



ULBS

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DOCTORAL THESIS SUMMARY

RESEARCH ON THE VALUIFICATION OF THE PRIMARY AND SECONDARY AROMATIC POTENTIAL OF AROMATIC AND SEMI AROMATIC VARIETIES

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KEYWORDS: *aroma compounds, wine, GC-FID, HPLC, enzymes, yeasts*

FROM THE AUTHOR

We designed this doctoral thesis with the intention of completing the studies regarding one of the most popular drinks, namely wine. A topic that is well known and debated, but which can still receive a lot of valuable information precisely because of the diversity of the elements that contribute to its production. The hills of Moldova are known for centuries thanks to the good quality wines that are obtained I hold here, but also by the desire of the winemakers to excel, approaching new techniques recommended by specialists. The doctoral thesis focuses on two important directions, namely: the physico-chemical and aromatic evaluation of the aromatic and semi-aromatic varieties from the Bohotin Wine Center and the Coast Vineyards, Cotnari, Huși and Iași and the evaluation of the technologies of wine manufacture that lead to the enhancement of their aromatic palette. The researches were carried out over a period of 4 Years, naturally starting with complex bibliographic studies. The experimental works were carried out within the Research Center in Biotechnologies and Food Engineers at the Faculty of Agricultural Sciences, Food Industry and Environmental Protection of the "Lucian Blaga" University of Sibiu, under the careful supervision of Prof. Ph.D. eng. Ovidiu Tița and the National Institute for Research and Development for Cryogenic and Isotopic Technologies - ICSI Rm. Valcea. The paper comprises 167 pages, 27 tables, 110 figures and Annexes, the first part being focused on a bibliographic study that presents information on the pedoclimatic complex of vineyards and notions about flavors, the second part being focused on studies on the aromatic potential of aromatic and semi-aromatic varieties from the Bohotin wine center, Cotești, Cotnari, Huși, Iași vineyards and its use through different technological procedures, such as maceration, use of strains with superior biotechnological properties. In the thesis, the lists of figures, tables, annexes and abbreviations are also attached, which lead to the synthesis of the information and the obtained results.

In this way I would like to first of all thank Mr. Prof. PhD. Ovidiu Tița, the coordinator of this PhD thesis without the support whose work would not have been completed, who supported and encouraged me all the time, and who provided me the laboratories of the Research Center in Biotechnologies and Food Engineers at the Faculty of Agricultural Sciences, Food Industry and Environmental Protection from the "Lucian Blaga" University of Sibiu and Dr. Diana Ionela Popescu, PhD, from the ICSI Analytics department of the National Research and Development Institute for Cryogenic and Isotopic Technologies - ICSI Rm. Vâlcea. I also want to thank the group of teachers and researchers who supported me materially and scientifically, but also to those who encouraged me in times of stress and discouragement.

And last but not least, I thank the family, with the regret that my father cannot stand by me at this moment full of emotion and gratitude.

THE AIMES AND THE SCIENTIFIC OBJECTIVES OF THE DOCTORAL THESIS

The purpose of this study is to capitalize on the aromatic potential of aromatic and semi-aromatic varieties from the region of Moldova, especially from the areas of Bohotin, Cotești, Cotnari, Huși, Iași in order to obtain aromatic wines, superior quality, full of flavor.

In order to achieve this goal, a series of objectives have been established such as:

- ◆ physico-chemical characterization of aromatic and semi-aromatic varieties from Bohotin, Cotești, Cotnari, Huși, Iași
- ◆ identification and quantification of aroma compounds from grapes and wines from Bohotin, Cotești, Cotnari, Huși, Iași
 - identification and quantification of terpenic compounds from musts and wines
 - identification and quantification of total polyphenols from selected musts and wines
 - identification and quantification of catechin tannins in musts and wines
 - identification and quantification of anthocyanin monoglucoside compounds from musts and wines
- ◆ identification and quantification of volatile compounds by chromatographic methods from wines from Bohotin, Cotești, Cotnari, Huși and Iași
- ◆ appreciation of the technological factors with major impact on their aromatic potential
 - the influence of enzymes in enhancing the aromas
 - the influence of yeasts with potential in the release of aromas / genus *Saccharomyces*
- ◆ sensory evaluation of selected aromatic and semi-aromatic wines from Bohotin, Cotești, Cotnari, Huși, Iași
- ◆ elaboration of optimized schemes for obtaining aromatic and semi-aromatic wines from Moldova

The novelty and the scientific originality are noted by the approach of the aromatic complex of wines under changing climatic conditions, innovative technologies, the odorant profile of the varieties and wines selected being established by high class methods and accuracy.

INTRODUCTION

The aroma is a fundamental element of the wine, the compounds that confer this attribute being multiple and of different chemical classes. In the wine were identified a multitude of volatile compounds, some originating from the grapes subjected to vinification, others formed during the different stages, with the direct input of the yeasts or of the technological parameters used.

The aromatic complex of the wine consists of volatile or non-volatile compounds such as polyphenols, ethyl alcohol, organic acids or polyglucides, esters, tannins and so on. concentrations ranging from a few $\mu\text{g} / \text{L}$ to a few g / L . In the wines, numerous elements and compounds have been identified that provide their tertiary aroma: esters, aldehydes, higher alcohols, ketones, terpenic compounds and other types.

Their perception is possible through the olfactory qualities of man, but most of them can be identified by modern methods (GC-MS, GC-FID, HPLC, etc.).

The quality of a wine is directly proportional to the chemical composition of the grapes, and the aromatic potential becomes a necessity for defining and controlling the overall aromatic quality of the wine. This characteristic of the wine is determined by the composition of the varietal aroma.

The control of the quality and the typicality of the aroma of the wines implies the knowledge of the aromatic precursors of the grapes, which are responsible for the aroma and the evaluation of the influence of some wine parameters on these precursors.

This fact would allow the adaptation of the raw material for the elaboration of the different types of wine, by rational choice of the viticulture and oenological techniques.

The study of aromas in wines has been a major interest lately due to the development of technologies and especially due to the possibility of combining different modern techniques with analytical methods.

Physico-chemical characterization of aromatic and semi-aromatic varieties from Bohotin, Cotești, Cotnari, Huși, Iași

- grapes from the varieties Busuioaca de Bohotin, Feteasca neagra, Muscat Ottonel, Pinot gris, harvests of 2016, 2017, 2018, from: Bohotin, Cotești, Cotnari, Huși and Iași, selected and pressed as must (the varieties were noted with acronyms: Busuioacă de Bohotin: BB, Feteasca neagra: FN, Muscat Ottonel: MO, Pinot gris: PG)

- in the characterization of these grape varieties were followed: the concentration of sugars (g / L), the concentration of titrable organic acids (g / L sulfuric acid), the concentration of nitrogenous substances: total nitrogen (mg / L)

- wines obtained from the varieties Busuioaca de Bohotin, Feteasca neagra, Muscat Ottonel, Pinot gris, harvests of 2016, 2017, 2018, from: Bohotin, Cotești, Cotnari, Huși and Iași. The wines were obtained by the classic technology, specific to the selected vineyard (DOC Specification)

- for the characterization of these wines the following analyzes were performed: determination of alcohol concentration (% vol), determination of reducing sugar (g / L), determination of total acidity (g / L sulfuric acid), determination of non-reducing dry extract (g / L)

The working methods were those accredited by the International Wine Organization (OIV) in the field

<http://www.oiv.int/en/technical-standards-and-documents/methods-of-analysis/compendium-of-international-methods-of-analysis-of-wines-and-musts>)

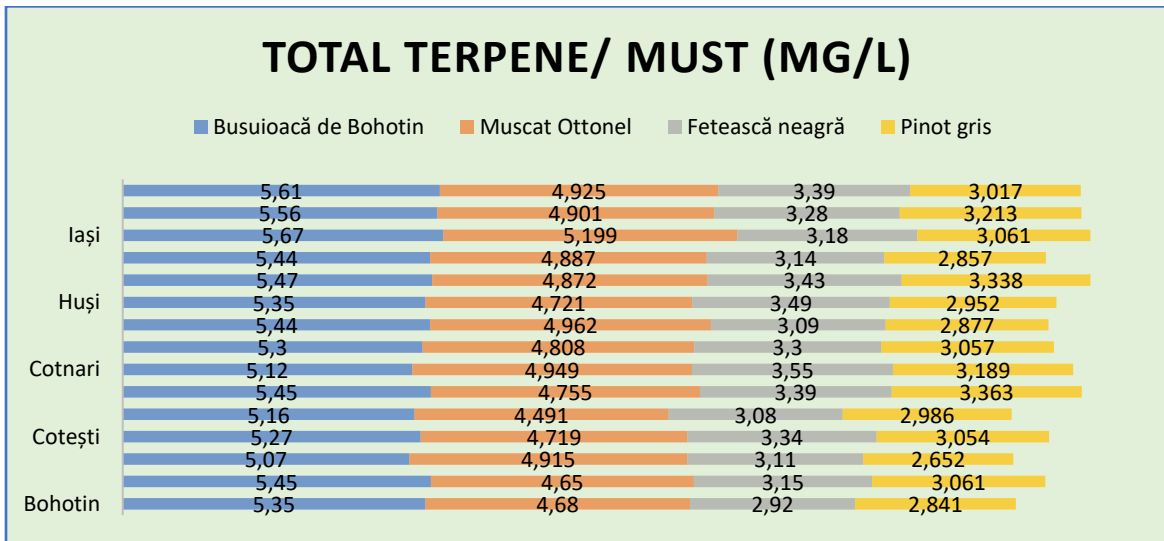
As a result of the determinations made, it was found that sugars have been increasing since 2016, which can be explained by the increase of the temperatures during the summer period, the decrease in volume of precipitations, in conclusion the main factors that contribute to their accumulation in grapes. The grapes selected for the study presented significant values of sugars, these competing for the quality of the wines obtained.

The alcoholic strength of the resulting wines is satisfactory, it is within the quality norms established at the vineyard level and both national and European legislation 12% -13.5% v.

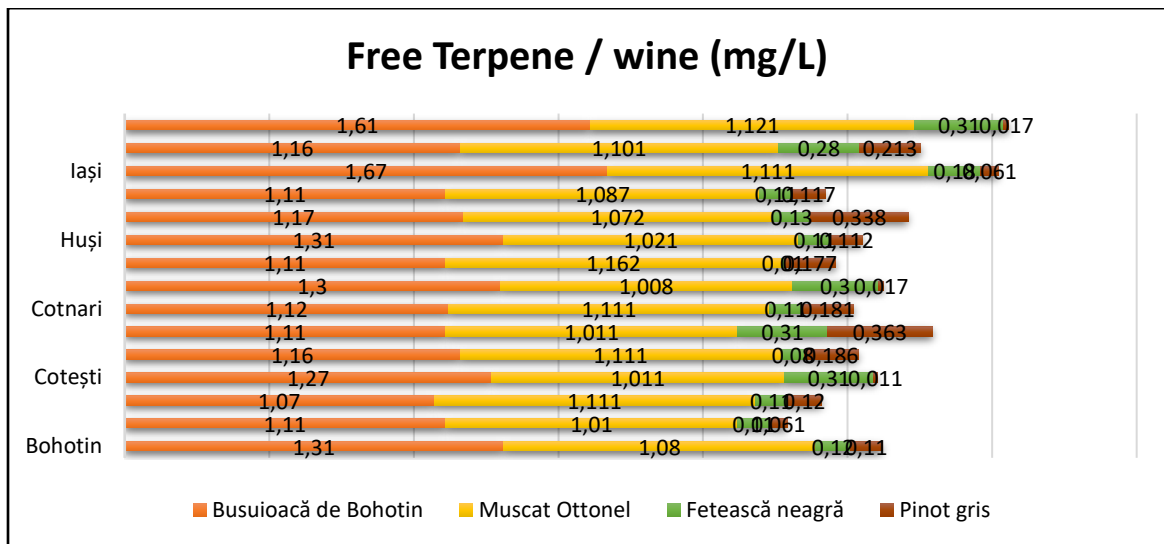
The acidity of the must undergoes a slight decrease compared to other years, and the non-reducing dry extract shows an upward accumulation over the years, due to the pedo-climatic conditions, the heating of the climate, the reduction of precipitation but also the increase of the sun during this period.

Identification and quantification of aroma compounds from aromatic and semi-aromatic varieties from Bohotin, Cotești, Cotnari, Huși, Iași

In the musts and wines from Bohotin, Cotești, Cotnari, Huși and Iași, terpenic compounds were identified and quantified by the spectrophotometric method, resulting in values according to the figures below:



Total terpene of musts



Free terpene of wines

- the free and bound terpenes have significant values in the case of aromatic varieties and reduced by about 50% in the semi-aromatic ones
- for the same year, different accumulations of terpenes occur, even if the study areas are close
- the amount of free and linked terpenes identified is related rather to the grape variety from which the must originates, rather than to the area of provenance
- the related terpenes are 3-5 times more significant than the free terpenes, the values being correctable in the following processes
- Increases the amount of α -terpineol and hotrienol and decreases the amount of linalool, geraniol, nerol and citronellol

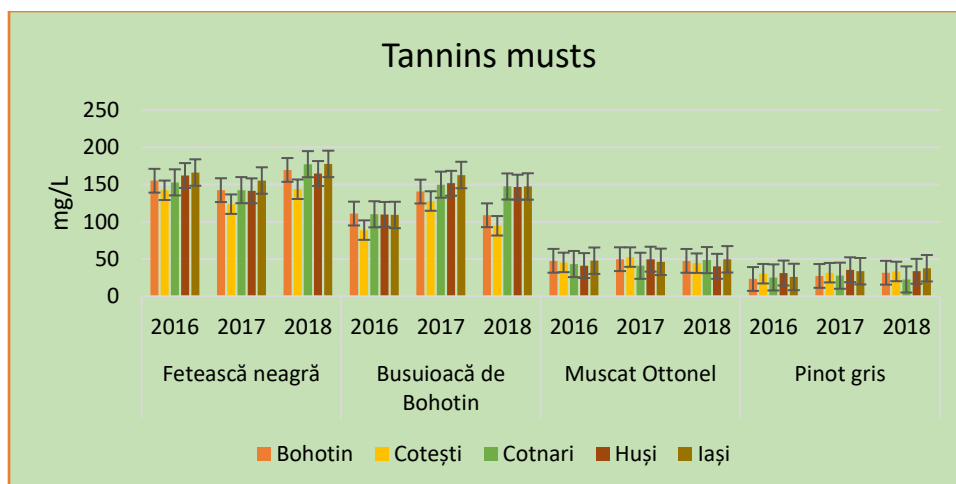
Identification and quantification of total polyphenols from musts and wines from Bohotin, Cotești, Cotnari, Huși and Iași by the Folin-Ciocalteu method

Following the determinations carried out, values between 2411.43 mgGAE / L and 1789.98 mgGAE / L in the case of Feteasca neagra grapes and 1206.09 mgGAE / L and 714.23 mgGAE / L in the wines of the same variety.

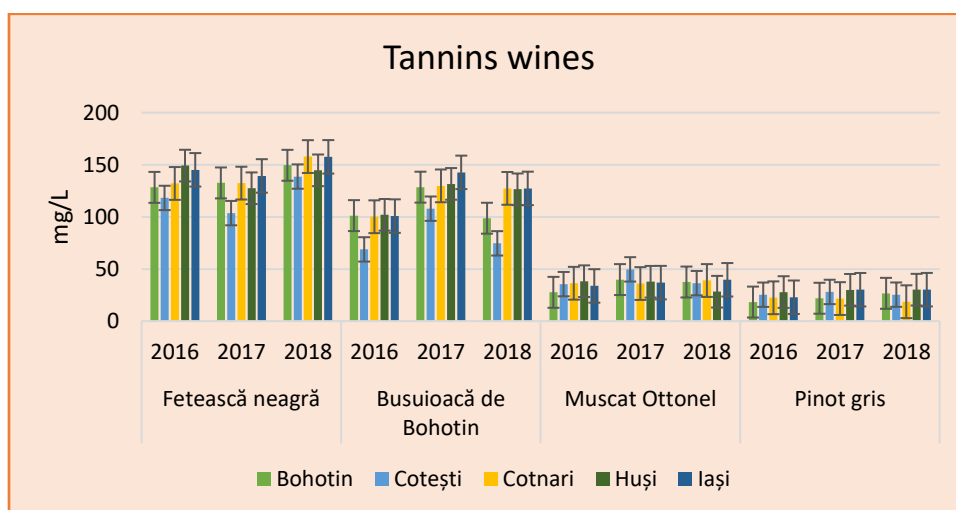
For Busuioaca de Bohotin must have been obtained between 1444.44 mgGAE / L and 1693.66 mgGAE / L, and for wine 612.31 mgGAE / L and 744.56 mgGAE / L. In the case of the Muscat Ottonel variety, the amount of polyphenols was for must between 516.27 mgGAE / L and 732.05 mgGAE / L and for wine between 221.98 mgGAE / L and 378.15 mgGAE / L. Muscat Ottonel white aromatic varieties have polyphenols on average 28% -30% more significant than white semi-aromatic ones, but lower on average 10% -15% compared to rosé

Identification and quantification of catechin tannins from musts and wines from Busuioaca varieties of Bohotin, Feteasca neagra, Muscat Ottonel, Pinot gris, harvests of 2016, 2017, 2018 from Bohotin, Cotești, Cotnari, Huși and Iași by HPLC method

The HPLC method was able to identify and quantify the following catechin tannins from the four varieties (Busuioaca de Bohotin, Feteasca neagra, Muscat Ottonel, Pinot gris) from Bohotin, Cotești, Cotnari, Huși and Iași: catechin, epicatechin, gallo-cat gallate. According to the data obtained, it is found that the most substantial amount is in the red and rosé varieties, that is to say, Feteasca neagra and Busuioaca de Bohotin.



Identification and quantification of catechin tannins from musts



Identification and quantification of catechin tannins from wines

From the variety of catechin tannins, in the present study, catechin tannins have been identified and quantified, which have significant values especially in the red and pink varieties Feteasca neagra and Busuioaca de Bohotin. In the white varieties the values of catechin tannins were on average four times lower than in the red or pink ones. As areas of interest the richest in catechin tannins were Huși and Iași, but in 2018 all five areas presented significant values. The wines studied presented amounts of catechin tannins on average 10-30% lower than the corresponding musts, the richest coming from 2018, the Feteasca neagra assortment.

Identification and quantification of anthocyanin monoglucoside compounds from musts and wines from Bohotin, Cotești, Cotnari, Huși and Iași by HPLC method

The Feteasca neagra musts taken into consideration presented according to the chromatograms obtained significant values of malvidol-3-monoglucoside, these being in 2016 between 56.2% in Cotnari and a maximum of 59.9% in Iasi, in 2017 the percentage values were - stood between 57.7% in Huși and 61.8% in Bohotin. In 2018, substantial amounts of malvidol-3-monoglucoside were observed in all areas, these being predominantly around 60%, with a maximum of 61.8% in Cotești.

Another valuable component in musts is petunidol-3-monoglucoside, which presented in the same Feteasca neagra must percentages which stood between 17.1% in Cotești and 19.9% in Iasi in 2016, then in 2017 and 2018 a minimum of 15.4% in Cotnari, respectively 15.2% in Iași and a maximum of 19.9% in Cotești and Husi.

An unlimited compound is also peonidol-3-monoglucoside, which reached maximum concentrations in 2016 and 2018 of 11.11%, in Bohotin and Cotești. Delfidinol-3-monoglucoside and cyanidol-3-monoglucoside accumulated in Feteasca neagra musts in amounts that exceeded 10.7% in Huși in 2017, respectively 7.2% in Cotnari in 2016.

According to the calculations made the total amount of monoglucoside anthocyanins in must varies between 356.75 mg / L and 423.54 mg / L for Feteasca neagra and between 337.21 mg / L and 388.11 mg / L for Bohotin Busuioaca. The monoglucoside anthocyanins in the must vary from year to year and from one variety to another.

In 2016, for the Feteasca neagra variety, values were obtained between 367.92 mg / L in Cotnari and 401.31 mg / L in Cotești. Between these two values were the musts from Iasi with 387.12 mg / L, Bohotin with 399.99 mg/L and Huși with 400.27 mg / L.

In 2017, an increase in anthocyanin content is observed for the musts from Bohotin, Cotnari and Cotești on average by 3% -4%, while for those from Huși and Iași, a decrease of 10% -13% is observed.

In 2018, there is a substantial accumulation of monoglucoside anthocyanins in musts from the five areas, so that all values exceed 400 mg / L.

The anthocyanin values were between a minimum of 404.04 mg / L in Iasi and a maximum of 423.54 mg / L in Cotnari.

Also a value close to the maximum was obtained also in Bohotin where the accumulation of anthocyanins reached the value of 423.42 mg / L. In Cotești, 410.45 mg / L of anthocyanins were accumulated, and in Huși 419.91 mg / L.

In the resulting wines, the anthocyanic monoglycoside compounds are found in amounts diminished on average by 20% -23% compared to the corresponding musts. In 2016 the wines from the Feteasca neagra variety showed maximum anthocyanins values of 333.11 mg / L in Huși and minimum values of 312.71 mg / L in Cotești. In Bohotin they were 329.76 mg / L, in Cotnari 320.88 mg / L, and in Iasi 321.34 mg / L. A decrease is observed in 2017 where the accumulation of anthocyanins is quantified to a maximum of 322.77 mg / L in Huși, and a minimum of 301.23 mg / L in Bohotin

In Cotești the monoglucosyde anthocyanins reach a value of 313.43 mg / L, in Cotnari of 318.89 mg / L, and in Iasi it does not exceed 302.39 mg / L. In 2018 the values of determined anthocyanins do not exceed a maximum value of 318.15 mg / L in Huși, in Bohotin and Cotești resulting in values close to 311.13 mg / L and 312.67 mg / L respectively. At Cotnari these values were at an amount of 309.98 mg / L, a value close to the minimum detected. The wines of Busuioaca de Bohotin also showed appreciable values of anthocyanins. Thus, in 2016, the determined values were between 267.89 mg / L in Cotnari and 288.45 mg / L in Iași. Intermediate values were observed in Bohotin and Cotești where they reached 270.09 mg / L respectively 275.88 mg / L, and in Huși the values did not exceed 281.01 mg / L. In 2017, the values of anthocyanins were between 256.94 mg / L in Cotești and 288.12 mg / L in Cotnari. In Bohotin and Iasi, close values are noted, namely 278.78 mg / L and 279.93 mg / L, and in Huși 287.76 mg / L. An increase occurs in 2018, where anthocyanin values reach 292.32 mg / L in Huși. This year the minimums were identified in Cotnari where the value of 279.75 mg / L was not exceeded, followed by the wines from Cotești and Bohotin with 288.12 mg / L respectively 289.16 mg / L. In Iasi, the identified anthocyanin value reaches 291.02 mg / L, close to the maximum established in Huși. In conclusion, it can be stated that the anthocyanins determined in the musts from Bohotin, Cotești, Cotnari, Huși and Iași from the varieties Feteasca neagra and Busuioaca de Bohotin presented generous values of anthocyanins. Maximum values were identified in the musts from the Feteasca neagra variety in 2018 in Bohotin and Cotnari, areas with a favorable climate for anthocyanin accumulation. In 2016 and 2017 the values of anthocyanins in musts were on average 3% -13% lower than in 2018.

Busuioaca de Bohotin variety presented maximum values in 2017 in Cotești, in 2016 and 2019 the values oscillating according to area and specific oenoclimatic characteristics.

The wines obtained were also rich in anthocyanins, their amount being lower than in musts, but at values that they recommend for consumption. Fetească neagră wine presented maximum values in 2016 in Bohotin, but in all the three years under study they were relatively close. For Busuioaca de Bohotin wine, anthocyanins were at reasonable amounts, on average 28% lower than in the corresponding musts.

Identification and quantification of volatile compounds by chromatographic methods from wines from Bohotin, Cotești, Cotnari, Huși and Iași

In order to determine these compounds, the following chromatographic purity materials over 95% were used to make the standards: 1-Butanol, 1-Hexanol, 3-Methyl-1-Butanol, 4-Methyl-1-Pentanol, 2-Methyl-1-Butanol, 1-Propanol, 1-Octanol, Benzyl Alcohol, Tyrosol, Isobutyl Alcohol, Isoamyl Alcohol, Methionol, 1-Heptanol, 2-Nonanol, Heptanoic Acid, Isovaleric Acid, Octanoic Acid, Dodecanoic Acid, Isobutyric Acid Acetic Acid Acid Butyric acid, ethyl octanoate, ethyl decanoate, diethyl succinate, ethyl lactate, isoamyl acetate, ethyl acetate, ethyl formate, hexyl acetate, heptyl acetate, methyl octanoate, white reference wine. By this method the following has been identified and quantified the following volatile compounds in wine:

Upper Alcohol: 1-Butanol, 1-Hexanol, 4-Methyl-1-Pentanol, 3-Methyl-1-Butanol, 2-Methyl-1-Butanol, 1-Propanol, 1-Octanol, Benzyl Alcohol, Tyrosol, Isobutyl Alcohol, Isoamilic alcohol, Methionol, 1-Heptanol, 2-Nonanol

Volatile acids: Heptanoic acid, Isovaleric acid, Octanoic acid, Dodecanoic acid, Isobutyric acid Acetic acid Hexadecanoic acid Butyric acid

Esters: Ethyl octanoate, Ethyl decanoate, Diethyl succinate, Ethyl lactate, Isoamyl acetate, Ethyl acetate, Ethyl formate, Hexyl acetate, Heptyl acetate, Methyl octanoate

The studied wines showed accumulations of higher alcohols in amounts ranging in 2016 between 196.07 mg / L in Huși - Feteas black and 237.31 mg / L also in Huși in the case of the Busuioaca de Bohotin assortment. Comparing the vineyards for the same assortment of wine, it can be seen that the differences can reach up to 12% -18%.

The most noticeable difference is in the case of Fetească neagră wine, where the values differ by 18% between the vineyards. In 2017, the values of higher alcohols increase not decelerating

amounts below 100 mg / L. The most significant values are noted in the case of Fetească neagră wine where the value of 257.2 mg / L was identified.

The vineyard is noteworthy as the vineyard where these values are remarkable regardless of the wine range. In 2018, Busuioaca de Bohotin presents the most significant accumulations of higher alcohols in all five vineyards, reaching a maximum of 255.32 mg / L. In contrast, Muscat Ottonel wine has higher alcohol values even below 100 mg / L for Cotnari and Huși vineyards.

Volatile acids in wines provide valuable information on acids belonging to the acetic series present in wine in free or compound form. The volatile acidity fluctuates around 15 mg / L, with slight increases at the Huși and Cotești Vineyards in 2016 and 2018, when it reaches 17.3 mg / L. In 2016 the values of volatile acids quantified in the four assortments of wine fall within the limits starting from 15.07 mg / L for Pinot gris from Huși, and reach a maximum of 17.92 mg / L for Muscat wine Ottonel from Cotnari. In 2017, the range of values detected starts from 15.04 mg / L volatile acidity in the case of Feteasca neagra wine from Cotești and reaches 17.43 mg / L in the case of Busuioaca de Bohotin wine from the Bohotin. Compared to 2016, the values determined in 2017 are lower on average by 5.6%.

Following the evolution of this parameter in 2018 it is noted that the values obtained are around 16 mg / L, a minimum of 15.07 mg / L volatile acidity in the case of Feteasca neagra wine from Cotești and a maximum of 17.27 mg / L in the case of Pinot gris wine from Huși.

It is noted that there are major differences between the accumulation of esters in wines from different vineyards.

The closest and constant values are noticeable in the case of Muscat Ottonel wine where in the case of all vineyards the value exceeds 120 mg / L.

In the case of Busuioaca de Bohotin wines, these values start at 73.1 mg / L in Huși, followed by Cotnari with 92.7 mg / L and Iasi with 98.8 mg / L. Higher values were obtained in the case of the Bohotin and Cotești vineyards where it is located at a level around 123 mg / L.

Feteasca neagra wine has values below 100 mg / L in all the vineyards studied, with the exception of Cotnari where they reach 124.3 mg / L.

Pinot gris wine oscillates around 100 mg / L, reaching a maximum of 111.2 / 111.4 mg / L for Cotești and Cotnari vineyards.

The year 2017 preserves the diversity of values in the accumulation of esters, starting from 93.5 mg / L in the case of Busuioaca de Bohotin wine and reaching 204.7 mg / L in the case of Cotești, Feteasca neagra.

In 2018, the values of higher quantified alcohols range from 82.9 mg / L in the case of Pinot gris wine from Bohotin and 115.2 mg / L in the case of Iași, the Busuioaca de Bohotin assortment.

Muscat Ottonel wine is noticeable in all five vineyards with values above 115 mg / L, while Pinot gris wine oscillates around 100 mg / L.

Following the analyzes carried out on GC-MS, it was possible to identify more than 35 volatile aromatic compounds, in amounts that can confer on the selected wines the qualities expected by the manufacturer. Higher weight is attributed to esters and higher alcohols, there is a correlation between them.

Particularly noteworthy are the ethyl esters that dominate the selected wines, the higher alcohols with the highest weight being the isobutyl and isoamyl alcohol.

The years studied were aimed at climate change, so some of the decelated compounds can be associated with this phenomenon.

The fermentative processes used by the producers lead to variations in the system of aromatic evaluation of the wines, even if we speak of the same assortment.

The volatile acidity reflects the concentration in heptanoic, isovaleric, octanoic, dodecanoic, isobutyric, hexadecanoic, butyric but especially acetic acid, printing the wine the specific taste of each vineyard.

The differences in value do not exceed acceptable margins of 5% -18%, in the case of determinations made, even if the wines come from different vineyards, the explanation being that the wine-growing area can print these characteristics from the point of view of pedo-climatic and structural evaluations.

The monitored indicators lead to the conclusion that the Feteasca neagraca wine presents an optimal ratio, so that it can be recommended as a local aromatic wine of superior aromatic quality.

Influence of enzymes on flavor enhancement

In order to obtain quality wines and to enhance their aromas, it is recommended by specialists to use different enzyme preparations. These can be focused on objectives such as improving the quality and yield of the must, intensifying and diversifying the aromatic potential, intensifying the

color or reducing the time to complete the wine. The specialists have also succeeded in obtaining broad spectrum enzymes, with multiple properties, enhancing aromas, precursors, superior color extraction, but also with higher pectolytic activity.

The studies performed so far certify that a correct intake of enzymes in the technological process of obtaining wines leads to the obtaining of significant results in this area so flexible and diverse, the methodology of identification and quantification of valuable compounds is becoming more efficient.

The chapter below aims to study the effect of two broad spectrum enzymes on the red varieties (Feteasca neagra), rosé (Busuioaca de Bohotin), aromatics (Muscat Ottonel) and white semiaromatics (Pinot gris) from Bohotin, Cotești, Cotnari, Huși and Iași.

In order to achieve this goal, the enzymes Safizym® Clean from the Fermentis range produced by Lesaffre Italia and ConZym™ Pex Uni from the SIHA range produced by Begerow Germany were selected.

The Safizym® Clean enzyme is obtained from a strain selected by *Aspergillus niger*, with pectinase activity (Endo-polygalacturonase, Pectin-methyl-esterase, Pectin-lyase) that can activate between wide temperature values (5°C-65°C).

The enzyme presents simultaneous qualities of clarification, extraction of the aromatic precursors, contributing to the softness of the red wines and to the complementation of the varietal aromas of the white wines.

It is involved in the extraction of polyphenols, anthocyanins, tannins, intensifying the color and helping to stabilize them.

The dosage used took into account the recommendations of the manufacturer so that for the white and rosé vinification was applied 1g / hL, and for the red vinification 2g / hL.

ConZym™ Pex Uni enzyme has superior pectolytic activity, intensifies the color of red wines, presents superior enhancing qualities of aromas (monoterpenes) and polysaccharides, helps in the quick clarification of musts. As a dosage, 4 mL / hL was used for both white and red varieties, varying the maceration time.

The technological process was carried out under microvinification regime in order to monitor the proposed parameters for the four varieties taken into operation.

Red varieties need a longer maceration period so that optimal extraction of the aroma and color compounds can be achieved. The Feteasca neagra variety from Bohotin presented free and bound terpenes values on average 3% -5% higher after a 240 hours maceration period.

Using the enzymes Safizym Clean results in an increase of up to 0.73 mg / L respectively 2.53 mg / L, these values being close to those obtained using the ConZym Pex Uni enzyme, of 0.81 mg / L respectively 2.61 mg /L.

The polyphenols have initial values of over 2000 mg / L, but decrease during the course to a minimum of 1122,44 mg / L respectively 1189,77 mg / L at a maceration carried out at a low temperature, for 10 days. Anthocyanins accumulate considerably, especially by using the enzyme ConZym Pex Uni at a maceration temperature of 18 ° C, reaching a value of 514.43 mg / L. The aromatic compounds increase in amount at the end of the period to 505.33 mg / L.

Following the results obtained in Cotești it is observed that the terpenes reach a maximum amount of 3.68 mg / L at a maceration for 10 days at a temperature of 18 ° C by using the enzyme Safizym Clean and at 3.95 mg / L maceration at 18 ° C, using ConZym Pex Uni enzyme under the same conditions.

Polyphenols range from 2113.82 mg / L to 2635.19 mg / L after 24 hours, decreasing to a maximum of 1666.04 mg / L after a maceration of 240 hours (10 days).

Following the evolution of anthocyanins it is noted that their value slightly increases cold extraction being favorable, the final values being between 510.91 mg / L and 515.88 mg / L the enzyme Safizym Clean being favorable for extraction.

The aromatic compounds also increase as the maximum value being reached at a maceration at a temperature of 18 ° C by using the enzyme Safizym Clean (495.12 mg / L).

In the Feteasca neagra variety from Cotnari we notice an increased amount of free and bound terpenes when using enzymes from the Safizym Clean range, but also a spectacular increase of the related terpenes processed at a temperature of 8 ° C, the values reaching from 1, 44 mg / L to 2.49 mg / L, at an addition of ConZym Pex Uni. Polyphenols decrease in time from 2235.17 mg / L to 1819.12 mg / L. Anthocyanins have the most significant amount when using the ConZym Pex Uni enzyme when it reaches a value of 615.21 mg / L at a maceration temperature of 18 ° C. The aromatic compounds have maximum amounts of 530.43 mg / L at a temperature of 18 ° C using ConZym Pex Uni enzymes.

For the Feteasca neagra variety from Huși, the free and bound terpenes grow as a quantum in both cases of enzyme use, the most significant values being obtained at a maceration temperature of 18°C.

The resulting values reach 3.44 mg / L respectively 3.49 mg / L.

The polyphenols have final values between 1577.91 mg / L and 1805.08 mg / L, the extraction being optimal by using the enzyme Safizym Clean at a temperature of 18 ° C.

In contrast, the amounts of anthocyanins increases with the use of the enzyme ConZym Pex Uni, even though maceration occurs at different temperatures, both at 8 ° C and 18 ° C, reaching 543.19 mg / L and 544.38 mg / L respectively.

The summed flavored compounds pass 490 mg / L to a maceration temperature of 8 ° C to a value of 490.59 mg / L, and to a maceration temperature of 18 ° C to a value of 494.84 mg / L by using ConZym Pex Uni enzymes.

The impact of Safizym Clean and ConZym Pex Uni enzymes on the Busuioaca de Bohotin variety is visible in the following tables, which differentially potentiate both the aromatic compounds and the color depending on the area of origin of the variety. It is observed that the free and bound terpenes accumulate in a maximum amount of 5.92 mg / L at an addition of Safizym Clean at a maceration temperature of 18 ° C and 6.18 mg / L at an addition of ConZym Pex Join at the same temperature.

Polyphenols increase on average by 0.58% after a maceration of 20 hours. In contrast, anthocyanins show accumulations of up to 555.05 mg / L at a 20-hour extraction at 8 ° C by addition of ConZym Pex Uni. Also a low temperature is favorable for the accumulation of anthocyanins and in the case of the use of the enzyme Safizym Clean where the values reach 491.04 mg / L. Flavored compounds such as esters are better extracted at a temperature of 8 ° C, the maximum values reached up to 166.56 mg / L, at a temperature of 18 ° C a maximum of 269.35 mg / L higher alcohols by using enzymes and at the same temperature Safizym Clean and a maximum of higher fatty acids of 20.87 mg / L using ConZym Pex Uni enzymes at a temperature of 18 ° C. Also, the influence of the enzymes on the Busuioaca de Bohotin variety from Cotești is observed where the bound terpenes have a maximum accumulation of 3.09 mg / L at a temperature of 8 ° C by using the ConZym Pex Uni product. Beneficial effects are also noted in the case of polyphenols where the maximum values reach 1588.41 mg / L at a maceration temperature of 18 ° C by using the enzymes Safizym Clean. Anthocyanins can be extracted more conveniently by using the

enzyme Safizym Clean, at a temperature of 8 ° C, the maximum reaching an amount of 463.27 mg / L. The total aromatic compounds show considerable increases at a temperature of 18 ° C by using ConZym Pex Uni enzymes, the maximum values reaching 481.51 mg / L.

In Cotnari the use of the enzymes Safizym Clean and ConZym Pex Uni leads to maximum accumulations of terpenic compounds of 3.5 mg / L and of 3.48 mg / L respectively at a temperature of 18 ° C, polyphenols of 1755 mg / L at the same temperature and anthocyanins of 479.08 mg / L. The esters have a maximum amount of 152.22 mg / L at a maceration of 20 hours at a temperature of 18 ° C in the presence of the enzyme ConZym Pex Uni, the higher alcohols a maximum of 236.08 mg / L at a temperature of 8 ° C in the presence of the enzyme Safizym Clean and volatile fatty acids a maximum of 21.88 mg / L at a maceration of 20 hours at a temperature of 18 ° C in the presence of the enzyme ConZym Pex Uni.

Following are the results obtained on the Muscat Ottonel aromatic variety under maceration conditions of 2/20 hours in the presence of the enzymes Safizym Clean and ConZym Pex Uni at temperatures of 8 ° C / 18 ° C, compared with control samples that do not contain added enzymes. The Muscat Ottonel variety from Bohotin has an amount of free and bound terpenes with a maximum value of 5.42 mg / L compared to the control sample where these values do not exceed 5.06 mg / L.

The total polyphenols reach 766.04 mg / L at a maceration time of 20 hours using ConZym Pex Uni enzymes, compared to the control sample where the values do not exceed 637.31 mg / L.

Esters have maximum values of 161.22 mg / L by using the same enzymes, volatile fatty acids are 24.86 mg / L.

The most significant results were obtained by using the enzyme Safizym Clean for higher alcohols, where the values reached 269.15 mg / L, compared to the control sample (245.69 mg / L). For the Muscat Ottonel variety from Cotești the results indicated terpenic maximums of 5.28 mg / L when using the ConZym Pex Uni enzyme, and the amount of polyphenols increased to 687.48 mg / L by using the enzyme Safizym Clean. The aromatic compounds showed maximum amounts when using the ConZym Pex Uni enzyme, reaching 151.12 mg / L for esters, 404.04 mg / L for higher alcohols and 22.97 mg / L for volatile acids.

Polyphenols are noted at values above 700 mg / L when using both enzymes compared to control samples where they do not exceed 630 mg / L.

Esters have a maximum amount of 169.87 mg / L respectively 168.53 mg / L, higher alcohols exceed 292 mg / L. Volatile fatty acids are around 23 mg / L, an increase of one unit from the control sample.

The use of enzymes has also proved beneficial in the case of the Muscat Ottonel variety from Iasi, so that the amount of terpenic compounds reaches values of 5.90 mg / L by using ConZym Pex Uni and at 5.82 mg / L by using Safizym Clean, compared to the control sample where the values do not exceed 5.18 mg / L.

The total polyphenols are extracted in a maximum amount of 651.15 mg / L using ConZym Pex Uni enzymes and at 628.05 mg / L using Safizym Clean enzymes.

The amount of the flavored compounds reaches maximum values of 510.57 mg / L by the addition of Safizym Clean, maceration for 20 hours at a temperature of 8 ° C and 471.16 mg / L by the addition of ConZym Pex Uni maceration for 20 hours at a temperature of 18 ° C.

Semi-aromatic varieties present a challenge for those skilled in the art, precisely because the aromas can be highlighted by simple but effective methods such as the use of enzymes. As noted in the study, the same broad spectrum enzymes were used, the same maceration temperatures, the impact time being reduced to the recommendation in the leaflet.

For the Pinot gris variety from Bohotin, the use of the enzymes Safizym Clean and ConZym Pex Uni led to results that materialized through the amounts of terpenic compounds of 3.36 mg / L respectively 3.30 mg / L, at temperatures of 18 ° C, action time of 4 hours.

Polyphenols accumulated at maximum values of 642.04 mg / L, and the aroma compounds exceeded 455 mg / L.

The use of broad spectrum enzymes is beneficial for aromatic, semi-aromatic and red varieties in the Moldova's area in enhancing the aroma and color compounds.

The optimum temperature of their action is 18° C in most cases, the values of the aroma compounds increasing on average by 3/30%.

In the case of the red varieties (Feteasca neagra), the terpenic compounds increase compared to the control samples, depending on the area of provenance, with percentages ranging from 4.33% to 10.64%, the most significant accumulation being observed in those coming from Cotești, and the most low to those from Iasi.

In the case of rosé varieties the terpenic compounds increase compared to the control sample with percentages between 8.42% and 11.41%, and the aromatic ones of muscular type with 8.77% -

12.23%. The semi-aromatic white varieties accumulate terpenic compounds depending on the area of origin at percentages between 3.44% and 6.22%. Anthocyanins are found in all selected samples (Feteasca neagra and Busuioaca de Bohotin), the most significant values being noted for the varieties coming from Cotnari and Huși by using ConZym Pex Uni enzymes at a temperature of 18 ° C. Polyphenols accumulate in maximum percentages compared to the control samples in the case of red varieties in Bohotin and Huși, in the case of rosé aromas in Cotnari and in Muscat Ottonel aromas in Cotnari and Huși. The enzymes with the best results were from the ConZym Pex Uni range at a temperature of 18 ° C.

Ester flavor compounds, higher alcohols and volatile fatty acids have accumulated in remarkable percentages at both 8 ° C and 18 ° C, the most significant results being obtained in the Busuioaca aromatic varieties of Bohotin and Muscat Ottonel. The semi-aromatic red and white varieties showed 7% -9% lower percentages than the aromatic ones.

The influence of yeasts with potential in the release of aromas / genus Saccharomyces

- grapes from the varieties Feteasca neagra, Busuioacă de Bohotin, Muscat Ottonel, Pinot gris, from Bohotin, Cotești, Cotnari, Huși and Iași, the production of the year 2018
- isolates of wine yeasts from the wine-growing areas of Bohotin, Cotești, Cotnari, Huși and Iași, noted with the acronyms: Bh43, Co27, Ct61, Hu97, Ia78
- Selected wine yeasts Viniferm Aura (VA)

The grapes were harvested at full maturity, processed in the microvinification system for 10 days.

- test control - spontaneous fermentation without the addition of selected yeasts at 18 ° C
- 240 hours maceration with ConZym Pex Uni enzymes (5g / 100 kg), temperature of 18 ° C for the red variety Feteasca neagra
- maceration for 20 hours with ConZym Pex Uni enzymes (5g / 100 kg), temperature of 18 ° C for the aromatic varieties Busuioaca de Bohotin and Muscat Ottonel
- mixing for 4 hours with ConZym Pex Uni enzymes (5g / 100 kg), temperature of 18 ° C for semi-aromatic Pinot gris variety
- the identification and quantification of the aroma compounds was carried out by the GC-FID method (Stegăruș 2016)

In Bohotin the varieties subjected to the study presented total values of volatile aromatic compounds which were for the control sample between 325.94 mg / L in the case of Pinot gris assortment and 361.68 mg / L in the case of the Feteasca neagra assortment.

In the case of fermentation with local strains (Bh43), an increase of flavored compounds is observed up to a maximum of 387.22 mg / L for Feteasca neagra, 379.14 mg / L for Bohotin Busuioaca. Selected yeasts Viniferm Aura contribute to an increase in the amount of flavored compounds up to 392.11 mg / L for Feteasca neagra, 389.77 mg / L for Bohotin Busuioaca and 388.21 mg / L for Muscat Ottonel.

In Cotești the use of local strains are favorable for a substantial accumulation of aroma compounds, the maximum values being of 395.38 mg / L in the case of Busuioaca de Bohotin sorbet.

Increases are also noted in the case of the Feteasca neagra, Muscat Ottonel assortments, but also Pinot gris compared to the control sample, with 15mg / L - 24 mg / L.

Fermentations carried out in the presence of Viniferm Aura yeasts ultimately lead to accumulations of flavor compounds ranging from 375.20 mg / L to 419.17 mg / L, values increased on average by 38 units compared to the control sample.

As for the use of selected yeasts from the Viniferm Aura range, their effect is visible by quantifying these compounds at values of 399.99 mg / L in Muscat Ottonel, 404.27 mg / L in Busuioaca de Bohotin, 395.34 mg / L in Feteasca neagraca and 381.15 mg / L in Pinot gris.

The effect of the addition of local yeasts in the winery processes from Huși is 11-26 units higher than the control sample.

A maximum amount is observed in the case of the Feteasca neagra assortment of 369.44 mg / L and Pinot gris of 377.31 mg / L. Selected yeasts Viniferm Aura enhances an increased amount of volatile aroma compounds, significant being the values obtained in the case of the Busuioaca de Bohotin assortment of 402.37 mg / L, followed by Feteasca neagra and Muscat Ottonel with 389.15 mg / L respectively 389.88 mg / L.

The Pinot gris assortment also approaches these values, obtaining a generous amount of 385.25 mg / L. These strains have shown potent flavoring qualities with few units compared to those established as Viniferm Aura. The qualities of these yeasts can be constantly improved by classical and modern methods so that they reach the local market in order to preserve the typicality of the local varieties.

In Bohotin isolate strain Bh43 has the most significant effect compared to the selected yeast Viniferm Aura in the case of the Feteasca neagra assortment, less in the case of the Pinot gris assortment. In Cotești the best potentiation of the Co27 strain is observed compared to the selected yeasts Viniferm Aura in the case of the Busuioaca de Bohotin assortment, and in Cotnari the best results of the Ct61 strain are visible in descending order in the case of the Busuioaca de Bohotin, Feteasca neagra wines Ottonel and Pinot gris.

In Huși the local strains Hu97 had the most significant effect on the Pinot gris assortment, and in Iași the local strain was noted for Muscat Ottonel, Busuioaca de Bohotin and Pinot gris wines.

Sensory analysis of Feteasca neagra, Muscat Ottonel, Busuioaca de Bohotin and Pinot gris wines from Bohotin, Cotești, Cotnari, Huși and Iași

Sensory analysis of wines from the Moldova's area shows that they accumulate valuable characteristics as such. The control wines processed without interfering with the selected yeasts receive a score very close to the wines fermented with selected strains from the area or selected cultures existing on the market.

Isolated strains from each area lead to wines with specific authentic characteristics, pleasant, soft, with a pronounced variety, which recommends them to be used, even if they do not yet have the potential of those existing on the wine market of external origin. The most significant scores were obtained in Muscat Ottonel wines fermented with local strains regarding the fruity character (Cotnari / Ct61), the bouquet (Cotești / Co27, Bohotin / Bh43), the softness (Cotnari / Ct61, Huși / Hu97), the olfactory intensity (Cotești / Co27) and taste persistence (Cotnari / Ct61). The unctuousness receives the maximum score for the Feteasca neagra wine from Cotnari / Ct61, and the Pinot noir wines have characters punctuated at significant values between 7-8, the isolated strains from the areas of origin being recommended for processing this variety.

As a result of the laboratory analyzes performed on the selected wines (aromatics: Muscat Ottonel, Busuioaca de Bohotin and semi-aromatic Feteasca neagra and Pinot gris) it was possible to achieve optimized technological schemes in order to exploit their aromatic potential. In these schemes it is observed that the technological parameters are adapted to the extent that the results are maximum in terms of the sensory character, the value of the flavors and not lastly the valorization of some specific characteristics of the variety. Maceration with a broad spectrum enzyme leads to simplification of the technological process but also the optimum maceration time has been

identified for each variety / assortment. An optimum maceration temperature was set at 18 ° C, the time being variable depending on the variety.

This led to the accentuation of the floral, fruity or freshness notes, and the use of isolated strains from the area of origin of the variety led to the creation of wines that retain the local character with specific, native notes.

The musts varieties contain significant amounts of glycosyls, which can be released by using enzymes that facilitate enzymatic hydrolysis, releasing terpenic compounds contributing to the formation of aromas in these wines.

The red varieties superimpose the maceration with the fermentation so that they result in balanced wines, corpulent with a great taste, rich in tannins and anthocyanins.

The use of broad-spectrum enzymes leads to the optimal extraction of aromatic compounds from skin and berries, resulting in wines that express complex varietal aromas.

The semi-aromatic white wines of the Pinot gris type accumulate significant quantities of flavored compounds by using the same enzymes, with a maceration of 4 hours. The positive effect of the use of enzymes and maceration is noticed by improving the extraction degree of the aroma compounds, with a harmonious bouquet and with a stable profile.

FINAL CONCLUSIONS

The decrease of the volume of precipitations between 2016-2018 and the increase of the temperatures led to a more accentuated accumulation of sugars in the grapes originating in the area of Moldova (Bohotin, Cotești, Cotnari, Huși, Iași), but also of the non-reducing dry extract.

All substances such as non-volatile acids, glycerol, pectic substances, polyphenols, gums, nitrogenous and mineral substances that define the non-reducing dry extract are concentrated in wine and give them fineness, softness, qualities that are found in Moldova's wines.

The free and bound terpenes have significant values in the case of aromatic varieties, but the obtained values do not show a strictly mathematical increase or decrease, so a direct correlation cannot be made depending on the average annual temperature or the oenoclimatic index

The amount of free and linked terpenes identified is related rather to the grape variety from which the must originates, rather than to the area of provenance

The anthocyanins determined in the musts from Bohotin, Cotești, Cotnari, Huși and Iași from the varieties Feteasca neagra and Busuioaca de Bohotin presented generous values of anthocyanins;

the wines obtained were also rich in anthocyanins, their amount being lower than in musts, but at values that they recommend for consumption.

The use of ConZym Pex Uni broad spectrum enzymes is beneficial for the aromatic, semi-aromatic and red varieties in the Moldovan area in enhancing the aroma and color compounds.

The optimum temperature of their action is 18 ° C in most cases, the values of the aroma compounds increasing on average by 3/30%.

Ester aroma compounds, higher alcohols and volatile fatty acids have accumulated in remarkable percentages both at 8 ° C and 18 ° C, the most significant results being obtained in the Busuioaca aromatic varieties of Bohotin and Muscat Ottonel. The semi-aromatic red and white varieties showed 7% -9% lower percentages than the aromatic ones.

Even if the same varieties were analyzed from each area, the temperature conditions and the enzymes used were identical, the results showed variations in the accumulation of valuable aromatic compounds, certifying that the pedo-climatic influences contribute to this. Particularly noteworthy are the ethyl esters that dominate the selected wines, the higher alcohols with the highest weight being the isobutyl and isoamyl alcohol. The years studied were aimed at climate change, so some of the decelerated compounds can be associated with this phenomenon. The volatile acidity reflects the concentration in heptanoic, isovaleric, octanoic, dodecanoic, isobutyric, hexadecanoic, butyric but especially acetic acid, printing the wine the specific taste of each vineyard. The differences in value do not exceed acceptable margins of 5% -18%, in the case of determinations made, even if the wines come from different vineyards, the explanation being that the wine-growing area can print these characteristics from the point of view of pedo-climatic and structural assessments.

The isolation of local strains leads to obtaining wines rich in aroma compounds, while preserving the local specificity. The selected yeasts from the Cotnari and Iași areas show the most significant increases in flavor compounds compared to the control samples processed. These strains have shown potent flavoring qualities with few units compared to those established as Viniferm Aura. The qualities of these yeasts can be constantly improved by classical and modern methods so that they reach the local market in order to preserve the typicality of the local varieties.

The sensory analysis of wines from the Moldova's area shows that they accumulate valuable characteristics as such Isolated strains from each area lead to wines with specific authentic characteristics, pleasant, soft, with a pronounced variety, which recommends them to be used, even

if they do not yet have the potential of those existing on the wine market of external origin. The most significant scores were obtained in Muscat Ottonel wines fermented with local strains regarding the fruity character (Cotnari / Ct61), the bouquet (Cotești / Co27, Bohotin / Bh43), the softness (Cotnari / Ct61, Huși / Hu97), the olfactory intensity (Cotești / Co27) and taste persistence (Cotnari / Ct61). The unctuousness receives the maximum score for the Feteasca neagra wine from Cotnari / Ct61, and the Pinot noir wines have characters punctuated at significant values between 7-8, the isolated strains from the areas of origin being recommended for processing this variety. Optimization of winemaking processes through the use of pectolytic enzymes with wide spectrum leads to obtaining wines with significantly superior aromas. The yeasts isolated from the region stabilize the fermentative processes leading to an above average extraction of the aroma compounds, outlining their typical characteristics. The yeasts used lead to the formation of the aromatic palette of wines from the region, improving the olfactory character, the fineness and the bouquet. Their role and the enzymes used are also noted in the red wines that presented intense colors, the extraction of anthocyanic compounds being at comfortable values. The proposed technological parameters have led to obtaining higher quality wines, economic efficiency by selecting a broad spectrum enzyme, but also by establishing an optimum time of maceration and alcoholic fermentation.

PERSONAL CONTRIBUTIONS

- ◆ the physico-chemical and aromatic characteristics of musts and wines from the Moldova's region have been evaluated for the first time in relation to climate change
- ◆ the concentration of terpenic compounds and the ratio of anthocyanic compounds from the varieties selected from the same perspective were established for the first time
- ◆ the impact of using broad-spectrum enzymes on aromatic and semi-aromatic varieties from the Moldova's area was studied
- ◆ the effect of isolated yeasts from the local area in obtaining local wines, with their aromatic configuration, was studied for the first time
- ◆ for each semi-aromatic, aromatic, white, rosé and red variety it was proposed an optimal variant for obtaining wines with a higher aromatic potential, the validation of the results being visible in the chapter of their sensory analysis

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Curriculum vitae Europass



Informații personale

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Experiența profesională

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Funcția sau postul ocupat *Asistent universitar ing.* - Facultatea de Inginerie Alimentară, Departamentul de Tehnologii Alimentare, Siguranța Producției Alimentare și a Mediului, Universitatea „Ștefan Cel Mare”, Suceava
Activități și responsabilități principale Activitate de coordonare a lucrărilor practice de laborator și seminar la disciplinele Microbiologia produselor alimentare, Controlul calității materiilor prime, Tehnologia și controlul calitatii laptelui, Tehnologia și controlul calitatii berii și a vinului, Bauturi alcoolice. Activități de cercetare în domeniul industriei alimentare și controlul calității produselor alimentare și a mediului.

Perioada 2001- 2007
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Activități și responsabilități principale Activitate de predare și practica școlară cu elevii claselor IX-XII
Educarea elevilor în spiritul unei activități desfășurate în grup.

Educație și formare

Perioada 2016 –prezent

doctorand, Universitatea Lucian Blaga Sibiu, domeniul Inginerie Industrială.

Numele și tipul instituției de învățământ	Universitatea „Ștefan Cel Mare” Suceava
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Numele și tipul instituției de învățământ	Facultatea de Inginerie Alimentară, Universitatea „Ștefan Cel Mare” Suceava
Perioada	2000-2006
Diploma obținută	Diplomă de licență – Inginer diplomat
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Perioada	1994-1998
Diploma obținută	Diplomă de Bacalaureat
Domeniul	Chimie-biologie
Numele și tipul instituției de învățământ	Colegiul Național Petru Rareș

Aptitudini și competențe personale

Limba (i) maternă(e)	Limba română				
Limba(i) străină (e) cunoscută (e)					
Evaluare certificat competență lingvistică emis de UTCN	Înțelegere		Vorbire		Sciere
Nivel european (*)	Ascultare	Citire	Participare la conversație	Discurs oral	Exprimare scrisă
Limba engleză	B1 Utilizator experimentat	A2 Utilizator experimentat	B1 Utilizator independent	B1 Utilizator independent	A2 Utilizator independent
Limba franceză	A2 Utilizator elementar	A2 Utilizator elementar	A1 Utilizator elementar	A1 Utilizator elementar	A1 Utilizator elementar
Competențe și aptitudini	<ul style="list-style-type: none"> - Cunoștințe operare calculator: Microsoft Office: Word, Excel, Power Point, Internet. - Autor și co-autor în lucrări științifice în domeniul ingineriei produselor alimentare și controlul calității produselor alimentare și a mediului. - Participări la conferințe naționale și internaționale. - Capacitatea de a lucra în echipă. - Flexibilitate în abordarea situațiilor de lucru, adaptabilitate, orientare spre rezultat. - Comunicare eficientă, dorința de a învăța continuu și de a-mi dezvolta potențialul personal și profesional. - Perseverență, putere de a învăța repede lucruri noi, sociabilitate, capabilitate de a lucra în condiții de stres, ușurință, claritate și coerență în exprimare. - Seriozitate la locul de muncă în ceea ce privește respectarea programului, a sarcinilor de lucru și a celorlalți colegi 				

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Semnătura:



LIST OF PUBLICATIONS

1. **Rebenciuc I.**, Dabija A., Buculei A., 2010, *Aspects en regardant la valorisation de la drêche comme produit secondaire dans l'industrie de la bière*, Le sixième colloque Franco-Roumain de Chimie Appliquée, COFrROCA,pg.167
2. **Rebenciuc I.**, Buculei A., Cioarba I., Batariuc A., 2010, *Étude comparative sur l'influence de la variation saisonnière sur la qualité du lait de la zone de Suceava*, Le sixième colloque Franco-Roumain de Chimie Appliquée, COFrROCA,pg.168
3. Cioarba I., Buculei A., **Rebenciuc I.**, Batariuc A., 2010, *The bran addition influence upon the fabrication of dietary dough staches with cranberries*, Journal of agroalimentary process and technologies- The 1st International Conference on Food Chemistry, Engineering & Technology – New trends in food safety and processing Timisoara 3-4 iunie.
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5. **Rebenciuc I.**, Buculei A., Pop G., Dabija A., 2010, *Impact of type of polypropylene film on quality of packing rye bread with seeds*, Journal of Agroalimentary Processes and Technologies, vol.16, Issue 4, pg.417-419
6. Buculei A., **Rebenciuc I.**, Ionescu V., 2010, *Some aspects regarding the degree of conservation of the cream packed in plastic material*, Annals Food Science and Technology Valahia University of Targoviste, vol.11
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12. Dabija A., Constantinescu G., **Rebenciuc I.**, Buculei A., 2011, *Studies regarding new way to render whey profitable*, Food and Environment Safety, Journal of Faculty of Food Engineering, Stefan cel Mare University Suceava, Year X, Nr.1., 43-46
13. Dabija A., Buculei, A., Constantinescu G., **Rebenciuc I.**, 2011, *Experimental studies concerning obtaining some wine cooler products*, Annals Food Science and Technology Valahia University of Targoviste, vol.12, Issue 1, 19-21
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24. Dabija A., Constantinescu, G., Buculei, A., **Rebenciuc I.**, 2011, *Study on evaluating antioxidant capacity and biologically active compounds from basil*, Annals of DAAM & Proceedings of the 22nd International DAAAM Symposium, 23-26th November, Volume 22, No.1, 1006-1008 Vienna, Austria
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26. Dabija A., **Rebenciuc I.**, Buculei A., 2014, *Study regarding the possibilities to obtain functional traditional foods from whey*, Proceeding of Bioatlas, Conference on New reserch in Food and Tourism, Journal of Ecoa Agroturism
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33. **Rebenciuc I.**, Tița O., 2017, *Influence of pectolitye enzymes on the quality of wine maceration*, Bulletin UASVM Animal Science and Biotechnologies 75(1)/ 2018
34. Tița O., **Rebenciuc I.**, Tița M., Țițu M., 2018, *Influence of accidental environmental and technological factors on wine quality in the region of Moldova*, CEFood Congress,24-26May Sibiu, Romania

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