Characterisation of wines produced from fungus resistant grape varieties

Dorothea Leis[1], Wolfgang Renner[2] and ERICH LEITNER[1]
[1] *Institute for Analytical Chemistry and Food Chemistry, Graz University of Technology, Stremayrgasse 9, 8010 Graz, Austria*
[2] *Fruit Research Station Haidegg, Agricultural Research Center Styria, Dep. of Fruit Growing and Enology, Ragnitzstraße 193, 8047 Graz, Austria*

Abstract

To deal with possible consequences of climate change, new varieties of grapes are needed that are resistant to some of the most common diseases that can arise from the changing growing conditions. One possibility is fungus resistant grape (FRG) varieties. Wines produced from these varieties might have different sensory features than wines from conventional cultivars. To characterize FRG wines we used different analytical techniques to quantify odorants in various concentrations. Additionally, a sensory study was done comparing the new wines to common Styrian wines. Using both analytical and sensory tools, a description could be achieved that might reduce consumer bias towards new products.

Introduction

Wine as an agricultural product is subject to the climatic conditions in its growing area allowing winemakers to cultivate similar grape varieties but still achieve very different wines. However, the changing climate (in Styria a rise of the annual average temperature of +1.5 °C until 2050 is predicted [1]) affects the growing conditions, influencing the vegetation period and might increase the risk of losses because of various plant diseases leading to a larger use of plant protection agents. One possibility to reduce these problems are fungus resistant grape varieties. FRGs are a cross between American and European wine cultivars that are resistant to some of the most common fungal diseases. Earlier attempts to establish FRGs have mostly failed due to unfavourable sensory properties like a ‘foxy note’ (methyl anthranilate; sweet, candy-like strawberry smell). Newer attempts eliminated this and several other problems and the new cultivars are better suited for the production of wines. Nevertheless, a comprehensive characterization of wine can help to find wines that reach the consumers’ expectations and fulfil the winemakers’ needs. Volatile organic compounds contribute to the aroma of a wine depending on their odour thresholds and their concentrations. This means compounds with very low odour thresholds can have an impact even at very low concentrations resulting in the need of analytical techniques with different selectivities and sensitivities to identify and quantify these compounds.

Experimental

Wine samples

Grapes of the FRG varieties Blütenmuskateller, Bronner, Cabernet Blanc, CAL 6-04, Chardonel, Muscaris, Solaris, Souvignier gris and VB 32-7 were grown in an experimental vineyard in the southern Styrian wine region. Out of these, wines were produced at the Fruit Research Station in Haidegg in microvinification using single strain yeasts. This was done to minimize the influence of parameters other than grape variety.

B. Siegmund & E. Leitner (Eds): Flavour Sci., 2018, Verlag der Technischen Universität Graz
DOI: 10.3217/978-3-85125-593-5-109,

GC analysis of the volatile compounds

Based on the large differences in sensory thresholds for the relevant aroma compounds, the respective instrumental methods had to be adjusted to the required sensitivity. In the following, a few of these techniques are described shortly. In general, volatiles were enriched using headspace solid phase microextraction (HS-SPME) with volumes of 0.1-1 mL of wine. Different methods were applied for some interesting volatile compounds that occur in different quantities (Table 1).

Table1: Instrument setting

	GC-MS Scan	*GC-MS SIM*	*GC-MS/MS*
	Agilent GC 7890		*Shimadzu TQ8040*
Compound	Aromaprofiles Fatty Acid Ethyl Esters	Linalool	IBMP IPMP
Sample	1 mL wine (Aroma profiles) 0.1 mL Ester quantification	0.1 mL wine + Standard	1 mL wine + IS Mix
SPME	Stable Flex fibre 50/30 µm DVB/Carboxen/PDMS 40°C for 30 min	Stable Flex fibre 50/30 µm DVB/Carboxen/PDMS 40°C for 30 min	Carboxen Wide Range Arrow fibre 60° C for 20 min
Column	HP5-MS UI (30 m x 0.25 mm x 1 µm)	HP5-MS UI (27 m x 0.25 mm x 0.25 µm)	ZB5-MS Si (30 m x 0.25 mm x 0.25 µm)
Carrier Gas	Helium	Helium	Helium
Temperature program	30 °C for 1 min to 240 °C at 5 °C/min and to 290 °C at 20 °C/min	-10°C (1 min) at 20 °C/min to 100°C to 160 °C at 6 °C/min and to 260 °C at 20 °C/min	40 °C for 1 min to 200 °C at 40 °C/min and to 310 °C at 25 °C/min for 1 min
GC settings	151 kPa, constant flow 35 cm/s; Injector Temp. 270°C	8.7 kPa, constant flow 33.25 cm/s; Injector Temp. 270°C	66 kPa, constant flow 40 cm/s; Injector Temp. 270°C
MS settings	Electron ionization Detector voltage relative to tune (2.0 kV) m/z: 35-300 5.19 scans/sec	Electron ionization Detector voltage: 1.4 kV Ion used for quantification of Linalool: 93 (dwell time 20 msec)	Electron ionization Detector voltage: 2.5 kV Transitions (Collision Energy): IBMP (RT 10.0-10.8 min): 124.10>94.10 (11); 124.10>81.10 (7); 124.10>79.10 (23) IPMP (RT 7.5-9.5 min): 152.10>137.10 (7) 137.10>109.10 (7) 152.10>124.10 (7)

Principal component analysis (PCA)

With the raw data from the aroma profiles were created using the MASstat software in the 3.02u version. m/z ratios excluded from the calculations were: 28, 32, 77, 133, 151, 207 and 281.

Sensory evaluation

To characterize the sensory properties of the FRG wines a tasting with a panel of 11 trained experts (10 men, 1 woman; 24-56 years) was conducted at the Agricultural Research Center using comparative descriptive analysis. The wines were compared to typical regional varieties like Muskateller, Pinot Blanc, Welschriesling and Sauvignon Blanc. In addition, a collection of characteristic descriptors was provided.

Results and discussion

For the analysis of the wine volatiles, three different techniques were used to get an overview about some of the most abundant volatiles in the upper µg/L range, like short chain fatty acid ethyl esters, as well as to quantify substances down to the low ng/L range like 3-isobutyl-2-methoxy pyrazine (IBMP). IBMP has a sensory threshold of 2 ng/L and is responsible for a characteristic green bell pepper aroma in Sauvignon Blanc wines and other varieties [4]. Higher concentrations of that compound have been associated with unripeness. In the same method, 2-isopropyl-3-methoxypyrazine (IPMP), which has a threshold of 0.32 to 2.29 ng/L [5], was quantified. Additionally, linalool, which is a varietal compound of Muscat wines that has a flowery aroma and a threshold of 15 µg/L [3], was quantified using GC-MS in SIM mode using standard addition.

Looking at Figure 1, three of the wines (Muscaris (with grape skin contact for 2 and 8 h) and Blütenmuskateller) form a separate cluster. Wines from these two cultivars usually have a higher concentration of several terpene compounds. Looking at the data from Table 2, a significantly higher linalool concentration in the wines from the two cultivars corresponds with the PCA results. In addition, the wines of Solaris and the Souvignier gris cultivars show some deviations which can be explained by significantly higher (Souvignier gris) and lower concentrations (Solaris) of short chain fatty acid ethyl esters.

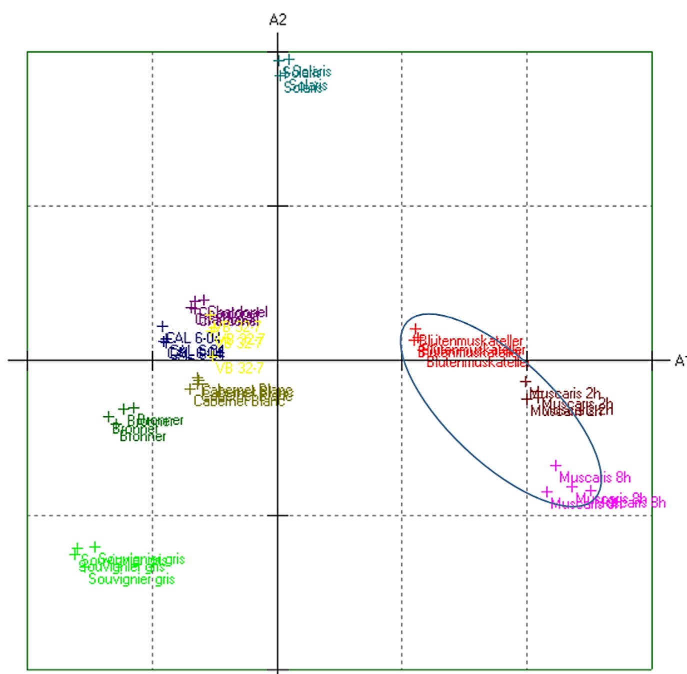

Figure 1: PCA on the basis of relative concentrations of different FRG wines (vintage 2016)

Table 2 shows the concentrations of the investigated compounds. Some of them help to explain the results of the PCA given in Figure 1 As this PCA is based on the relative concentrations of the investigated wines, the concentration of IBMP, which cannot be detected in the aroma profiles due to its low concentrations, does most probably not affect these results.

Table 2: Concentrations of selected compounds with Odour Activity Values (OAV)

	Sum Ester C4-C10 [µg/L]	*Sum Ester OAV*	*Linalool [µg/L]*	*OAV*	*IBMP [µg/L]*	*OAV*	*IPMP OAV [µg/L]*	
Blütenmuskateller	4555	1253	230	15	<0.001	<1	0.007	3
Bronner	5831	1582	<15	<1	<0.001	<1	<0.001	<1
Cabernet Blanc	5211	1476	<15	<1	0.007	4	<0.001	<1
CAL 6-04	6232	1737	<15	<1	0.006	3	<0.001	<1
Chardonel	4692	1392	<15	<1	<0.001	<1	<0.001	<1
Muscaris	3668	1032	560	37	<0.001	<1	<0.001	<1
Solaris	2261	584	<15	<1	<0.001	<1	<0.001	<1
Souvignier gris	9735	3144	<15	<1	<0.001	<1	<0.001	<1
VB 32-7	5904	1661	<15	<1	0.020	10	<0.001	<1
Analytical Method	GC-MS Scan		GC-MS SIM		GC-MS/MS MRM			

Table 3: Sensory description of the wines

Grape variety	*Sensory description*
Blütenmuskateller	Instantly fragrant, elderberry flower, Muscat-type
Bronner	Slightly fruity, neutral, medium bodied, Burgundy-type
Cabernet Blanc	Green, spicy, pomaceous fruit, well balanced, Sauvignon-type
Chardonel	Apple, banana, neutral, tender, lean, Burgundy-type
Muscaris	Flowery, citrus, stone fruits, complex, full bodied, Muscat-type
Souvignier gris	Slightly fruity, spicy, full bodied, Burgundy-type
VB 32-7	Green bell pepper, green apple, spicy, full bodied, Sauvignon-type
CAL 6-04	Apricot, apple, lime, black currant

The results of the sensory evaluations showed a good correlation with the instrumental data. Wines that had higher concentrations of terpenes like linalool were classified as Muscat-type, which usually show higher concentrations of these compounds. Wines with higher IBMP concentrations were the ones that ranked highest in the Sauvignon-type descriptor.

Different instrumental techniques are necessary for interference free quantification of relevant aroma compounds at different concentration levels. The analytical result can provide tools and methods for better understanding of the sensory properties of wine. Knowing the concentration and the impact of some of the key aroma compounds can help to classify new wines in terms that help the communication between winemakers and consumers.

References

1. APCC (2014): Österreichischer Sachstandsbericht Klimawandel 2014. Verlag der Österreichischen Akademie der Wissenschaften. ISBN 978-3-7001-7699-2.
2. Ferreira V., Lopez R., Cacho J.F. (2000) J. Sci. Food Agric. 11: 1659-1667.
3. Guth H. (1997) J. Agr. Food Chem. 8: 3027-3032.
4. Maga J.A. (1990) In: Flavors and off-flavors. (Charalambous G. ed) Elsevier Science Publishers B.V., pp 61-70.
5. Pickering G.J., (2007) J. Food Science 7: 468-472.
6. http://www.piwi-international.de