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EVALUATING SOME OLFACTORY CHARACTERISTICS OF WINE IN THE CONTEXT OF GLOBAL WARMING IN THE "PLAIURILE DRÂNCEI" VITICULTURAL REGION

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Abstract

Global warming is recognized among the scientific community as a worrying fact for the environment, which generally speaking causes unwanted changes in the species' evolutionary accommodation mechanism to superior thermal conditions. In this context, this study's purpose is to point out some chemical transformations which positively contribute to the olfactory characteristics of wine. Global warming determines an increase in the alcohol levels, therefore causing a proportional increase of secondary fermentation products, which are helpful in giving a pleasant aroma. The samples used for the analysis were of the 'Sauvignon Blanc' variety from the "Plaiurile Drâncei" vineyard. The alcohol concentration of the samples varies between 11.8 and 13.6% v/v. The identification of chemical compounds was performed using the head space technique coupled with GC-MS. Following the analysis, there were identified chemical compounds which mainly give floral, fruity, citric notes and also not specific to fermentation, moreover giving a pleasant olfactory sensation to the final product. Therefore, the olfactory characteristics of wine depend on a series of factors beginning from climate parameters and ending with the fermentation process.

Key words: wine, *GS-MS, global warming*

INTRODUCTION

Romania is country rich in soil and diverse microclimates. It is for these reasons why from the country's territory there can be obtained from white wines characterized by freshness and lean fruity aromas to red wines, noble, suited for aging and also wines with low or high acidity and even wines suitable for producing sparkling wines. Therefore, unlike in other countries, the climate of Romania allows for variation in the types of vinification. (Stoian, 2011; Cotea et al., 2003).

The "Plaiurile Drancei" vineyard is located in the hilly terrain of the fields of "Oltenia", towards the Danube and is part of the vinicultural region of the "Getic" plateau and is one of the most southern vineyards of Romania. Documentary certified sources indicate the fact that viticulture began to develop in this area beginning around 1407, the most well-known vinicultural locations being "Oravița", "Rogova", "Drâncea" and "Oprișor". Around the year 1900, during the visit of King Charles I, the wines of this vineyard became renowned in the whole country, being sought after by every "collector" of good wines. These wines are characterized by high levels of alcoholic concentration and rich in mineral substances and extract.

The vineyard is situated on slopes, divided into two regions: the North West region of the fields of "Oltenia" which descends towards the Danube in several stages which have altitudes smaller than 200m; and the region around the "Bălăcița" plateau which has altitudes between 200m and 300m. The tilt of the slopes varies between 5 to 10 degrees. This placement is one of the factors that contribute to the superior quality of the wines. Another factor is the soil's composition. Their composition is made of: 60% brown-red strongly eroded soil, 15% ordinary brown-red soil, 10% brown-red

eroded soil, 10% ordinary leached chernozem and 5% ordinary alluvial soil.
Ion Ionescu de la Brad claimed in one of his papers that in “Oprișor” the sun falls on the vineyard all day long and that the soil in this locality was “red clay”, referring to the brow-red soil. The hydrography is characterized by a network of small rivers and their tributaries.
In these vinicultural areas the clime is continental temperate with mediterranean influences and is characterized by hot summers and relatively mild and wet winters (the frost seldom happens or it is of weaker intensity). The average temperature is between -1 and -2 degrees Celsius in January and between 21 and 22 degrees Celsius in July. The average annual temperature is 11 degrees Celsius and the average annual precipitations are between 550 and 600 mm, while snow is relatively scarce. During the periods of drought there is a water deficit. By taking into account all these parameters of the natural setting, they add up to an ecosystem that is favourable for high quality viticulture (Cotea and Andreescu, 2008; Cotea et al., 2003; Toti et al., 2017; Ionescu, 1968).
According to the National Meteorology Administration’s estimations, which were presented in a report, the average annual temperature of Romania increased during 1961-2014 by 0.5 degrees Celsius and regarding precipitations, their quantity resulted in an increase in the number of extremely droughty years. The forecasts on this subject show that in the following years (2021 - 2050) the summers will become hotter, draughty and the precipitations will decrease by up to 10-20% on average (Sandu, 2015).
The ‘Sauvignon Blanc’ variety is the second most popular white wine in the world and is native to France, Bordeaux but it is grown from the oldest times in the Loire Valley, in New Zeeland or in the USA. It belongs to the category of quality wines. Due to its adaptability, in present it is being grown in a lot of countries and on all the continents. It is assumed that the name “Sauvignon” comes from the French word “*sauvage*” which means untamed or wild, the association being made with the wild vines or with its special aroma. Generally, it is a wine with a soft aroma. Based on the grapes’ degree of ripening they can give herbal, vegetable or green fruity tones, and when coming to a higher degree of ripening they can give floral and exotic fruity tones. Therefore the range of aromas can vary from forest apples, grapefruit, passion fruit, kiwi and well ripened cantaloupe. Furthermore, the specifics of this variety consist of the smell of “cat urine”, but experienced in a pleasant way which is a designator of quality and is used as a means of identification. Although it is a variety that offers herbal (green leaves) tones, this changes when the level of alcoholic concentration rises or oak is used in the winemaking process and the exotic tones prevail (Old, 2013; Stoian, 2011; Cotea et al., 2003).
In the context of global warming this paper takes a more positive approach on the changes caused by the climate factors. The trend is that of the vineyard, through its characteristics, to be able to adapt to the sharp rise of temperatures, respectively resisting to the absence of precipitations. If a variety of grapes is developing naturally, while keeping its specifics, in a certain range of temperature, when the temperature rises on average even with as little as 1-2 degrees Celsius there is a risk of losing its defining attributes or not being able to adapt at all in these new climate conditions. In that case the approach taken by the winemaker is very important. The biggest change in wines that is caused by global warming is the increase in the alcoholic concentration (even with as much as 2-3%). Once this happens, the intensity of the aroma also increases, especially the aromas of oven baked fruits, exotic aromas, spicy or oak aromas. The current trend of the Romanian consumer is to drink white young wines which are as floral, fruity and fresh as possible. The formation of these aromas can be better studied through volatile chemical compounds, which are responsible of the product’s final result (Jones, 2007; van Leeuwen, 2016).

MATERIALS AND METHODS

The samples belong to the ‘Sauvignon Blanc’ variety from the vinicultural region of the “Getic” plateau, “Plaiurile Drâncei” vineyard, Oprișor locality, and were obtained in three different years: 2013, 2014 and 2015. A number of five samples was chosen for this study (denoted SB0-SB4) and the difference between each other consists of the type of yeast strain used for the fermentation process. Sample SB0 was obtained through gravitational clarification in the absence of yeast and the rest of the samples (SB1, SB2, SB3, SB4) were obtained through gravitational enzymatic clarification.

The samples from 2015 were chosen for a more thorough analysis, from which a volume of 7 mL was collected and analysed through gas chromatography using the head-space technique coupled to a mass spectrometer. The equipment used was a Shimadzu Head Space HS 20 trap - GC 2010plus-MS8040TQ. The compound identification was done by correlating with the software's database and the quantitative results were obtained using the internal standard method by comparing with 4-methyl-2-pentanol (Grigorică, 2017). The samples' alcoholic concentration was determined according to the OIV-MA-AS312-01 method (OIV, 2018).

RESULTS AND DISCUSSIONS

After determining the alcoholic concentration of all the samples, the values from Table 1 were obtained:

Table 1. Alcoholic concentration of samples for year of production 2013-2015

Year of production	Samples	Alcohol (%v/v)
2013	SB0	12.8
2013	SB1	13.1
2013	SB2	13.1
2013	SB3	13.0
2013	SB4	13.0
2014	SB0	11.8
2014	SB1	12.0
2014	SB2	12.1
2014	SB3	11.9
2014	SB4	12.0
2015	SB0	13.1
2015	SB1	13.6
2015	SB2	13.3
2015	SB3	13.3
2015	SB4	13.5

In 2015 there is an increase in alcoholic concentration of approximately 0.5% v/v across all samples, compared to 2013. This is somewhat expected given the climatic changes, especially the air temperature, which is strongly connected with the increase of alcoholic concentration. 2014 was an unusual year, being considered by the National Meteorology Administration as the fourth rainiest year from the last fifty years. This caused a decrease in temperatures and July did not bring any heat waves as it was expected (Polifronie, 2014).

Therefore, following a comparison between the samples' alcoholic concentration, it was expected that the wine from 2015 would be richer in volatile compounds which give more intense fruity aromas. This was confirmed by the results from the chromatographic analysis (Table 2). There were several volatile compounds that were identified by this analysis, but are showed only those for which the literature gives clear information of their flavour (Wu, 2016; *thegoodscentscompany) and especially those which have a positive impact and through which the influence of alcoholic concentration can be observed.

By analysing the aromatic profile it is obvious that the dominating aromas are fruity. Responsible for this are the chemical compounds from different classes such as alcohols, esters and carboxylic acids. Their concentration in this case is also influenced by the yeast that was used for fermentation - this explains the difference between the values of the same compound and with the same alcoholic concentration (for example in the case of ethyl octanoate for samples SB2 and SB3 or in the case of hexanoic acid for the same samples).

Most of the chemical compounds may have several sensorial characteristics (from pleasant fruity aroma to fatty and waxy repelling aromas), depending on the concentration in which they are present (Wu, 2016). From the numerical data obtained it follows that ethyl octanoate and ethyl decanoate have the biggest influence in forming the fruity aromas. The specifics of these aromas are apricot, banana, pear, pineapple, apple or wine.

Other compounds that present sweet and fruity aromas are 3-methyl-1-pentanol, 2-undecanol, ethyl decanoate, isoamylacetate (banana or pear), 3-methylbutyl decanoate (banana), decanoic acid (citrus), ethyl nonanoate (apple or banana), 3-hexenol acetate (banana or candy) or ethyl pentadecanoate (honey).

Table 2 Results of chromatographic analysis for wine samples from 2015

	Alcohol concentration (%v/v)	13.1	13.6	13.3	13.3	13.5
	Samples	SB0	SB1	SB2	SB3	SB4
Chemical compounds	Flavour	Samples concentration (microequivalents internal standard/L)				
isoamylacetate	banana, pear	ND	260.77	63.34	43.61	ND
2-methyl-1-propanol	ethereal, apple, bitter, cocoa, winey	ND	22.14	27.18	14.33	ND
2,6-dimethyl-4-heptanone	sweet, mint	37.19	52.54	ND	ND	44,4
3-hexenol acetate	banana, candy, floral, green	36.19	31.97	40.31	30.09	19.56
5-methyl-2-hexanol	grassy	7.36	7.63	6.2	6.48	17.9
3-methyl-1-pentanol	fruity	2.9	9.89	ND	ND	9.6
ethyl octanoate	sweet, fruity, apricot, banana, pear, pineapple, wine, waxy, dairy	1309.57	2266.25	1911.94	1057.88	2376.98
1-hexanol	floral, green, resin	4.92	24.9	17.93	20.24	14.35
3-hexenol	moss, fresh	13.89	93.62	59.48	47.4	ND
2-hydroxyethyl propanoate	butter	76.14	59.07	23.42	28.69	156.46
1-hydroxy-2-propanone	butter, grassy, malt, spicy	4.88	ND	4.11	ND	ND
ethyl nonanoate	fruity, apple, banana, rose, winey, cognac, waxy	5.99	20.08	13.49	9.4	17.4
2-undecanol	fruity	9.71	27.91	19.72	18.96	24.74
ethyl decanoate	sweet, fruity, apple, waxy	2141.92	1848.29	1828.46	1054.08	1211.38
isobutanoic acid	acidic, sour, cheesy, dairy, buttery, rancid	50.59	66.34	6.19	6.15	32.2
2,3-butanediol	fruity, buttery	35.53	29.41	ND	ND	11.11
butanoic acid	sharp, acidic, dairy, cheesy, sour, buttery with a fruity nuance	17.15	29.62	ND	ND	3.56
diethyl succinate	fruity, passion fruit, apple; apricot; cranberry, peach, pear, chocolate, grape, floral, musty, waxy, earthy	7	37.88	36.93	35.8	33.18
isovaleric acid	fruity, cheese, dairy, acidic, sour, pungent	18.27	36.97	28.98	25.3	30.18
ethyl palmitate	fruity, waxy, creamy and milky with a balsamic nuance	295.06	520.17	402.47	386.69	339.95
3-methylbutyl decanoate	sweet, fruity, banana, waxy, green nuance	5.91	10.49	9.31	9.42	4.14
hexanoic acid	sour, fatty, sweat, cheese	271.96	345.82	312.73	274.28	268.49
2-phenylethanol	sweet, floral, fresh and bready with a rose, honey nuance	225.19	237.77	251.38	251.17	255.68
ethyl myristate	sweet, violet, iris, waxy	ND	5.04	ND	31.48	ND
octanoic acid	waxy, dirty, cheese, phenolic, fatty, oily	728.65	864.24	784.73	792.78	703.07
ethyl pentadecanoate	sweet, honey	ND	12.03	ND	ND	6.21
decanoic acid	citrus, unpleasant, rancid, sour, fatty	312.55	162.56	141.03	114.26	99.43
ethyl tetradecanoate	mild, waxy	ND	10.13	13.71	11.12	8.89
ethyl linolate	fruity, mild, fatty	ND	8.3	5.35	5.83	7.2

*ND - not detected

Some compounds may have a specific wine aroma or in the case when the samples evolve in time (in gets older in a good way) there may be even aromas of brandy - in the case of 2-methyl-1-propanol, ethyl nonanoate.
The fact that the Sauvignon Blanc variety is also characterized by herbal aromas was also proved by the presence of compounds that can give this kind of aroma - 3-hexenol acetate, 1-hexanol, 3-methylbutyl decanoate. In most of these cases the samples which have a higher alcoholic concentration also have higher concentration of these compounds comparing with the other samples which have a lower alcoholic concentration. The fatty acids and their esters have a less pleasant contribution, but taking into account the relatively small concentrations in which they are present it is not disturbing. Most of them are responsible for the fatty, buttery, waxy and sometimes sour sensation - decanoic acid, octanoic acid, hexanoic acid, isobutanoic acid, ethyl tetradecanoate, ethyl linolate.
By categorizing the resulted aromas by the class of chemical compounds from which they come, one can notice that most of the pleasant, fruity aromas are owed to esters. The weight of the chemical compounds that give fruity aromas is larger than those that give unpleasant and disturbing smells.

CONCLUSIONS

The perception of an aroma largely depends on the experience and the sensitivity of the evaluator. However, the volatile chemical compounds which are responsible of aromas could be better highlighted if there is an alcoholic concentration which increases their volatility.

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