AROMA PROFILE OF MACEDONIAN AND HUNGARIAN WINES ASSESSED BY GC-MS

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Introduction

Aroma compounds are important factor for the quality and sensory properties of wine. The content of aroma depends on the varietal characteristics, viticultural practices and wine-making techniques. These compounds belongs to three categories: free aroma compounds that contribute directly to odour, and polyhydroxylated forms and glycosidically conjugated forms of monoterpenes that do not have direct contribution to the wine aroma.

GC-MS is recognized as a highly efficient technique that can be used for separation and identification of volatile compounds. In this study, liquid extraction method with dichloromethan was applied for analyses of 8 different wines (Vranec, Merlot, Cabernet Sauvignon, Portugiser, Cuve, Chardonnay, Temjanika and Tokaji) in combination with GC-MS to determine the aroma profile of Macedonian and Hungarian red and white wines and to compare the cultivars from both countries.

Experimental

Sample preparation:

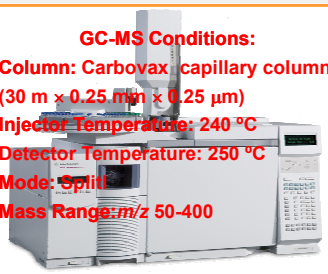
50 mL wine + 25 mL CH_2Cl_2 + I.S (1-octanol) 30 min extraction on magnetic agitator
Centrifugation
Evaporation under nitrogen stream
Injection into GC-MS

Temperature Programme

°C/min	Temprature/ °C	Hold time/min
-	40	3
3	180	0
2	260	10

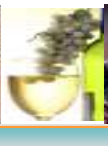
GC-MS Conditions:

Column: Carbovax capillary column (30 m × 0.25 mm × 0.25 μm)
Injector Temperature: 240 °C
Detector Temperature: 250 °C
Mode: Split
Mass Range: *m/z* 50-400








Results

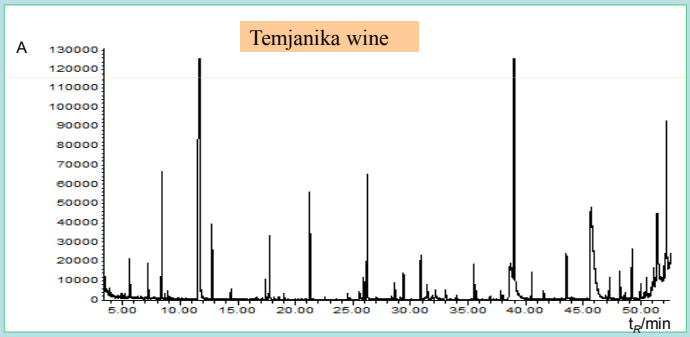


Fig. 1. GC-MS chromatogram of Temjanika wine analyzed after liquid extraction

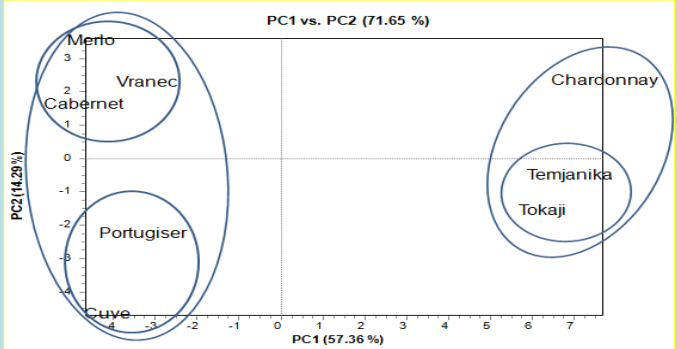


Fig. 2. Principal Component score plot with PC1 and PC2 of the variables based on the

Table 1. Aroma compounds identified and quantified in Macedonian and Hungarian wines

Name	t_R/min	LRI	Merlo	Vranec	Cabernet S.	Portugiser	Cuve	Temjanika	Chardonnay	Tokaji
Ethyl propanoate	3.82	954.5	11.20 ± 0.44	11.42 ± 015	/	12.67 ± 0.32	13.04 ± 0.41	10.57 ± 0.11	12.63 ± 0.28	10.57 ± 0.55
Ethylisobutyrate	3.98	963.5	10.59 ± 1.04	9.85 ± 0.19	/	10.30 ± 0.1	10.29 ± 0.6	/	/	/
3-Heptanol	4.96	1011.1	72.54 ± 0.28	72.22 ± 0.2	71.99 ± 0.22	71.80 ± 0.11	71.81 ± 0.3	71.97 ± 0.14	71.94 ± 0.10	71.82 ± 0.16
Bis-(dichloromethyl)eter	5.17	1018.5	11.74 ± 0.78	10.83 ± 0.06	10.32 ± 0.14	10.55 ± 0.5	10.31 ± 0.7	/	/	/
Ethyl butanoate	5.62	1033.8	23.61 ± 0.30	22.47 ± 0.26	22.78 ± 0.62	19.73 ± 0.76	19.47 ± 0.99	26.61 ± 0.36	44.56 ± 2.67	26.15 ± 2.37
Isobutyalcohol (2-methyl-1-propanol)	7.24	1089.2	110.50 ± 3.02	100.42 ± 0.62	108.39 ± 0.94	111.89 ± 2.82	105.03 ± 2.03	83.94 ± 0.55	85.28 ± 0.76	87.83 ± 2.69
Isoamylacetate	8.40	1122.4	31.61 ± 1.05	30.38 ± 1.03	22.59 ± 0.77	17.62 ± 0.3	16.96 ± 0.32	73.67 ± 1.26	165.05 ± 0.58	64.37 ± 6.26
Butylformate	9.11	1140.9	16.13 ± 0.44	12.51 ± 0.27	/	13.85 ± 0.28	/	10.04 ± 0.24	12.10 ± 0.23	11.32 ± 0.51
				1736.63 ±						
1-Pentanol	11.77	1209.7	2567.39 ± 84.2	39.25	2156.44 ± 2.82	1600.81 ± 85.9	1449.99 ± 137.78	1198.4 ± 44.83	1403.07 ± 66.27	1076.28 ± 115.81
Etylcaproate	12.79	1233.9	19.74 ± 0.16	17.32 ± 0.43	18.36 ± 0.08	16.73 ± 0.5	19.40 ± 0.36	46.29 ± 0.4	52.93 ± 0.66	40.94 ± 3.35
Hexylacetate	14.40	1272.2	/	/	/	/	/	13.24 ± 0.27	19.76 ± 0.40	16.18 ± 0.65
3-Methyl-1-pentanol	16.66	1325.6	/	/	/	/	/	71.51 ± 0.09	72.22 ± 0.04	/
1-Butamine, N-nitro	17.42	1343.5	28.87 ± 1.26	29.69 ± 0.8	45.12 ± 1.02	126.81 ± 4.36	169.13 ± 12.22	20.15 ± 0.54	13.53 ± 0.26	18.68 ± 0.61
1-Hexanol	17.78	1351.8	104.13 ± 1.66	86.15 ± 0.05	110.00 ± 2.0	87.60 ± 1.03	92.91 ± 0.24	98.12 ± 0.59	50.90 ± 0.43	110.40 ± 2.87
E-3-Hexanol	18.19	1361.5	72.03 ± 0.02	70.82 ± 0.08	71.62 ± 0.02	70.87 ± 0.1	70.93 ± 0.05	71.41 ± 0.11	94.14 ± 0.35	73.43 ± 0.45
3-Ethoxy-1-propanol	18.57	1280.7	/	/	/	/	/	/	/	/
Ethyl caprilate	21.26	1434.3	19.51 ± 0.71	19.75 ± 0.07	15.83 ± 0.27	20.66 ± 0.89	24.86 ± 0.45	65.23 ± 0.08	84.62 ± 1.08	66.52 ± 4.99
Ethyl-3-hydroxybutanoate	24.60	1514.8	16.69 ± 0.82	17.01 ±0.1	16.50 ± 0.38	13.44 ± 0.27	14.59 ± 0.57	11.95 ± 0.22	14.86 ± 0.21	11.75 ± 0.09
2,3-Butanediol	25.57	1539.4	28.82 ± 2.56	29.80 ± 1.32	35.68 ± 0.82	37.38 ± 0.97	34.96 ± 2.96	14.23 ± 0.83	36.17 ± 0.98	32.04 ± 1.89
β-Linalol	25.94	1548.8	/	/	/	/	/	19.19 ± 1.0	/	20.83 ± 0.67
1,3-Butyleneglycol	27.06	1577.2	73.33 ± 0.36	73.96 ± 0.56	74.27 ± 0.42	74.65 ± 0.24	74.72 ± 0.37	/	/	/
Butyrolactone	28.66	1618.3	426.12 ± 5.05	503.72 ± 5.83	429.98 ± 10.32	899.14 ± 25.46	1018.71 ± 10.9	295.22 ± 0.93	24.29 ± 0.45	384.06 ± 16.34
1,4-Dioxanylhydrooxide	29.19	1632.3	10.50 ± 0.23	10.26 ±0.23	9.99 ± 0.2	9.78 ± 0.16	10.18 ± 0.27	/	/	/
Ethyl caprinate	29.42	1638.3	10.54 ± 0.9	10.40 ±0.29	10.01 ± 0.04	9.34 ± 0.36	11.30 ± 1.13	22.61 ± 0.94	25.64 ± 1.15	23.31 ± 0.52
Diethylsuccinate	30.91	1677.5	55.74 ± 1.21	54.28 ± 0.51	93.32 ± 1.69	253.22 ± 6.72	357.58 ± 4.55	31.63 ± 0.36	27.28 ± 0.38	39.78 ± 0.89
(-)-α-Terpineol	31.34	1688.9	/	/	/	/	/	14.92 ± 0.5	/	15.85 ± 0.57
3-(Methylthio)-1-propanol	32.19	1711.7	104.43 ± 3.63	90.46 ± 0.62	103.41 ± 1.5	87.37 ± 0.55	89.15 ± 0.44	74.72 ± 0.45	75.07 ± 0.36	75.23 ± 0.57
1,6-Dideoxygealactitol	33.08	1736.3	79.19 ± 0.58	78.03 ± 0.39	77.40 ± 0.35	72.17 ± 0.11	72.31 ± 0.25	/	/	/
Methyl-4-hydroxybutanoate	34.12	1764.7	/	/	9.44 ± 0.23	8.35 ±	/	/	/	/
2-Methylthiolane	35.55	1804.2	79.65 ± 1.24	63.42 ± 1.48	82.12 ± 1.82	55.11 ± 0.87	55.30 ± 0.39	27.65 ± 0.42	43.68 ± 0.32	24.91 ± 0.33
Phenylethylacetate	35.76	1810.4	11.77 ± 0.11	12.66 ±0.57	10.29 ± 0.37	10.60 ± 0.23	10.18 ± 0.43	12.43 ± 0.17	20.92 ± 0.10	13.96 ± 0.33
trans-Geraniol (Nerol)	36.99	1845.7	/	/	/	/	/	10.08 ± 0.35	9.43 ± 0.31	9.45 ± 0.14
N-(3-methylbutyl)acetamide	37.54	1861.7	22.07 ± 0.18	10.37 ±0.05	44.29 ± 1.14	12.17 ± 0.27	13.63 ± 0.54	/	/	/
Benzylalcohol	37.88	1871.3	82.25 ± 0.62	73.61 ±0.07	83.31 ± 0.71	86.03 ± 0.53	92.26 ± 0.38	74.24 ± 0.2	77.69 ± 0.21	72.86 ± 0.09
Phenylethylalcohol	39.05	1905.2	2253.66 ± 61	1634.14 ±30.65	2107.00 ± 27.53	1697.71 ± 74.7	1771.22 ± 93.22	558.83 ± 9.04	657.33 ± 10.79	566.28 ± 17.89
2,6-Dimethyl-3,7-octadiene-2,6-diol	40.51	1948.6	/	/	/	/	/	22.16 ± 0.4	/	21.16 ± 0.48
2,6-Dimethyl-7-octene-2,6-diol	41.56	1979.8	10.94 ± 0.37	71.82 ± 0.18	/	/	/	12.26 ± 0.5	/	11.57 ± 0.22
Diethylmalate	43.57	2042.3	21.37 ± 0.73	24.46 ±0.05	18.25 ± 0.48	35.90 ± 1.1	33.79 ± 0.71	34.57 ± 1.54	35.63 ± 1.0	48.05 ± 1.33
Octanoic acid	45.73	2111.3	60.83 ± 30.2	44.44 ±2.49	52.81 ± 0.25	53.24 ± 4.6	64.95 ± 3.11	283.77 ± 4.4.3	341.21 ± 15.23	272.07 ± 11.62
Acetylglycineethylester	47.00	2153.1	11.98 ± 0.34	12.52 ±0.56	11.82 ± 0.06	11.90 ± 0.28	11.19 ± 0.45	/	/	/
Succinic acid, 2-hydroxy-3-methyl-diethylester	47.31	2163.	18.53 ± 0.58	23.3 ±0.11	18.68 ± 0.32	34.12 ± 0.91	55.52 ± 0.41	20.60 ± 0.7	16.54 ± 0.46	14.17 ± 0.23
Vinylguiacol	48.22	2193.1	13.31 ± 0.40	10.36 ± 0.05	/	12.92 ± 0.46	/	25.59 ± 2.1	27.00 ± 0.82	30.35 ± 2.15
5-Oxotetrahydrofuran-2-caboxylic acid ethyl ester	49.27	2233.3	40.10 ± 0.76	50.32 ±0.70	33.58 ± 0.68	36.23 ± 0.76	50.24 ± 0.68	38.85 ± 0.59	38.29 ± 0.23	22.16 ± 1.99
Ethyl palmitate	49.97	2261.2	/	/	/	/	/	15.61 ± 1.31	17.13 ± 4.38	/
E-11-Hexadecanoic acid ethylester	50.52	2283.4	/	/	/	/	/	15.50 ± 1.30	10.77 ± 0.88	/
Decanoic acid	51.40	2336.5	/	12.75 ± 0.54	/	52.11 ± 1.98	25.08 ± 1.62	72.13 ± 2.37	82.41 ± 5.46	101.02 ± 5.85
Dihydrobenzofurane	52.19	2398.2	24.24 ± 1.01	16.39 ± 0.89	21.94 ± 1.84	22.03 ± 1.53	187.49 ± 6.43	47.82 ± 2.9	37.11 ± 0.57	39.98 ± 3.64
Tyrosol	57.03	2248.5	242.75 ± 0.30	176.54 ± 4.54	224.10 ± 19.77	180.20 ± 4.9	/	/	/	/

The values are average from 3 replicates ± Sd, expressed in μg/mL

Conclusions

The extraction method with CH_2Cl_2 is suitable for analyses of 48 aroma compounds present in red and white wines. The main volatile component was phenylethyl alcohol present in concentrations ranging from 558.8 to 657.3 mg/L in the white wines and 1697.7 to 2253.6 mg/L in red wines. Linalol and terpineol were detected only in Chardonnay and Tokaji wines, ethylpalmitate was determined while the concentration of butyrolactone was highest in the Hungarian red wines, Portugiser and Cuve.

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