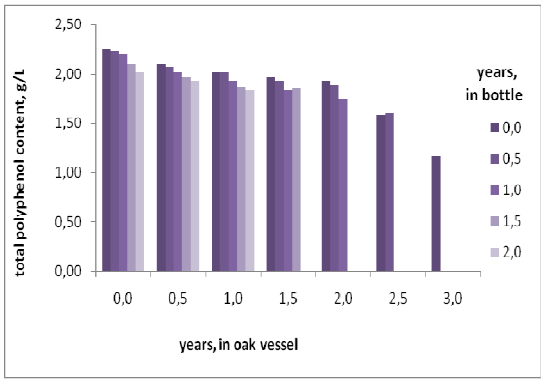

Fig.5.3.4.: *The Evolution of the total polyphenol content (personal archive)*

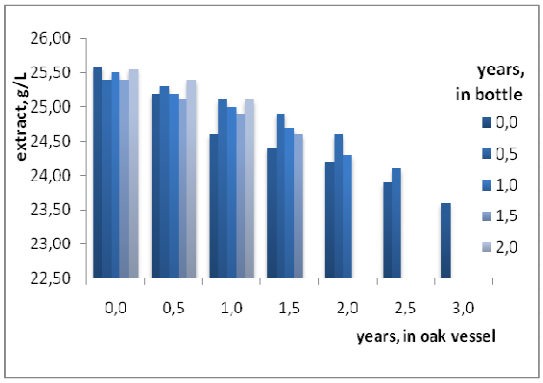

Fig.5.3.5.: *The Evolution of the extract (personal archive)*

The quality potential of Drăgăşani red wines obtained from the Cabernet Sauvignon occur most in the process of maturing in oak barrels and aging in bottles.

Through maturing of red wines from Cabernet Sauvignon in oak vessels and the aging in glass vessel, it was made an obvious improvement of the organoleptic characteristics and the chemical composition.

Speed and intensity of evolutionary processes were higher during the first years of maturing the wine in the oak vessels and the first year of aging in glass.

There were obtained through maturing for two years in oak vessels and aging one year in bottles the fine wines, round, with a pleasant bouquet.

5.4. The study of the anthocyanin fingerprint of red wine in Drăgăşani vineyard

The fingerprint of the anthocyanins in red wines in Drăgăşani vineyard , expressed in percentage of free and acyl anthocyans reflects the spectrum of the anthocyanins of grapes from which originates wine. For establishing the fingerprint of the anthocyanin in red wines were analyzed the free and acyl (acetyl + coumaryl) anthocyanin of Cabernet Sauvignon wines Drăgăşani, obtained from grapes from the Olt Hill , the harvests 2008,

2009, 2010 and Merlot harvest2009. Wine was matured 1.5 years in oak vessel in the wine Iordache cellar, then bottled in 750 ml glass bottles, sealed with cork stopper and stored in the same wine cellar up to perform analyzes. It has been used high performance liquid chromatography (HPLC) with spectrophotometric detection by which is determined free glucoside anthocyanins in wine. The results are presented in the chromatograms in figure 5.4.15 - 5.4.18

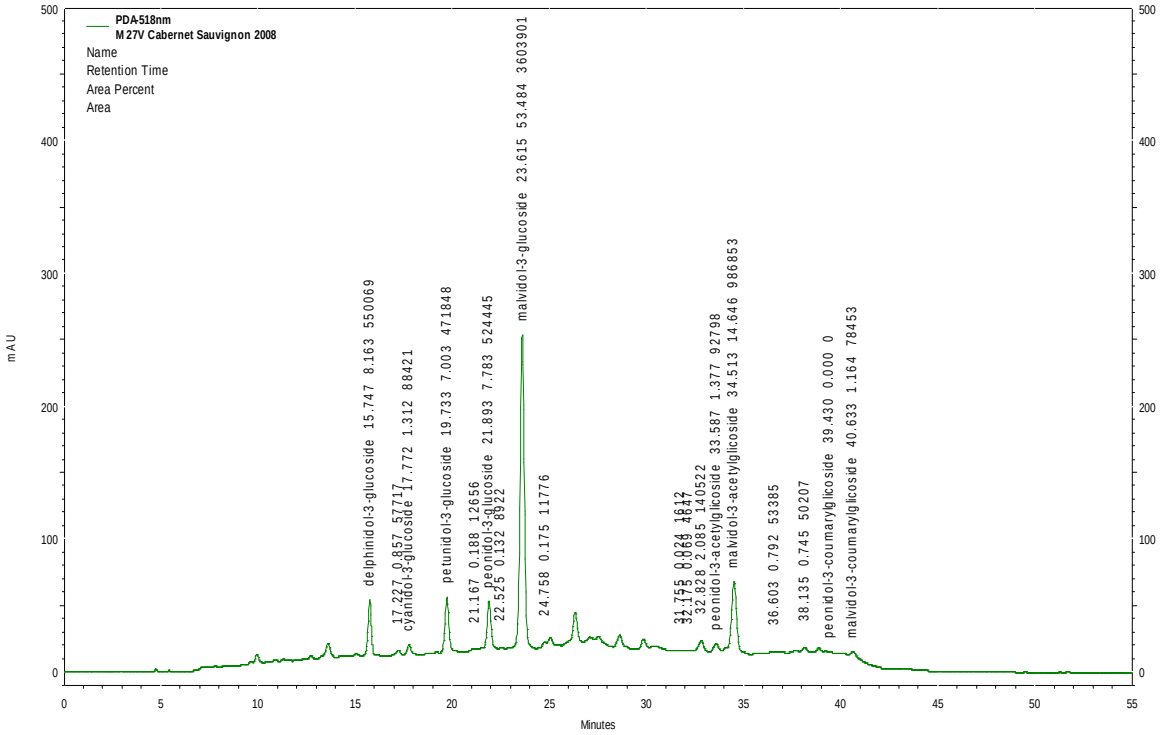

Fig. 5.4.16 – *Cramatograma for Cabernet Sauvignon 2008 (M1) (personal archive)*

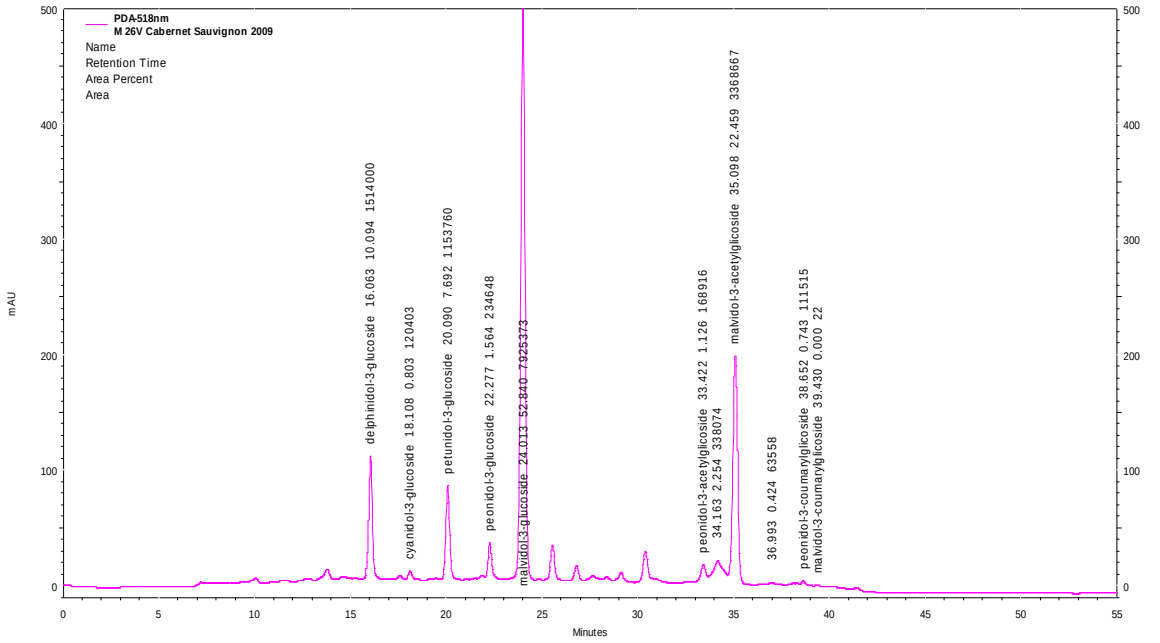

Fig. 5.4.17 – *Cramatograma for Cabernet Sauvignon 2009 (M2) (personal archive)*

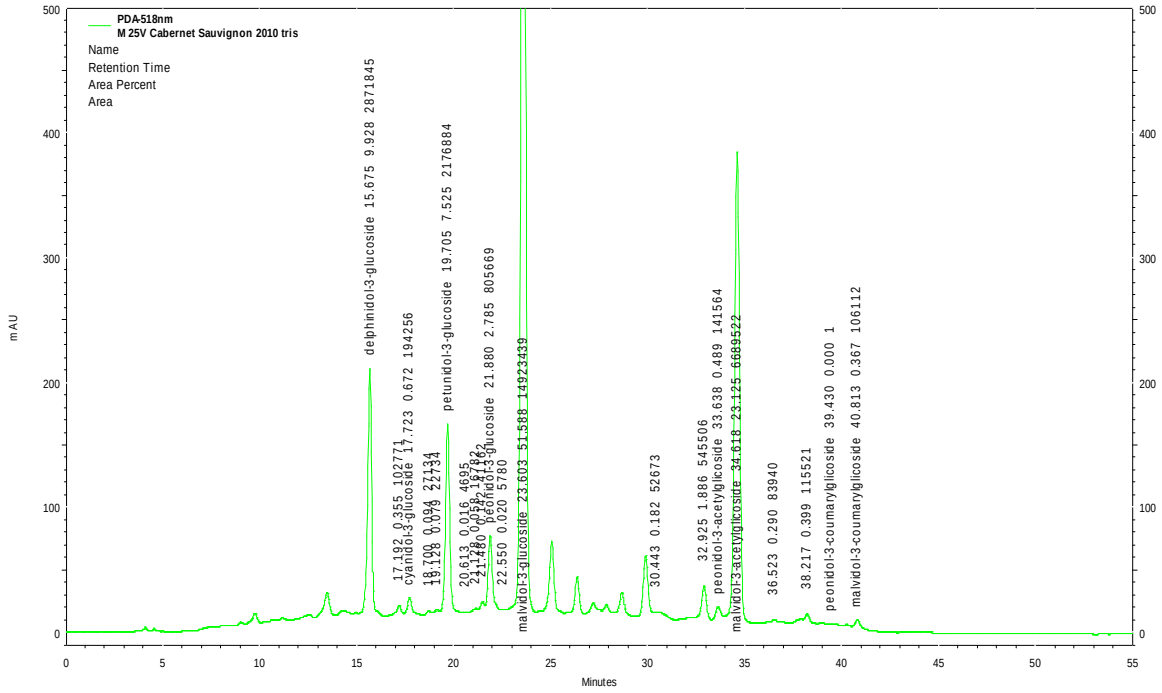

Fig. 5.4.18 – *Cramatograma for Cabernet Sauvignon 2010 (M3) (personal archive)*

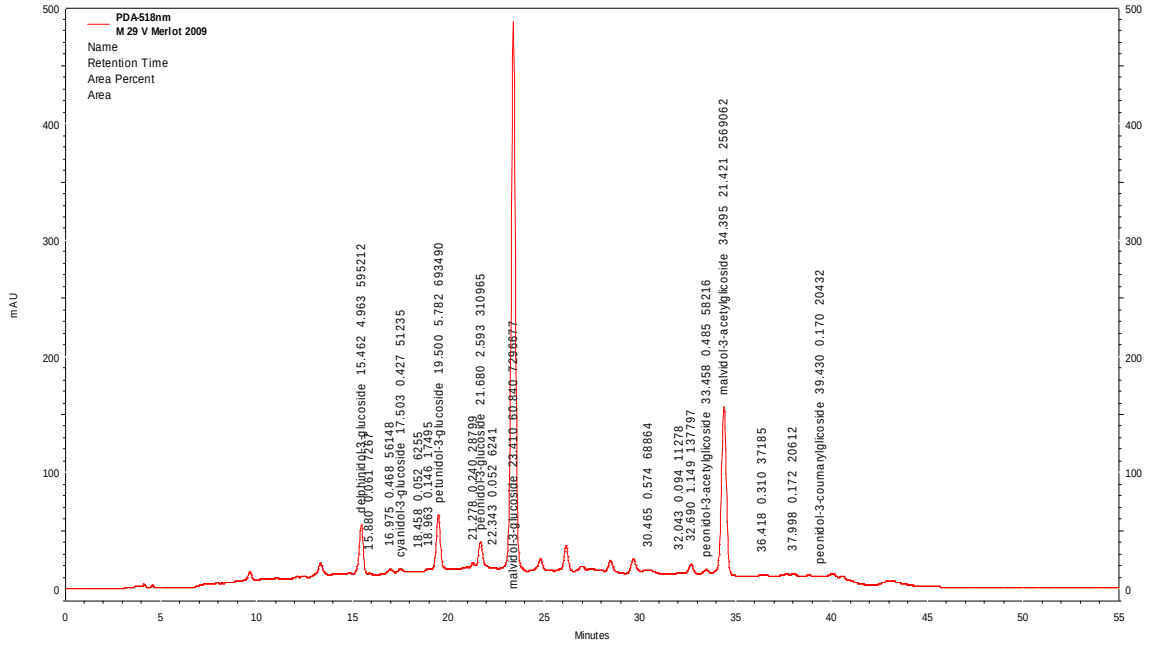

Fig. 5.4.19 – *Cramatograma for Merlot 2009 (M4) (personal archive)*

In the case Cabernet Sauvignon in Drăgăşani vineyard , the highest percentage of anthocyanins possess malvidol-3-glucoside (from 53.484% in 2008 to 51.588% in 2010), followed by malvidol-3-acetylglicoside (between 23.125 % in 2010 and 14.646% in 2008) and delphinidol-3-glucoside (from 10.094% in 2009 to 8.163% in 2008). The lowest proportions are at malvidol-3-coumarylglicoside (between 0.367% in 2010 and 1.164% in 2008), peonidol-3-acetylglicoside (between 0.489% in 2010 and 1377% in 2008) and cyanidol-3-glucoside (between 0.672% in 2010 and 1.312% in 2008).

In the Merlot 2009 wine in Drăgăşani vineyard is kept about the same order of the proportions of the anthocyans as in the Cabernet Sauvignon wines. The largest proportion of the anthocyanins holds malvidol-3-glucoside (60.84%), followed by malvidol-3-acetylglicoside (21.421%) and delphinidol-3-glucoside (8.163%). The lowest proportions are monoglucozid peonidol-3-acetylglicoside (0.485%) and cyanidol-3-glucoside (0.427%).

5.5. The study of the isotopic fingerprint of red wines in Drăgăşani vineyard

Determining the composition of natural in stable isotopes or radioactive to a wine is one of the applications performance analytical chemistry namely establish the connection relationship between the final product (wine) and the raw materials (water, CO2) in their natural environment.

Isotopic fingerprinting of wine involves many aspects, for example determining the geographical origin, year of harvest, grower the wine and quality .

It is therefore necessary that the proof of authenticity of wine to be based on the specific parameters of origin that does not change during vinification or are difficult to falsify.

Isotopic analysis on water and alcohol from the wine is integrated into a global program of the European for establish authenticity wines.

The isotopic analyzes were performed in the Laboratory for analysis Physico-chemical, the environmental and food quality LAFMCA of the National Research and Development Institute for Cryogenic and Isotopic Technologies ICSI Rm.Vâlcea. The laboratory is equipped with two magnetic sector mass spectrometers with continuous flow of new generation CF-IRMS (Isotope Ratio Mass Spectrometer Continuous Flow) DELTA V Plus, coupled to a series of sample preparation modules of specific analysis of stable isotopes (deuterium, carbon 13 and oxygen 18):

a) System of balancing GasBench II: the determination of isotopic ratio $D/H_{vsVSMOW}$ and $^{18}O/^{16}O_{vsVSMOW}$,

b) *Elemental analyzer EA 1112 HT:* to measure isotopic ratios $^{18}O/^{16}O$, D/H, $^{13}C/^{12}C$

Figure 5.5.1.: *Continuous flow mass spectrometer to determine reports of stable isotopes CF-IRMS DELTA V Plus (LAFMCA- ICSI Rm Vâlcea)*

Extraction of ethanol and water in the wine

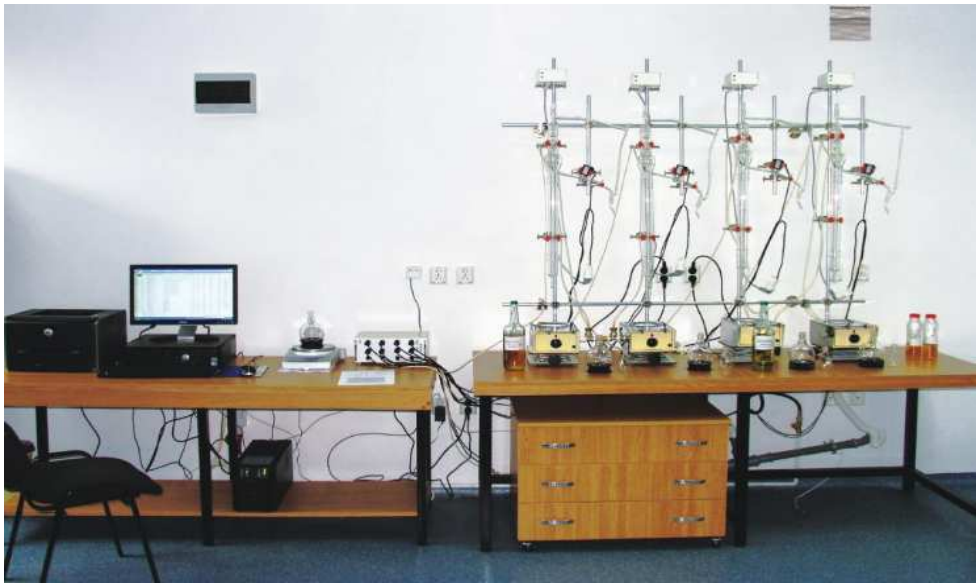

Figure 5.5.4.: *System fractional distillation automatically four collars CADIOT –A.D.C.S. (LAFMCA- ICSI Rm Vâlcea)*

Isotopic analysis itself:

- **Determination of stable isotopes deuterium and oxygen 18:**

Figure 5.5.5.: Preparation of samples for balancing the system *GasBench II (LAFMCA- ICSI Rm Vâlcea)*

Figure 5.5.6: *Introduction the vials with sample in the system of balancing GasBench II (LAFMCA ICSI Rm Vâlcea)*

There were used for experiments Cabernet Sauvignon wines samples, obtained from grapes from the Olt Hill, the harvests: 2008, 2009, 2010, and Merlot harvest 2009.

As a completion to isotopic data of red wines in Drăgăşani vineyard were analyzed isotopes of two water samples from wells.

The obtained results in determining the isotopic ratios $\delta^{13}C$ and $\delta^{18}O$ of the ethanol extracted from analysis wines and results obtained in determining the isotopic reports $\delta^{1}H$ and $\delta^{18}O$ in the waters analyzed are presented in Table 5.5.6.

Table 5.5.6.: *Values of isotopic ratios obtained for samples of red wine, DOC and water Drăgăşani growing zone from where the samples of wine:*

Nr.	Sample	Analysis report LAFMCA02	$\delta^{13}C_{VPDB}$ (‰)(1)	$\delta^{18}O_{VSMOW}$ (‰)(1)	$\delta^{2}H_{VSMOW}$ (‰)(1)
1.	**M1** *Cabernet Sauvignon, 2010, DOC-CT sec*	24/06.02.2012	**-26,50 ± 0,32**	**0,39 ± 0,20**	**-**
2.	**M2** *Cabernet Sauvignon, 2009, DOC-CT sec*	25/06.02.2012	**-26,59 ± 0,32**	**0,28 ± 0,20**	**-**
3.	**M3** *Cabernet Sauvignon, 2008, DOC-CT sec*	26/06.02.2012	**-26,33 ± 0,32**	**3,50 ± 0,20**	**-**
5.	**M4** *Merlot, 2009, DOC-CMD, demisec*	28/06.02.2012	**-26,53 ± 0,32**	**3,53 ± 0,20**	**-**

6.	**M5** *the water fountain of the Via Iordache (23.01.2012)*	58/16.02.2012	**-**	**-9,42 ± 0,20**	**-66,92 ± 0,44**
7.	**M6** *the water fountain Drăgăşani-city (23.01.2012)*	58/16.02.2012	**-**	**-9,35 ± 0,20**	**-66,54 ± 0,44**

The approach of the isotopic fingerprinting of samples of wine for this paper took into account the national and international interest for the development of new analytical methods to authenticate the origin, both geographical and botanical raw material for wine and how they influence climate conditions and grower this fingerprint. Was observed as isotopic ratios (Carbon 13 and Oxygen 18) of natural wines obtained in different years of production varies inversely proportionate with active thermal balance with precipitations during the maturation of grapes and proportionate to the duration of brilliance the sun during the maturation of the grapes of those years. Isotopic fingerprinting authenticated vineyard, harvest year and the quality of wine, if there is a database updated of the vineyard and the precipitations of those years.

CHAPTER 6. CONCLUSIONS

Through correlating the experimental results obtained with the scientific objectives of the thesis and formulation of the partial conclusions from the experimental studies results the following general conclusions:

1. PhD Thesis aimed the study the optimization of the technology for obtaining red wines in Drăgăşani vineyard. The research was performed during the period 2008 - 2010

2. The quality and characteristics of the red wine in "Dragasani" vineyard is due essentially the conditions of cultivation of the vine, the geographical environment with its natural and human factors.The Drăgăşani vineyard dispose the conditions necessary cultivation the black grape varieties from which to can obtained high-quality red wines with designation of controlled origin. The 2009 year was the year the most productive between years of study, given that the BTG, BTA, BTU has achieved the highest values, plus significant precipitations in August. Duration of brilliance the sun in the months August and September 2009 lower than in 2010, has yielded black grapes poorer in the sugars and the anthocyanins that those in 2010, but richer as those of 2008, when BTG, BTA, BTU registered the lowest values in years of study.

3. In the technology for obtaining quality red wines, a very important role it represented by the time of harvest the black grapes. In the three years of study, it is found that phenolic maturity is achieved at varieties studied after full maturity at about 10 days, between 15.X and 25.X for Cabernet Sauvignon, between 10.X and 20.X for Merlot.

4. The quality of red wines does not only depend on their quality, but also on the vinification process. By the application of technology corresponding of work can obtained

red wines with a deep red color, fresh bouquet, personality, typical of the variety , harmonious taste, lack of toughness and bitter, rich in components with beneficial effects the consumer. Choosing adequately for wine production system, the working parameters and treatments applied can improve the quality red wines in Drăgăşani vineyard .

Based on the obtained results there were established the optimal conditions of maceration – fermentation for obtaining high quality of red wines from the "Drăgăşani" vineyard: the total sulfur dioxide content of 80 to 100 mg / L, temperature 25 ° C, mixing regime: 2x5min / day, duration the maceration - fermentation of the marc: 7 days.

5. The quality potential of Drăgăşani red wines obtained from the Cabernet Sauvignon occur most in the process of maturing in oak barrels and aging in bottles. Through maturing of red wines from Cabernet Sauvignon in oak vessels and the aging in glass vessel, it was made an obvious improvement of the organoleptic characteristics and the chemical composition. Speed and intensity of evolutionary processes were higher during the first years of maturing the wine in the oak vessels and the first year of aging in glass. Were obtained through maturing in oak vessels for two years and aging one year in bottles, fine wines, round, with a pleasant bouquet.

6. In the case Cabernet Sauvignon in Drăgăşani vineyard , the highest percentage of anthocyanins possess malvidol-3-glucoside (from 53.484% in 2008 to 51.588% in 2010), followed by malvidol-3-acetylglicoside (between 23.125 % in 2010 and 14.646% in 2008) and delphinidol-3-glucoside (from 10.094% in 2009 to 8.163% in 2008). The lowest proportions are at malvidol-3-coumarylglicoside (between 0.367% in 2010 and 1.164% in 2008), peonidol-3-acetylglicoside (between 0.489% in 2010 and 1377% in 2008) and cyanidol-3-glucoside (between 0.672% in 2010 and 1.312% in 2008). In the Merlot 2009 wine in Drăgăşani vineyard is kept about the same order of the proportions of the anthocyans as in the Cabernet Sauvignon wines. The largest proportion of the anthocyanins holds malvidol-3-glucoside (60.84%), followed by malvidol-3-acetylglicoside (21.421%) and delphinidol-3-glucoside (8.163%). The lowest proportions are monoglucozid peonidol-3-acetylglicoside (0.485%) and cyanidol-3-glucoside (0.427%).

7. The approach of the isotopic fingerprinting of samples of wine for this paper took into account the national and international interest for the development of new analytical methods to authenticate the origin, both geographical and botanical raw material for wine and how they influence climate conditions and grower this fingerprint. Was observed as isotopic ratios (Carbon 13 and Oxygen 18) of natural wines obtained in different years of production varies inversely proportionate with active thermal balance with precipitations during the maturation of grapes and proportionate to the duration of brilliance the sun during the maturation of the grapes of those years. Isotopic fingerprinting authenticated vineyard, harvest year and the quality of wine, if there is a database updated of the vineyard and the precipitations of those years.

8. Interpretation of obtained results in terms of technology indicated that the Drăgăşani vineyard can produce red wines with a designation of controlled origin and quality levels.

9. The study is valuable for fundamental research the results obtained can constitute benchmarks for new experiments or to establish efficient processing conditions in the wine industry in Drăgăşani vineyard, to realize quality and stability of finished products in accordance with modern quality standards.

Chapter 7 Personal contributions and perspectives of further research

Personal contributions

Research on the optimization of the technology for obtaining the red wines in "Dragasani" vineyard were conducted during the period 2008 -2010.

Achieving the objectives of this thesis was made possible through a large accumulation of information in the literature but primarily through a large number of experimental determinations. In this sense we can define the individual contributions that are found in the release that we've made on various occasions (see list of publications):

1. The study of the natural factors that determine quality red wine Drăgăşani
2. The study of the evolution of the physico-chemical characteristics and anthocyanin content of grapes Cabernet Sauvignon in Drăgăşani vineyard, in 2008-2010;
3. The study of factors what influence the operation of maceration-fermentation
4. The study of the process of maturation of red wine in Drăgăşani vineyard
5. The study of the anthocyanin fingerprint of red wine the Drăgăşani vineyard
6. The study of isotopic fingerprinting of red wines the Drăgăşani vineyard
7. The study of the isotopic water footprint ground cloth vineyard Drăgăşani

Perspectives of further research

The results obtained can be a starting point for further research to bring new solutions to alcoholic and malolactic fermentation, conditioning, stabilization and bottling of these wines.

It requires that in the future,in the Dragasani vineyard, new plantations are created primarily with black grape vines from which to can obtain high quality red wines with designation controlled origin, knowing that in the world has required increased the red wines with controlled appellation of origin of high quality.

Having regard to competition between countries producing red wines, the vineyard Drăgăşani focus should be on red wine typicity and authenticity. For this we have to create a database of footprint of the anthocyanins and isotopic fingerprint red wines in the Drăgăşani vineyard

Chapter 8. Dissemination of research results

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8. Tuşa Ciprian[1] , **Rădulescu Axenia[1],** Tiţa Ovidiu[1]* *The influence of filtration conditions on the quality of Muscat Ottonel*, Integrated systems for agri – food production, Sipa 2011, Nyiregyhaza, Ungaria, ISBN 978-615-5097-26-3, p. 251-254
9. **Rădulescu, A.,** Tuşa C.,Tita,O**,** 2010**,** *Influence of the thermal regime on the process of fermentation maceration in rotary tanks*, Acta Universitatis Cibiniensis Series E: FOOD TECHNOLOGY , , Vol. XIV (2010), no.1, ISSN: 1221 - 4973 p.37
10. Ovidiu Tiţa, Letiţia Oprean, Ciprian Tuşa, **Axenia Rădulescu**, Eniko Gaspar, Ecaterina Lengyel, Mihaela Tiţa, Cristina Tiţa, *Evolution of color and antioxidative proprieties of red wines*, Proceedings of the Wine Active Compounds (WAC) 2011 International Conference, Beaune, France, www.chaireunesco-vinetculture.u-bourgogne.fr/WAC2011, p.41-44
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