Sensory and chemical attributes of dessert wines made by different freezing methods of Marselan grapes

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Abstract

Introduction. The purpose of research was to determine the impact of different freezing methods of Marselan grapes on sensory and physicochemical compositions of obtained icewines.

Materials and methods. Sweet wines were obtained by two ways of freezing of Marselan grapes: naturally and alternative – cryogenic extraction. The production and physicochemical parameters of wines were conducted in agreement with the provisions of the International Organization of Vine and Wine relating to icewine technology. Quantitative and qualitative composition of aromatics in sweet wines were determined by gas chromatography. Sensory analysis consistent with ISO 8586-2 showed the organoleptic attributes of dessert wines.

Results and Discussion. According to the agricultural climatic resources of Northen Black Sea coast exactly in Odesa region red variety Marselan is suiTable for processing into dessert wine of premium sector. Freezing of grapes by cryogenic extraction was slower and at a lower temperature (-10°C) compare to natural method (harvesting at -7°C) for obtaining of must with a high sugar content.

The chemical composition of the wine grape Marselan, frozen in various ways were not significantly different. Positive correlations among the variables responsible for the content of sugar, ethanol and volumetric mass concentrations of volatile acids were observed in both samples. 35 and 37 aroma compounds were found in wines made by natural (NF) and alternative freezing (AF) respectively by gas chromatography. Concentrations of alcohols in both wines were the highest among aroma volatiles counting more than 60 % and 40 % in wines of NF and AF accordingly. Esters, higher alcohols, volatile acids differ in mass concentration, and C_6 compounds were found only in the wine produced from grapes frozen on the vine. Sensory analysis showed differences in intensity of fruit notes, hints of nuts and longitude of aftertaste.

Conclusions. The results of the research demonstrate the peculiarities in the formulation of unique aromatic and chemical profiles of icewines made from Marselan, as well as a way of freezing affects the defining characteristics of the wines.

Introduction

Using the new varieties in non-classic technologies impacts on developing of original wines whereby expanding of range inside market. Icewine is relatively new wine type for production of which particular conditions are required [1]. An agricultural climatic factors and cold resistant cultivars are the main aspects to obtain frozen grapes from vines. The white skinned varieties are widely applicable in atypical technology but recently winemakers have started to freeze dark grapes that also can withstand frosts [2].

To our knowledge icewine from Marselan grapes had not been produced in the world and its aromatic and chemical characteristics also had not been investigated in scientific literature [1], [2], [7], [8]. Marselan cultivar originated from cross-breeding of Cabernet Savingnoun and Grenache in France [3] was chosen due to characteristics appreciated for icewine grapes including thick skin, late maturing variety with a high natural acidity. A cold resistant of variety was determined through leaving grapes on vines after major of harvest had been picked for another wine types from vineyards of Shabo. Riesling is considered as king of icewine grapes in the world [4] but unfortunately due to the distribution of precipitation most of which was high in months of autumn cultivar was rotten in Northen Black Sea coast, Odesa region, Ukraine (Figure 1).

In order to avoid lost entire amount of grapes intended for icewine before temperatures will be cold producers use artificial methods of freezing. Place is especially important in wine grape production because soils and climate cannot be modified by humans, and thus geographic branding has become increasingly spatially specific [5].

The aim of current article was to determine the peculiarities of aromatic and chemical compositions of wines obtained by natural and alternative freezing of Marselan grapes. The main objectives of research were to compare chemical and sensory properties of dessert wines. The expected practical result was to produce the new premium wine possessing unique aroma and flavor due to atypical technology.

Materials and methods

Grape materials. In December of 2016 Marselan grapes from vineyards belonged to terroir of Shabo in Northen Black Sea coast, Odesa region, Ukraine were harvested and pressed at required level of temperature according to Definition of the vitivinicultural products by code sheet of OIV [6]: - 7°C. The sugar content of obtained must was over 300 mg/l that is accordance with international documentation about icewine production. Two month earlier another portion of Marselan grapes had been frozen using refrigerator during one week until statutory sugar level was reached in berries (until -10°C). The grapes had been picked while technological ripeness of variety was observed on October of 2016.

Fermentation. The intense advertence is devoted to choice of yeast strain that contributes to chemical and sensory attributes thereby question of optimal and suiTable yeast for icewine is still discussed by major of producers and researchers [7], [8], [9], [10], [11]. Before fermentation musts were clarified by Microcol bentonite alpha (Laffort CO., France) with concentration of 1g/l combined with Polylact (Laffort CO., France) for effective fining. The adding of Assotan (Esseco SRL, Italy) contributed to essential antioxidant protect. Both samples of must formerly heated to 18-20 °C were inoculated with Saccharomyces cerevisiae VIN 2000 hybrid (Anchor, South Africa) at rate of 5 g/dal. The yeast starter was prepared by such wise: 1) rehydration of yeast to intended concentration 5 g/dal, 2) after 15 minutes of rehydration equal volume of yeast and must previously heated to 28-30°C were mixed and then resulted started was left during 1 hour,

3) in this starter equal volume of sweet must was added and left at temperature of 25-30 °C stirring every 45 minutes. The yeast starter was appended triply: in 1st day of fermentation, after 2 days of fermentation and after one week in order to acclimatization and accumulation of yeast biomass. Also to reducing the fermentation time and increasing the rate of process simultaneously complete fermentation activator and yeast nutrient Maxaferm (DSM Food Specialties B.V, The Netherlands) with concentration of 2 g/dal and Booster Blanc (Lallemand, Canada) with concentration of 3 g/dal were added to both musts after 2 days of beginning of fermentation. The aforementioned nutrients were diluted in water 1:10 and supplemented one time.

Chemical methods. Chemical analysis was conducted according to prevailing laws in winemaking of Ukraine and international documentation regard to icewine production. The sugar content of must was measured by Digital Hand-Held "Pocket" Refractometer PAL1 (Atago CO., LTD, Japan) and then converted from Brix into g/l using Table giving the sugar content of musts and concentrated musts in grammes per liter recommended by OIV [12]. The pH was determined by pH- meter S220 (Mettler-Toledo International Inc., Switzerland). The concentration of titrated acid (TA) was determined in accordance with first method of GOST 14252-73. Concentrations of volatile acids (VA) were identified by analytical equipment Apparatus for the extraction of volatile acidity by direct distillation 116300 (Dujardin-Salleron Laboratory, France).

Determination of volatiles in the wines was carried out using of Gas chromatography Agilent Technology 7890A (Agilent Technologies, Inc., USA). The main characteristics of chromatograph utilized in ascertainment of volatiles are following Silica capillary column VF-WAXms 60 m, the carrier gas was helium at rate of 3 ml/min, column diameter – 0,33 mm, the temperature of the evaporator and the detector pointed 245 °C, the temperature of thermostat was from 450 to 245 °C with rate of 40 / min, sample volume – 1 mcl. The concentration was calculated according to the method of absolute calibration. A pentanol—standard solution (internal standard - 5 mg/l and 1 ml of methylene chloride) were added to 10 ml of wine base. After stirring for 2 hours on a magnetic stirrer methylene chloride layer was separated, which had been evaporated by pure nitrogen gas flow to a volume of 50 microliters. The extract was analyzed by a chromatograph mass spectrometry detector. The components were identified by comparing the mass spectra of the substances identified in the chromatogram and of the standard library of mass spectra. The concentration was calculated according to the ratio of the peak areas pentanol (5 mg / l) and the identified peaks of volatile substances without correction factors.

All methods of determination of wine and must compositions were conducted in producing laboratory of winery «Shabo» in triplicate. Data about amount of precipitation was obtained from meteocenter of territory where Shabo is located.

Sensory assessment. Analysis of organoleptic attributes of dessert wines were done in laboratory of sensory analysis of Odesa national academy of food technologies (ONAFT), Odesa, Ukraine by a panel of 10 judges who had trained according to ISO 8586-2 [13]. The most applicable descriptive terms had been selected during tasting to create own aromatic profile of dessert wines.

Statistical analysis. In order to determine differences in sensory and chemical attributes of obtained wines XLSTAT (Addinsoft; Paris, France) statistical software was performed. The diversity between chemical variables of grape musts and wines Factor analysis was utilized (Table 1, Table 2). LSD test showed the influence of temperatures on sugar contents of Marselan grapes frozen by refrigerator ($p \leq 0{,}05$) (Table 3). ANOVA (Assessor/Descriptors) was carried to calculate which descriptors had had the biggest influence on sensory parameters using grade scale with anchors at 0 to 7. Anchors for parameters of length of aftertaste and color were labeled as low intensive and high intensive, for other attributes grades were characterized as low or high starting from 0. Using Descriptive analysis mean scores of descriptors defined by each judges were determined (Figure 2). Means and its standard deviations of volatiles of 2 dessert wines were calculated (Table 4). All Figure s were created using Excel software (Microsoft Office, USA).

Results and discussion

1. Natural and alternative freezing of Marselan grapes

Marselan originated from south of France and favored in hot climate withstood frequent precipitation especially during October in Northern Black Sea coast, Odesa region that also is important to produce rare wine without loses of grapes caused by high water status in ground before first frosts (**Figure 1**).

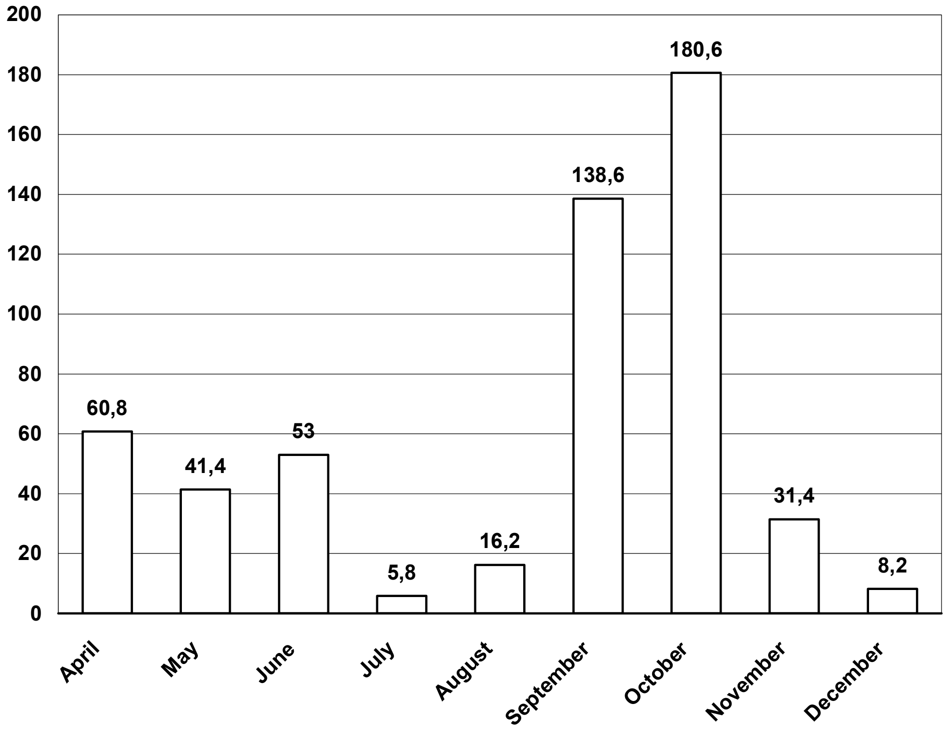

Figure 1. Precipitation from April to December of 2016 in Shabo, mm

The value of water for technological characteristics of grapes is essential: the more precipitation in the period of active vegetation of the plant, especially the berries growth, the higher the acid content in the grapes and aromatic substances [14].

In sequential decrease in temperature (-6 °C, -8 °C, -10 °C) for Marselan grapes harvested at the technological maturity in wine season 2016 have been frozen using the refrigerator working around the clock for seven days. The influence of different level of temperatures on sugar content of cultivar is represented in Table 3. Due to the the structure of thick peel variety achieved proper level of sugar needed for the production of dessert wines such as Icewine only under the lowest temperature -10 °C in refrigerator compared to natural freezing, when temperature was -7 °C.

Table 1

Pearson correlation matrix for Marselan musts made by natural and alternative freezing

Variables	Sugar content	TA	pH
Sugar content	**1**	**0,984**	-0,987
TA	**0,984**	**1**	-0,957
pH	-0,987	-0,957	**1**

Data based on 6 samples. Values in bold are different from 0 with a significance level alpha=0,05

Table 2

Pearson correlation matrix for wines produced by 2 different treatments

Variables	Sugar content	TA	pH	Ethanol	VA
Sugar content	**1**	**0,784**	0,000	0,983	**0,869**
TA	**0,784**	**1**	-0,032	**0,720**	**0,899**
pH	0,000	-0,032	**1**	-0,101	-0,348
Ethanol	**0,983**	**0,720**	-0,101	**1**	**0,861**
VA	**0,869**	**0,899**	-0,348	**0,861**	**1**

Data based on 6 samples. Values in bold are different from 0 with a significance level alpha=0,05

Regardless of freezing treatment both wine sample had the same correlations between variables – parameters (Table 2). Volatile acidity had positive association with sugar content due to activity of hyperosmotic stress of yeasts that had contributed to increasing of acetic acid. Also the higher sugariness the biggest concentration of ethanol was produced likely for reason of fermentation conversion into alcohol. The positive correlation between titraTable acidity and sugar content can be explained by freezing that concenters all substances of grapes passing into wine (Table 1, Table 2). Level of pH was independent from sugar content and negatively correlated with other attributes.

Table 3

Temperature, °C	**(1) 318,23**	**(2) 306,90**	**(3) 287,33**
-10		0,018164	0,000121
-8	0,018164		0,001436
-6	0,000121	0,001436	

The data of LSD test showed significant differences between the samples of grapes emphasizing the effect of temperature on the sugar content of berries (Table 3). The largest difference of sugar content was observed in grapes at -6°C sequential triple freezing, which is associated with activation of biochemical processes, due to a sharp decrease of temperature.

2. Sensory evaluation

According to descriptive analysis (Figure 2) wine produced by natural freezing is characterized by fruits notes including perceived nuances of pear, plum and apricots. The character of tropical fruits such as figs, banana of dessert wine made by alternative method was higher compared to first sample. The citrus aromas were more notable in wine grapes for which had been frozen in refrigerator but nutty tones were higher in experimental icewine. The lowest taste of spicy and caramel and approximately the same honey tins were presented in both wines. Length of aftertaste of wine obtained from naturally frozen Marselan was more intensive and deeply colored, than another sample.

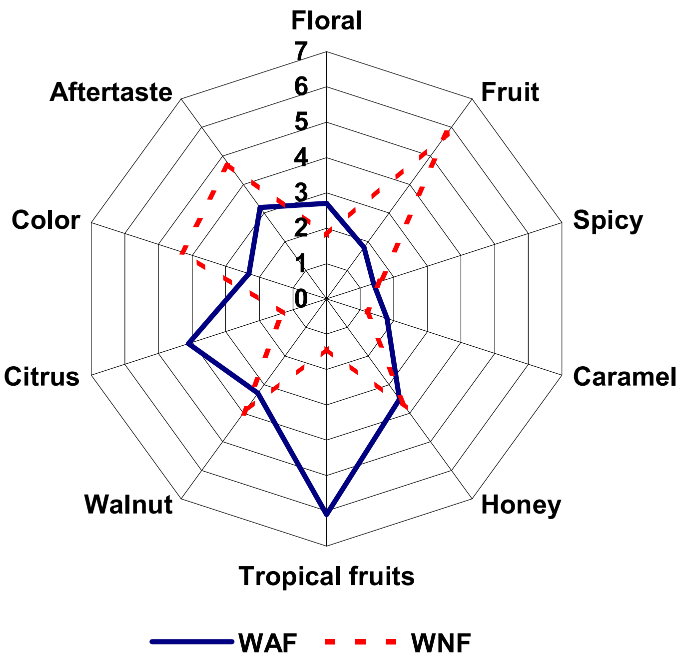

Figure 2. Biplot of sensory descriptors of dessert wines

Results of ANOVA shown that scores determined by each judges were different and distinguished significantly (F=18,883, p=0,051). The abovementioned descriptors were chosen by consensus. Each assessor proposed aroma characteristics according to own perception. Thus, terminology was ascertained for conducting of tasting. In general, the scores of all descriptors were not differed significantly estimated by judges. The most variation was presented in evaluation of intensity of caramel, walnut and citrus. The whole compliance was reached in determining of aromas of fruits, spicy and color.

3. Volatile compositions

In wine made by natural freezing (NF) 35 compounds were detected and 37 ones were found in wine of alternative freezing (AF). Means of volatiles and its standard deviations are represented in Table 4. Chemical standards, quantitative and qualitative ions for icewine and dessert wine from Marselan variety are shown in Table 5.

Table 4

Means and standard deviations of volatiles of 2 dessert wines

№	Volatiles	Wine of NF	Wine of AF
1	Phenylethyl Alcohol	74,85 ± 0,502	55,13 ± 0,0125
2	3-methyl- 1-Butanol	63,93 ± 0,562	53,60 ± 0,687
3	2-methyl-1-Propanol (isobutanol)	9,51 ± 0,044	7,52 ± 0,045
4	1-Propanol	8,37 ± 0,468	6,10 ± 0,358
5	2,3-Butanediol	5,17 ± 0,003	11,17 ± 0,001
6	3-ethoxy-1-Propanol	1,64 ± 0,302	0,46 ± 0,301
7	1-Butanol	0,63 ± 0,044	0,65 ± 0,047
8	3-methyl-1-Pentanol	0,22 ± 0,019	0,23 ± 0,017
9	3-(methylthio)-1-Propanol	0,21 ± 0,050	0,23 ± 0,058
10	1-Octen-3-ol	0,11 ± 0,004	
11	1-Hexanol	0,78 ± 0,273	0,63 ± 0,217
12	Cis-3-Hexen-1-ol	0,06 ± 0,001	
13	3-methyl-1-Butanol, (Isoamile acetato)	31,50 ± 2,109	32,72 ± 0,128
14	Ethyl Hexanoate	8,31 ± 1,639	9,25 ± 1,247
15	Ethyl butyrate	4,33 ± 0,804	3,87 ± 0,812
16	Ethyl hydrogen succinate (monoethyl ester)	3,02 ± 1,670	2,06 ± 1,238
17	Ethyl octanoate	4,44 ± 0,358	8,26 ± 1,647
18	2-Phenethyl acetate	2,28 ± 0,424	6,04 ± 0,547
19	Diethyl succinate	1,70 ± 0,071	0,71 ± 0,078
20	Ethyl decanoate	1,35 ± 0,164	3,45 ± 0,161
21	Ethyl lactate	0,95 ± 0,090	0,89 ± 0,07
22	Ethyl 3-hydroxybutyrate	0,27 ± 0,038	0,25 ± 0,09
23	3-Ethoxypropyl acetate	0,23 ± 0,036	0,10 ± 0,031
24	Hexyl acetate	0,19 ± 0,005	0,35 ± 0,001
25	1,3-propanedioldiacetate	0,19 ± 0,004	0,19 ± 0,005
26	Benzaldehyde	0,58 ± 0,014	
27	Benzeneacetaldehyde	0,43 ± 0,007	0,24 ± 0,007
28	Acetoin	0,15 ± 0,023	1,93 ± 0,067
29	N-(3-Methylbutyl) acetamide	0,11 ± 0,002	
30	Octanoic acid	17,44 ± 0,131	37,51 ± 0,147
31	Neodecanoic acid	8,18 ± 0,076	12,14 ± 0,029
32	Hexanoic acid	6,69 ± 0,432	10,94 ± 0,427
33	Acetic acid	5,22 ± 0,124	7,15 ± 0,143
34	n-Decanoic acid	4,80 ± 0,127	18,88 ± 0,125
35	Butanoic acid	0,32 ± 0,007	0,31 ± 0,09
36	3-methyl valeric acid		0,57 ± 0,001
37	2-Methoxy-4-vinylphenol		0,18 ± 0,001
38	Linalol		0,53 ± 0,125
39	Dihydro-2-methyl-3(2H)-Thiophenone		0,55 ± 0,05
40	Ethyl 5-Oxotetrahydrofuran-2-carboxylate		0,14 ± 0,078
41	Ethyl 4-hydroxy-3-methoxybenzoate		0,35 ± 0,097

Table 5
Chemical standards, quantitative and qualitative ions for Marselan icewine and dessert wine

Cas number	Compounds	Quanti-fication ions (m/z)	Qualitative ions (m/z)	Odor characteristics
60-12-8	Phenylethyl Alcohol	91	65, 51	Burnt, rose, oily
3391-86-4	1-Octen-3-ol	57	72,82	Mushroom
928-96-1	3-Hexen-1-ol	67	41,82	Green grass, resin
123-51-3	3-methyl- 1-Butanol (izoamyl alcohol)	55	70,42	Malt, rancid, pungent
78-83-1	2-methyl-1-Propanol	43	41,31	Fruity, floral
71-23-8	1-Propanol	31	59,42	Sweet, ripe fruit
513-85-9	2,3-Butanediol	45	57,89	Fruity, buttery, bitter[36]
111-35-3	3-ethoxy-1-Propanol	31	59,45	Not found
111-27-3	1-Hexanol	56	43,55	Leaf, grassy, resin, medicinal
71-36-3	1-Butanol	56	31,41	Medicinal, phenolic
589-35-5	3-methyl-1-Pentanol	56	69,41	vinous, herbaceous, cacao
505-10-2	3-(methylthio)-1-Propanol (Methionol)	106	41,53	VegeTable , boiled potato, and soup-like[36]
565-67-3	2-methyl-3-Pentanol	59	59,74	Fuel
626-89-1	4-methyl-1-Pentanol	56	69,41	Almond, toasted, nutty
98-55-5	alpha-Terpineol	59	75,63	Lilac, Citrus, Lime, sweet
100-51-6	Benzyl alcohol	79	85,93	Floral, fruity
123-92-2	3-methyl-1-Butanol, (Isoamile acetato)	43	55,70	Banana
123-66-0	Ethyl Hexanoate	88	99,43	Fruity, green, apple, banana
105-54-4	Ethyl butyrate	71	43,88	Apple
1070-34-4	Ethyl hydrogen succinate (monoethyl ester)	101	85,94	Herbaceous
106-32-1	Ethyl octanoate	88	101,127	Fruity, banana, pineapple, peach, sweet
103-45-7	2-Phenethyl acetate	104	42,47	ripe fruit, floral
110-38-3	Ethyl decanoate	88		Sweet, grass

Table 5 (continue)

Chemical standards, quantitative and qualitative ions for Marselan icewine and dessert wine

Cas number	Compounds	Quanti-fication ions (m/z)	Qualitative ions (m/z)	Odor characteristics
97-64-3	Ethyl lactate	45	29,75	Acid, medicine
5405-41-4	Ethyl 3-hydroxybutyrate	43	36,49	Apple
94825-54-4	3-Ethoxypropyl acetate	43	85,63	Sweet
142-62-1	Hexyl acetate	43	56,61	Fruity, apple, pear
628-66-0	1,3-propanedioldiacetate	43	44,87	Potato
1126-51-8	Ethyl 5-Oxotetrahydrofuran-2-carboxylate	85	51,39	Not found
617-05-0	Ethyl 4-hydroxy-3-methoxybenzoate	151	114,79	Not found
100-52-7	Benzaldehyde	106	111,56	bitter almond
122-78-1	Benzene acetaldehyde	91	58,74	Almond
513-86-0	Acetoin	45	75,98	Butter flavor
13434-12-3	N-(3-Methylbutyl) acetamide	30	44,68	Vinegar
124-07-2	Octanoic acid	60	78,81	Grass, rancid
26896-20-8	Neodecanoic acid	87	56,39	Strong odor
142-62-1	Hexanoic acid	60	45,68	Cheese
64-19-7	Acetic acid	43	69,81	Strong odor, Vinegar
334-48-5	n-Decanoic acid	73	78,63	fatty, unpleasant
107-92-6	Butanoic acid	60	71,54	Cheese, rancid
105-43-1	3-methyl valeric acid	60	55,46	Unpleasant, sour
7786-61-0	2-Methoxy-4-vinylphenol	150	54,97	Spicy clove
78-70-6	Linalol	71	101,46	Flowery
13679-85-1	Dihydro-2-methyl-3(2H)-Thiophenone	60	112,84	Balsamic

Concentrations of alcohols in both wines were the highest among aroma volatiles counting more than 60% and 40% in wines of NF and AF respectively. Concentration of Phenylethyl Alcohol in dessert wine obtained by NF of Marselan was higher than in another wine. Such tendency can explain that current alcohol rises with the degree of ripeness of grapes. According to information[15] Phenylethyl Alcohol has the high concentrations in dessert special wines that is agree with current findings and it is more abundant in white wines from Riesling, Chardonnay, Pinot blanc and Gewürztraminer [16].

Alcohol with mushroom odor 1-Octen-3-ol was found only in late-harvest wine which is in agreement with several studies [17], [18], [19]reporting occurrence of alcohol in wines made from overripe grapes and possible rotten by fungal infections. Aforementioned statements coincide with that Marselan grapes used for freezing in refrigerator were clean and health.

C_6 compounds are partly responsible for the green and herbaceous aroma of grapes and wines [20]. High water status in ground, especially during the later stages of ripening have negative effects on wine aroma. Too much water contributes to more vegetal in wine, bell pepper and grassy character [21]. The rainfall during experiment period from late October until December was high, above 200 mm in total, thus affecting the herbaceous character in Marselan wine made by natural freezing. It should be pointed out that the later harvest date (hanging time of berries on vine) also impacted on the highest concentrations in wines of 1-hexanol and Cis-3-Hexen-1-ol [22] [23]. Also the addition of antioxidation agents to the must affects the content of these compounds [24].

Isoamyl alcohol, 1-propanol and Isobutanol had highest concentrations in wine obtained by natural way due to spontaneous alcoholic fermentation of grape must conducted by action of different yeast genera and species [25] that probably were on Marselan grapes before harvest. Also the important factor of forming of higher alcohols as well as N-(3-Methylbutyl) acetamide is adding yeast nutrients including amino acids and ammonium used for must fermentation for both samples. Although, acetomide was not observed in wine produced from frozen grapes synthetically. The effect of the ammonium addition can be explained by the increased capacity of the yeast to transform the synthesized a-ketoacids, avoiding their accumulation and later expulsion to the medium after their reduction to higher alcohols [26], [27], [28]. Concentrations of 3-ethoxy-1-Propanol in natural sweet wine was denominated much. This fact accounts for actions of yeast during fermentation. Concentrations of 1-Butanol and 3-methyl-1-Pentanol had been noted distinction in both wine samples. The higher alcohols significantly influence on aromatic of wines possessing pungent and fusel odor, but the most significant aspect of them is their function in the formation of esters [29]. Such substances as 2-methyl-3-Pentanol, 4-methyl-1-Pentanol and alpha-Terpineol were identified only in icewine made by alternative method. An alpha-Terpineol is derived from linalool itself and therefore implying its sensorial character [30].

The ethyl 5-Oxotetrahydrofuran-2-carboxylate and ethyl 4-hydroxy-3-methoxybenzoate were detected only in wine produced by alternative way and concentrations of majority of other esters were higher compared to esters presented in natural-made icewine. With reference to data [19] decrease of acids in late-harvest grapes effect to forming of esters. As expected concentration of 3-methyl-1-Butanol, (Isoamile acetato) was the highest among all esters in wines that plays important role in aroma background in wines [31]. Ethyl hexanoate, ethyl lactate and ethyl butyrate are responsible for the full-bodied fruity and floral aroma of wine [32]. Tendency to a limited increase of isoamyl and 2-phenethyl acetate was found in dessert wine obtained naturally and previously had been observed in botrytized wines due to the esterase activity of B. cinerea, which probably persisted in the juice [33].

The fatty acids, formed enzymatically during fermentation, constitute an important group of aroma compounds that can contribute with fruity, cheese, fatty, and rancid notes to the wine's sensory properties [34]. Volatile acids such as hexanoic, octanoic and decanoic acids existed in our study were also found in sweet wines from Muskat and Malvasia grapes [35].

In wines made by NF and AF phenylethyl alcohol, 3-methyl- 1-Butanol, 3-methyl-1-Butanol, (Isoamile acetato) and octanoic acid had the highest concentrations among others volatiles. Also in wine produced by alternative method concentrations of n-decanoic acid, ethyl hexanoate, acetic acid, acetoin, hexyl acetate, 2-phenethyl acetate, ethyl decanoate, ethyl octanoate and 2,3-butanediol were found in biggest amount compared to natural-made icewine. The standard deviations of volatile substances of 2 dessert wines were not significantly high with the exception of ethyl hexanoate and ethyl hydrogen succinate (monoethyl ester) in both samples. The standard deviation of 3-methyl-1-Butanol (Isoamile acetato) of classic icewine was identified as highest among alcohols.

Conclusions

Firstly, in Ukraine icewine was produced from dark-skinned variety Marselan according to agricultural climatic conditions of Northern Black Sea coast in Odesa region. The physicochemical and aromatic profiles were determined for comparative evaluation of dessert wines obtained by different methods of freezing:

1. Chemical attributes: both wine sample had the same correlations between variables – parameters including sugar content, titraTable acidity (TA), volatile acidity (VA), ethanol but pH was not associated with abovementioned properties.
2. Sensory analysis: nuances of pear, plum and apricots and longest of aftertaste were inherent for natural-made icewine from Marselan and in wine by AF tropical fruits such as figs, banana and citrus perception were identified.
3. Chromatographic analysis: both wine samples were similar to majority of volatile compounds but differ by its concentrations where alcohols and esters were determined as the main aroma indicators characterized by fruity and flowery odors.

Agricultural climatic conditions of Northern Black Sea coast allow to harvest Marselan grapes in winter without alternative freezing, which is energy-consuming in the production of elite wines.

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