Scientific Papers. Series B, Horticulture. Vol. LXIII, No. 1, 2019
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

COMPOSITIONAL AND SENSORY CHARACTERISTICS OF SOME AROMATIC AND SEMI-AROMATIC WINES FROM IAȘI VINEYARD

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Abstract

The major influence on the volatile profile of wine is due to factors such as grape variety, soil, climatic conditions and winemaking process. Volatile compounds are of major importance in defining wine quality. The main volatile compounds that participate in wine sensorial profile are alcohols and esters, followed by acids, aldehydes, ketones, terpenes, fatty acids, lactones, volatile phenols. The main purpose of the study is to investigate the composition and the aroma profile for ''Fetească Regală'', ''Muscat Ottonel'' and ''Busuioacă de Bohotin'' wines from Iași vineyard. The wines were obtained using a 12 hours maceration with pectolytic enzymes. After fermentation, wines were racked, filtered and bottled. The characterization of wine samples was made by determining the standard parameters. The identification of volatile compounds was performed by a gas chromatographic method using a Shimadzu HS20trap-GC 2010plus-MS040TQ. Moreover, the aromatic profile of samples was evaluated by a tasting panel in the Oenology Laboratory of U.S.A.M.V Iasi, with grades referring to certain aromatic indices. A correlation between the identified aroma compounds and the sensorial analyses was studied.

***Key words**: autochthonous grape varieties, white wines, rosé wines, aroma compounds.*

INTRODUCTION

Wine's chemical structure and sensory characteristics depends on numerous elements such as: grape varieties, soil properties, climate conditions, maturation degree, must – fermentation time, yeasts and oenological microflora, winemaking technologies, wine's aging and storage condition (Etievant, 1991). Many studies have been realised on the effect of oenological practices on wine composition. Wine is a complex system, the major components being water, alcohol and sugars.

Aroma compounds are known to be important for defining the quality of wines, contributing to the definition of organoleptic, hygienic, sanitary and typicity characteristics (Ribéreau-Gayon, 2006).

The aroma of wines is determined by the presence of a group of volatile compounds that stimulate olfactory receptors. Substances that contribute to the aroma of wine fall into two main categories: those that already exist in the grapes (terpenes, pyrazines) and other that are generated during must extraction and as a result of prefermentation treatements (Furtună, 2012).

The compounds that impart a certain olfactory character to wines depend on the grape variety, climatic conditions of the year, soil characteristics and wine-making technology. During wine-making operations, aromatic compounds are released following chemical and enzymatic hydrolysis reactions (Cotea, 2009).

Although the composition of volatile compounds of wine is of particular interest within the multitude of compounds that can be identified in grapes and wine, only a few contribute to the formation of its flavour.

The main ingredients involved in wine aroma are alcohols, acids and esters. Small amounts of higher alcohols contribute positively to wine quality. Esters and fatty acids contribute to the bouquet (Zhu *et al*., 2015).

Higher alcohols are very important in the technology of obtaining semi-aromatic white

wines. Esters also contribute to the formation of flavours and the production of wines with pronounced aromas (Tana, 2014).
'Fetească Regală' is the most cultivated Romanian grape variety, it is considered semi-aromatic, obtaining elegant wines with good acidity, floral notes and fruity aromas (especially citrus and apricot) (Moroșanu et al, 2017). 'Muscat Ottonel' is a variety used in the production of aromatic, generally sweet wines, which impress by their fruity aroma and strong flavour, being suitable for aging (Dobrei *et al.,* 2017).
'Busuioacă de Bohotin' is a Romanian variety, suitable for obtaining dessert wines with a silky body, with notes of rose and basil, rarely found in other aromatic wines (Dobrei *et al.,* 2017).

MATERIALS AND METHODS

The grapes were harvested manually in autumn 2018 and processed in the Oenology Laboratory of the Faculty of Horticulture, Iași.
Experimental samples were obtained by using the classic method for producing white wines.
After the quantitative and qualitative reception, the grapes were crushed and pressed.
The must was inoculated with *Saccharomyces cerevisiae* yeast, specific for the production of neutral wines, having a small influence on the characteristics of the aromatic profile. After the end of alcoholic fermentation, the wine was sterile filtered, bottled and labelled in 750 mL glass bottles.
The samples were stored under controlled temperature conditions for 3 months and physical-chemical analyses were performed. Wine samples were analysed for density, alcohol concentration, total acidity, volatile acidity, reductive sugars, non-reductive extract. The physical-chemical analyses were done in accordance to the regulations of the International Organization of Vine and Wine. Volatile compounds were analysed via gas-chromatography, from the headspace and identification was done based on internal spectrum libraries.

Sample preparation:
In two vials of 20 mL, there were added:
a) 7 mL sample + 70 µL standard solution (4-methyl-2-pentanol);
b) 6 mL sample + 60 µL standard solution (Na_2SO_4, KH_2PO_4, NaCl).
The gas-chromatographic method allows for the achievement of performance results in the identification of volatile compounds. The volatile compounds were thermally stable so they can reach the volatilization stage.
The determination is based on the fact that some organic compounds are vaporized in a carrier gas through a chromatographic column up to the detector. The sample is introduced with a syringe into the evaporator at the end of the column. The components are quickly evaporated and absorbed by the stationary inert phase of the column (Pop, 2015).
As analysis method, gas chromatography coupled with mass spectrometry, headspace technique is used, as follows: 1000 µL gas from headspace are injected in the GC column, splitless mode.
Analysis conditions: temperature grew from 35°C to 250°C at a rate of 5 °C/min. Reaching 250°C, it was maintained at this level for 2 minutes, injector temperature 220 °C, detector temperature 250°C.
Scanning was done in the range of 30 m/z – 200 m/z (detector sensibility 1,0 kv) and 50m/z - 200m/z (detector sensibility 1,1 kV). The analysis lasted 55 minutes (Colibaba L.C., 2013).
The organoleptic analysis was realised by 10 specialized tasters, with extensive knowledge in oenology and trained in wine tasting and marking techniques. In this context, a scoring sheet with the most important aromatic indices marked from 0 to 9.

RESULTS AND DISCUSSIONS

The results of the physical-chemical analyses of the samples are presented in table 1.
The volatile acidity of a wine is an extremely important parameter in assessing quality and health state (Țârdea, 2010). Volatile acidity is characterized by the presence of acetic acid. The analysed samples registered values (0.19-0.45 g/L $C_2H_4O_2$) within the regulated normal range. Total acidity is an important indicator for the definition of wine quality, according to the Law of Vine and Wine 164/2017, it should have values between 4.5 and 9 g/L tartaric acid. The analysed samples present values within the

regulated normal range (4.9 - 6.1 g/L $C_4H_6O_6$), indicating a good state of health and a good evolution of the wine.
In terms of alcoholic concentration, the analysed wines recorded between 12.4 and 13.2 % vol., classifying them in the category of quality wines.
The reductive sugars varied between 2.7 and 10 g/L. These values show that the samples can be registered as dry or demi-dry wines. Carbohydrates that are unable to be oxidised and cannot reduce other substances are known as non-reductive sugars. Analysed samples recorded values between 17.6 – 20.5 g\L for non-reductive extract and 25.5 – 31.3 g\L for total dry extract (OIV-MA-AS2-03B).
Limits allowed by current legislation on sulphur dioxide content are: 210 mg/L total SO_2 and 50 mg/L free SO_2 (Law no. 164/2017). The analysed samples showed values below the prescribed limits (15.03 – 29.5 mg/L). Due to the used sulphur dioxide that has an antiseptic, antioxidant and antimicrobial role, the wines have been stabilized and properly conditioned.
The main compounds are represented in figure 1, primary axis represents the compounds identified in 'Muscat Ottonel' and 'Busuioacă de Bohotin' samples.
The secondary axis was drawn for 'Fetească Regală' sample, as the values were much lower.
Figure 1 presents a unitary image of the identified aroma compounds in the three studied wine samples.
The ester with the highest concentration was ethyl caprate, found in Muscat wines and gives grapes and apples aroma.
Terpenes constitute the most important category correlated with basic floral aroma, beginning with linalool recognized in Muscat grapes about 50 years ago (Flamini, 2008).
Fatty acids are produced by yeast and bacteria during alcoholic fermentation to help build the bouquet.
The organoleptic characteristics of wine are significantly influenced by the presence of acids in its composition. Secondary products resulting from the alcoholic fermentation process are octanoic, hexanoic and decanoic acids. They usually have unpleasant aromas (barnyard, horse sweat) but, during maturation and aging, they form with alcohols subsequent esters with fruity or floral aromas.
Octanoic acid was identified in all analysed samples, the highest concentration was found in 'Fetească Regală' variety.

Table 1. Main physical-chemical parameters of analysed wines

Sample	Alc. conc. (% vol. alc.)	Reductiv e sugars (g/L)	Vol. acid. (g/L $C_2H_4O_2$)	Total acid. (g/L $C_4H_6O_6$)	Free SO_2 (mg/L)	Total SO_2 (mg/L)	Densit y	p H	Total dry extract (g\L)	Non-reductive extract (g\L)
Fetească Regală	12.8	10	0.19	6.1	28.2	51.3	0.9950	3.2	30.5	20.5
'Muscat Ottonel'	13.2	7.9	0.45	4.9	29.5	52.9	0.9927	3.5	25.5	17.6
'Busuioa că de Bohotin'	12.4	2.7	0.45	5.86	15.03	56.70	0.9958	3.1	31.3	28.6

The sensory profile reveals the variety specificity (figure 2), the analysed samples were balanced in taste. Fruits and floral notes are specific for all three types of analysed samples.
Pineapple notes were identified in two samples but Muscat wines presented a more intense aroma, as is confirmed by the GC chromatogram in the case of ethyl caprylate (figure 1). Also, ethyl caprate and ethyl laurate were identified in 'Muscat Ottonel' samples, followed by 'Busuioacă de Bohotin'.
It is noted that the flower flavor was strongly expressed in 'Muscat Ottonel' samples (highest concentration of linalool), being characteristic to this variety, but it was registered in less intense odours in the other samples too.
Following the sensory chart (figure 3), the sweet sensation and the wine body was more pronounced in 'Busuioacă de Bohotin' sample, as can be seen in the total dry extract values, followed by 'Muscat Ottonel' and 'Fetească Regală' samples.

Acidity is a gustative sensation that gives wine its fresh, pleasant, balanced taste, pronounced on 'Fetească Regală' wine. The perception of bitter taste was low in all samples.

The sample evaluated with the highest grade was 'Muscat Ottonel', due to its good structure and persistence its freshness and elegant aromas.

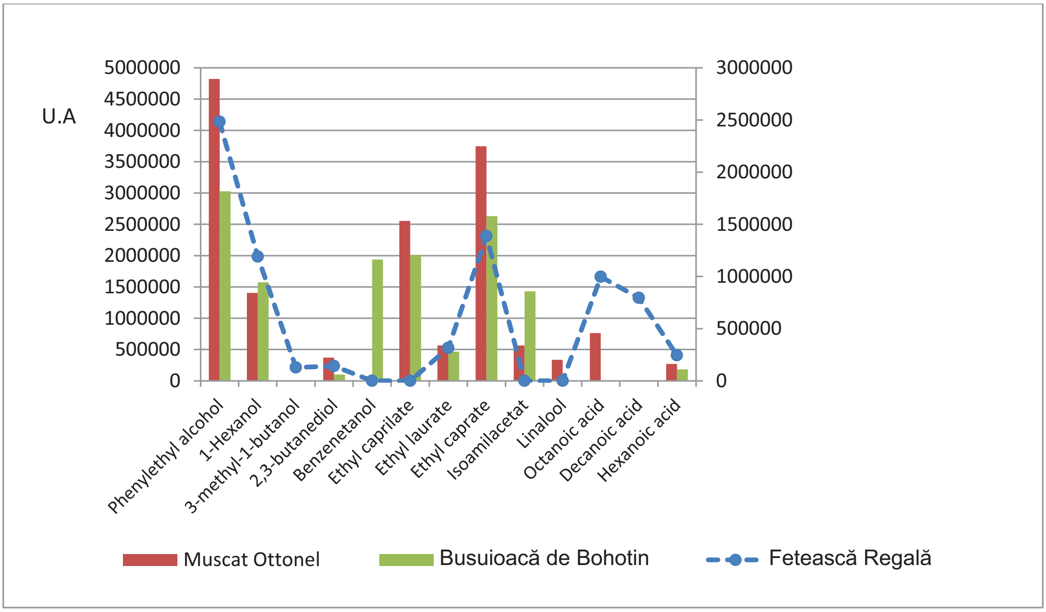

Figure 1. Volatile compounds found in the analysed samples

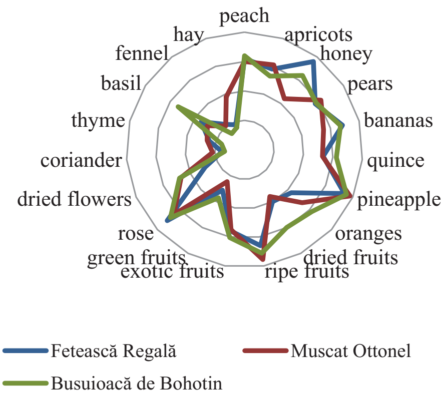

Figure 2. Results of sensory analysis for analysed samples

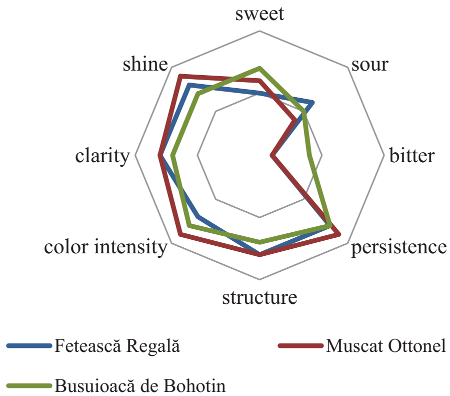

Figure 3. Gustative and visual assessment

Table 2. Main volatile compounds identified in the analysed samples

	Chemical compounds	Odour descriptor	Variety	References
ALCOHOLS	Phenylethyl alcohol	Pollen, honey, field flowers, basil, rose	‘Muscat Ottonel’ ‘Fetească Regală’ ‘Busuioacă de Bohotin’	Losada M., Andrés J., Cacho J., 2011
	1-Hexanol	Green, grassy	‘Busuioacă de Bohotin’ ‘Fetească Regală’ ‘Muscat Ottonel’	Colibaba Lucia Cintia, 2013
	3-methyl-1-butanol	Odor characteristic of fermentation, cheese, rancid	‘Fetească Regală’	Rocha S.M. (2006)
	2,3-butanediol	Fruity	‘Fetească Regală’ ‘Muscat Ottonel’ ‘Busuioacă de Bohotin’	Vararu F. (2015)
	Benzenetanol	Rose, honey	‘Busuioacă de Bohotin’ ‘Muscat Ottonel’ ‘Fetească Regală’	R.G.Berger
ESTERS	Ethyl caprylate	Pineapple, peaches	‘Muscat Ottonel’ ‘Busuioacă de Bohotin’	Moroșanu Ana Maria (2017)
	Ethyl laurate	Fruits, grapes, apples	‘Muscat Ottonel’, ‘Busuioacă de Bohotin’, ‘Fetească Regală’	Rocha S.M. (2006)
	Ethyl caprate	Grapes, apples	‘Muscat Ottonel’	Vararu F. (2015)
	Isoamilacetat	Fruit, bananas		
	Linalool	Floral smell	‘Muscat Ottonel’	R.G.Berger
ACIDS	Octanoic acid	Hard smell, cheese	‘Fetească Regală’ ‘Busuioacă de Bohotin’, ‘Muscat Ottonel’	Colibaba Lucia Cintia (2013)
	Decanoic acid	Smell of rancid, unpleasant, fat	‘Busuioacă de Bohotin’, ‘Fetească Regală’	R.G.Berger
	Hexanoic acid	Tobacco, spicy, cheese, rancid, sour	‘Muscat Ottonel’ ‘Busuioacă de Bohotin’	Rocha S.M. (2006)

CONCLUSIONS

All analysed samples contain compounds such as alcohols (1-hexanol, 2,3-butanediol), esters (ethyl caprylate, ethyl laurate) and acids (octanoic acid, decanoic acid, hexanoic acid.

‘Muscat Ottonel’ wines were characterised by higher concentrations of phenylethyl alcohol, the main responsible for the intense aroma of field flowers, roses and honey.

Aromas as pineapples, peaches, ripe fruits were given by ethyl caprylate presence and identified in ‘Fetească Regală’ and ‘Muscat Ottonel’ samples.

This research refers to Romanian grape varieties that require to be studied in-depth and better represented to consumers around the world.

ACKNOWLEDGEMENTS

The research was funded by the Romanian Ministry of Education, the FDI project, registration final code CNFIS-FDI-2019-0267.

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