

# VOLATILE COMPOUNDS IDENTIFIED AND QUANTIFIED IN MOLDOVA'S WINES

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**ABSTRACT:** In this paper we studied and characterized four wines from the grape varieties Busuioaca de Bohotin, Feteasca neagră, Muscat Ottonel, Pinot gris, harvests of 2016, 2017, 2018, coming from the: Bohotin, Cotești, Cotnari, Huși and Iasi vineyards. The GC-MS methods were utilized to identifying and quantifying the volatile compounds of these wines. The results obtained being grouped into three categories, namely: higher alcohols, volatile acids and esters. It was found that the higher alcohols have minimum values between 195.07 mg / L and maximum values of 257.2 mg / L in Huși and Bohotin for Feteasca black wine, the volatile acids do not exceed 17.92 mg / L in Cotnari in Muscat wine Ottonel and the esters reach values of 204.78 mg / L at the Cotești vineyard in the case of Feteasca neagră wine. From the results obtained we distinguish the Feteasca neagră wine with the optimal ratio between the three monitored indicators.

**KEY WORDS:** volatile compounds, GC-MS, Moldova's wines

## 1. INTRODUCTION

The aromatic complex of wines is the main element of their selection by the consumer. Aroma is a very important characteristic in wine (Lengyel 2012). The current trend of winemaking is to produce wines with different aromatic nuances to provide a variety of wines in the developing market. Flavor is known to depend on pedo-climatic conditions, variety of grapes, region, methods of extraction of volatile substances applied in wine production technology, selected yeast strains, intrinsic value of various compounds and precursors, including established winemaking methods and practices. or how it is conditioned and stored (Styger et al. 2011, Lengyel 2012). Volatile compounds have an important role to characterize the aroma. The olfactory thresholds of these compounds may differ considerably, so that some compounds present in the traces may play a key role in the aroma of a wine, while others, although more abundant, may do so to a lesser extent. "Many of the volatile chemical compounds contained in wine can be used as differentiation parameters to determine the origin of the wine" (Stegăruș 2015).

The volatile profile of a wine is influenced by several factors: the grape variety, soil, climatic conditions, the vinification process, during which it can intervene at any stage and the conditions of wine storage (Lengyel 2015, Sacchi et al. 2005).

These flavors are mostly attributed to classes of compounds such as: terpenes, higher alcohols, aldehydes, ketones, esters, fatty acids (Andujar-Ortiz et al. 2009, Wust 2003). The aromatic, volatile compounds of wine are currently in the order of hundreds, this aspect not being fully elucidated until now. We can mention the phenolic and terpenic compounds, the benzene derivatives, the norisoprenoids, the thiols, the carbonyl groups, the methoxy-pyrazines, generally the polyphenols, the wine chemistry being particularly attractive from this point of view (Waterhouse 2002). In the last years the techniques of quantification of the various elements have led to the identification of many groups of aroma compounds that, even without the threshold of human perception. All these elements, even if they are in a small amount, actively participate in the formation of the aromatic complex of wines. Aroma is one very

important factors that determine the quality of the wine and their sensorial character (Villamor et al. 2013). Some of the aromatic compounds are released directly from grape beans, while others are formed during the fermentation and ripening process (Pretorius et al. 2008). The most important aromatic compounds in wine are those that come from the fermentation process, which mainly include higher alcohols and aldehydes, fatty acids and esters. The much aroma characteristics of wine are give by chemical compounds: esters of decanoic acid, hexanoic acid, octanoic acid, isoamyl acetate, isobutyl acetate

(Ferreira et al. 2016). The concentration of volatile compounds differs from one variety to another, being of the order of mg / L to a few ng / L, the olfactory perception varies considerably. The red wines content in the early stages of wine life many of monomeric anthocyanins (Alcalde-Eon et al. 2007; Torchio et al. 2011) but are involved in different reactions (copigmentation), polymerization, vinification and further in the aging of the wine) which can change its concentration (Briz-Cid et al., 2014). Vinification involves musts and wines in constant evolution. Vitis-type grapes are relatively rich phenolic compounds, thus that their extraction is an advantage in increasing the polyphenol content in wines. The phenolic content of the wine depends on the raw material and the type of vinification followed, which affects the physical and chemical phenomena and biochemical phenomena (oxidation, degradation, condensation, etc.) (Mulero et al., 2015, Wust 2003). The type and concentration of phenolic compounds in wine depends on the variety of grapes, baking, atmospheric conditions, viticulture and winemaking techniques (Rodríguez-Delgado et al., 2002). The physical properties and chemical characteristics of the wine

give it the sensory quality and the phenolic compounds are responsible for the bitterness, color, astringency they are an important quality parameter of red wine. Red wines are mainly composed monomeric anthocyanins, derivatives of monomeric anthocyanins and non-anthocyanin phenolic compounds. These include flavonols, hydroxybenzoic acids, flavanols and hydroxycinnamic acids. The bitterness and the astringency of red wine is a result of flavanols and phenolic acids, and the color is

insured of the quantity and quality of monomeric anthocyanins ( Lengyel et al. 2015, He et al., 2012b).

Several studies have shown that low temperature favors the synthesis and retention of flavors in the fermentation process. Thus new species of wine yeasts are able to promote a fermentation at a low temperature, the consequence being the aromatic improvement of the wine. Specialized studies explore oenological features of different *Saccharomyces* species and hybrids relevant to the current wine industry. The techniques used were biochemical in nature, analytical chemistry, including molecular techniques to verify the enzymatic activity, detection, determination of the flavor profile and analysis of the transcriptome during the fermentation period of the wine. Studies show that the production and release of aromas in vinification depends on the strain that carries out the fermentation process but also on the temperature used (Stegăruș et al. 2017).

## 2. MATERIALS AND METHODS

- Busuioaca de Bohotin, Fetească neagră, Muscat Ottonel, Pinot gris wines, harvests of the years 2016, 2017, 2018, from the vineyards: Bohotin, Cotești, Cotnari, Huși and Iași, (the varieties were noted with the acronyms: Busuioaca de Bohotin : BB, Fetească neagră: FN, Muscat Ottonel: MO, Pinot gris: PG)

- GC / FID (Varian 450 GC gas chromatograph coupled with Varian 240 MS, flame ionization detector, Thermo Scientific TG-WAXMS capillary column (Waltham, MA USA) (60m x 0.32 x 0.25 pm). was developed and published by Stegăruș (2016). This method sought to identify and quantify the following volatile compounds:

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

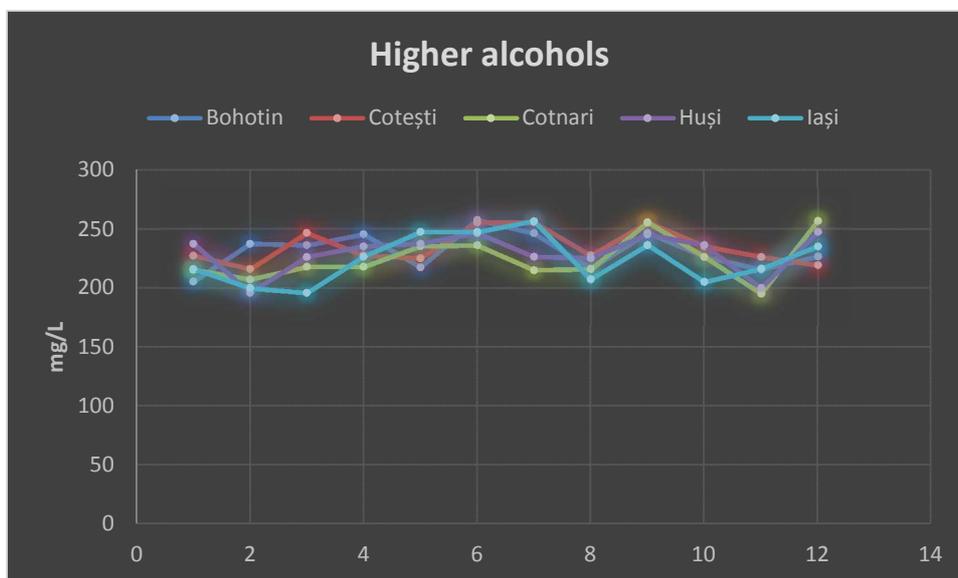
Volatile Acids: Isovaleric Acid, Octanoic Acid, Heptanoic Acid, Dodecanoic Acid, Isobutyric Acid, Acetic Acid, Hexadecanoic Acid, Butyric Acid

Esters: Ethyl Octanoate, Ethyl Formate, Ethyl Decanoate, Ethyl Lactate, Isoamyl Acetate, Ethyl Acetate, Diethyl Succinate, Isoamyl Acetate, Hexyl Acetate, Heptyl Acetate, Methyl Octanoate

The standards for the volatile compounds identified and quantified in the present work are of chromatographic purity and come from the Sigma-Aldrich company.

## 3. RESULTS AND DISCUSSIONS

The volatile compounds influence the organoleptic properties of the wine contributing to the formation of the aroma, the volume being in very varied amounts, their combinations conferring originality and uniqueness to each assortment. The studied wines showed accumulations of higher alcohols in amounts ranging in 2016 between 196.07 mg / L in Huși - Fetească neagră and 237.31 mg / L also in Huși in the case of the Busuioaca de Bohotin assortment (Figure 1). Comparing the vineyards for the same wine assortment, it can be seen that the differences can reach up to 12% -18%. The most noticeable difference is in the case of Feteasca black 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 the year 2018 Busuioaca de Bohotin presents the most significant accumulations of higher alcohols in all five vineyards, the values reaching a maximum of 255.32 mg / L. In contrast, Muscat Ottonel wine has higher alcohol values even below 100 mg / L in the case of Cotnari and Huși vineyards.

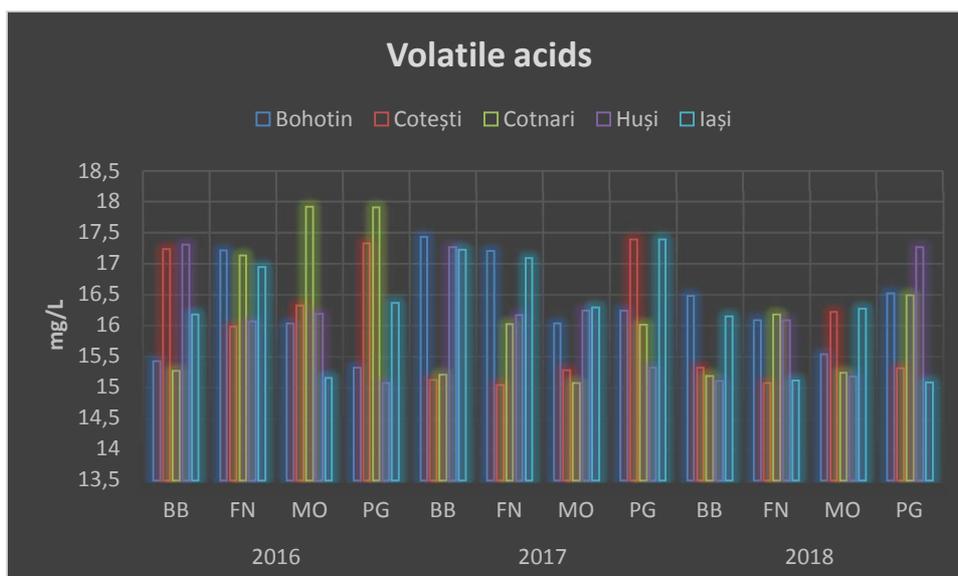


**Figure 1.** The sum of the higher alcohols identified and quantified in the wines Busuioaca de Bohotin, Feteasca neagra, Muscat Ottonel, Pinot gris, of the years 2016, 2017, 2018, from the Bohotin, Cotești, Cotnari, Huși and Iași vineyards

Volatile acids in wines provide valuable information on acids belonging to the acetic series present in wine in the free state and in the form of salt. As shown in figure 2, 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, reaching a maximum of 17.92 mg /

L for Muscat Ottonel wine from Cotnari. In 2017, the range of values found 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 obtained values are around 16 mg / L, a minimum of 15.07 mg / L volatile acidity in the case of Feteasca

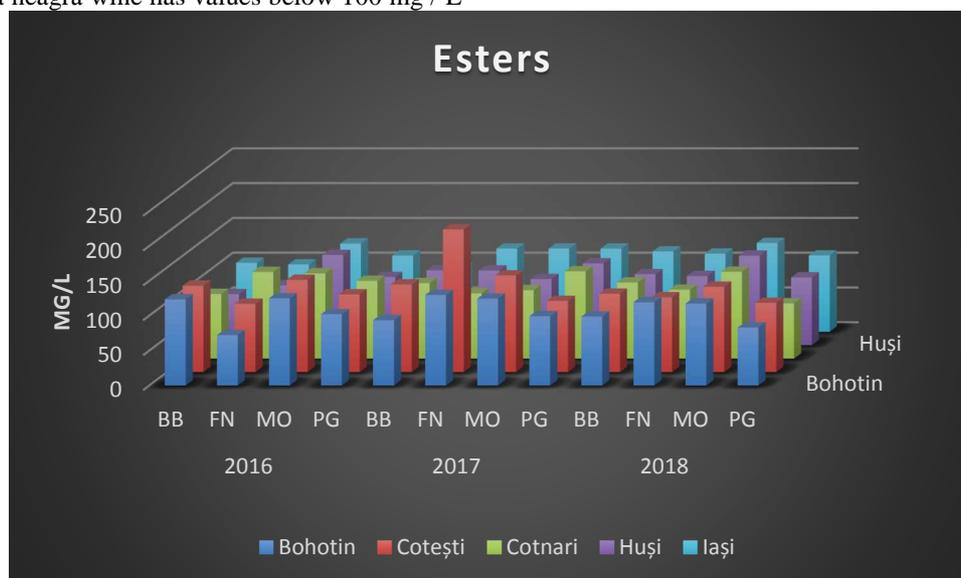
neagra wine from Cotești and a maximum of 17.27 mg / L in the case of Pinot gris wine from Huși.



**Figure 2.** The sum of the volatile acids identified and quantified in the wines Busuioaca de Bohotin, Feteasca neagră, Muscat Ottonel, Pinot gris, harvests of 2016, 2017, 2018, from the Bohotin, Cotești, Cotnari, Huși and Iași vineyards

As shown in Figure 3 the sum of the esters varies in 2016 between 73.1 mg / L in the case of the Busuioaca de Bohotin assortment from Huși and a maximum of 132.1 mg / L in the case of the wine from Cotești, Muscat Ottonel. It is noted that there are major differences between the accumulation of esters in wines from different vineyards. The closest and constant values are noted 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 they are located at a level around 123 mg / L. Feteasca neagră wine has values below 100 mg / L.

in all 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 in the case of 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, Fetească neagră. 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.



**Figure 3.** The sum of the esters identified and quantified in the wines Busuioaca de Bohotin, Feteasca neagra, Muscat Ottonel, Pinot gris, harvests of the years 2016, 2017, 2018, from the Bohotin, Cotești, Cotnari, Huși and Iași vineyards

#### 4. CONCLUSIONS

Following the analyzes carried out on GC-MS, it was possible to identify more than 35 volatile aromatic compounds, in amounts that can give the selected wines the qualities expected by the manufacturer. The highest weight is given by the 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 that 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 the 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 the pedoclimatic and structural evaluations. The monitored indicators lead to the conclusion that the black Feteasca wine presents an optimal ratio, so that it can be recommended as a local aromatic wine of superior aromatic quality. The aromatic characterization of these wines, the quantification of valuable volatile compounds contributes to the promotion of Romanian wines from the Moldova area, but also offers the opportunity to continue these studies.

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