Advances in
Biotechnology & Microbiology
ISSN 2474-7637

Juniper Publishers
key to the Researchers

Review Article
Volume 16 Issue 2 - March 2021
DOI: 10.19080/AIBM.2021.16.555933

Adv Biotechnol Microbiol

Monitoring Processes and Improvement of Wine Quality by Determining of Catechin and Phenolic Compounds in Slovakian Wines

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Submission: February 05, 2021; **Published:** March 03, 2021

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Abstract

Moderate consumption of wine seems to be beneficial to health, because phenolic compounds and catechin as antioxidants are considered to be important bioactive compounds. Interest in wine polyphenols, their interactions has increased among food research fields. In this study, Analytical properties of caftaric acid, (+)-catechin, caffeic acid, 4-OH-cinamic acid, vanillic and gallic acid were studied in five Slovakian protected white wines from Južnoslovenská winegrowing region. (+) Catechin was the major individual phenolic compound in PDO (protected designation of origin) wines obtained from this region harvested in vintage 2016-2018. The content of (+) catechin varied from 16.58 mg/L in the year 2016 to 26.29 mg/L in the year 2018. Much more varied the content of caffeic acid in the vitage 2016 2.30 mg/L to 11.38 mg/L in vintage 2018, which could be responsible for oxidation levels that the wine is undergone and/or grape varieties. The purpose of this study was also to discuss different styles of Slovakian wine varieties: Traminer rose, Pinot gris and Irsai Oliver.

Keywords: Wine phenolic compounds; (+) Catechin in wine and wine polyphenols

Introduction

There has been an explosion in diverse types of wines including petillant naturel, oxidised and 'whole bunch' wines. The white wines, oak-driven white wines, full-flavoured, high alcohol, broad-shouldered wines and also aromatic white wines made from Sauvignon or Riesling are preferred. There is no doubt that this explosion in diversity comes to a revolution in the way that a new generation of wine drinkers who are more educated and more discerning about value of aromas than ever before [1]. Consumers are demanding more information about phenolic acids in wine products. Wine typicity and terroir is that the geographical origin and oenological practices, along with the grape variety, make an important contribution to the final expression of the finished wine. It means that protected designation of origin (PDO) or Protected Geographical Indication (PGI) in more european wines carry more of the variety and region's signature taste, texture, flavour and aroma. In the end of clarification process, total phenolic acids of the wines was higher than in the must. Polyphenols are one of the most important secondary metabolites in grapes and wine [2] It was found out that geographic location could affect how wine experts and degustators rate quality of wine like balance and acidity of wine. Therefore, it is very useful to have an analytical tool for identification of odor and polyphenols in wine [3]. (+) Catechin is a major individual flavonoid phenolic compound in the wine. The differences in catechin and caffeic acid content of wines in Turkey were found to be significant, the differences in epicatechin, ferulic acid and vanillic acid contents were not found to be significant [4, 5]. In Portugal wine was found out the role of gallic and caffeic acid in white wine preservation. Moreover, the wine with gallic acid obtained the highest scores according to the sensory evaluation and wines demonstrated a rich aromatic profile [6]. Slovakian legislation prescribes strict controls before introducing the wine into the market. The aim of this study was to evaluate the differences between phenolic compounds (flavonoid and non-flavonoid) in Slovakian wine varieties Traminer rose, Pinot gris and Irsai Olliver which are PDO wines from Južnoslovenská winegrowing region. It was found, that vintage year plays role in content of polyphenols and also grape variety.

The article documents that wine from the same vineyard with the same PDO Južnoslovenská could have similar climatic conditions and similar technology, but do not possess the same aromatic characteristics, which is in agreement with literature [7].

Materials and Methods

Two different vineyards from the same PDO area were chosen. In total 5 samples of wine (Traminer rose 2016, Traminer rose 2017, Irsai Oliver 2018, Pinot gris 2016, Pinot gris 2017) were tested. The HPLC method with fluorescence detection was used for the determination of phenolic compounds in samples. The samples were filtered through a 0,45 μm membrane and direct injection of 20 μl was used. Agilent Technologies system was used with an injection valve (Rheodyne), thermostat, diode array detector and fluorescent detector (Agilant Technologies, Santa Clara, USA). The chromatographic column was LiChrospher 100RP-18 (5um), the mobil phase for gradient elution was a mixture of methanol: water: formic acid (70:28:2) The column temperature was kept at 40°C, Spectrophotometric detector was operated at 280 nm. The Fluorimetric detector was operated at λ(ex)=278 nm and λ(em)=360 nm (gallic acid, vanillic acid) , λ(ex)=278 nm and λ(em)=454 nm (p-coumaric, caffeic acid and (+)catechin) The identities of the different chromatographic peaks were confirmed by comparing their spectral characteristics to standards and retention times. Each sample was measured 3 times and average was taken in all cases. The white wines were obtained from famous Slovak wine producers in Južnoslovenská winegrowing region Dufrex s.r.o., Hurbanovo (Traminer rose and Pinot gris) and Vinohradnícko-vinárske družstvo, Dvory nad Žitavou (Irsai Oliver). OIV methods were used for the determination of basic parameters in all wines (alcohol, volatile acids, total acids, extract, reducing sugars, total SO2). Analysis were carried out in accredited laboratory in Bratislava, under ISO 17025.

Results and Discussion

Phenolic compounds are divided into flavonoid and non-flavonoid compound. Flavonoids are flavan 3-ol (anthocyanin, catechin, epicatechin) and Nonflavonoids are hydroxycinnamate acid, hydroxybenzoic acid. Caftaric acid is a non-flavonoid compound in wine, it is an esterified phenolic acid, composed of caffeic acid, a hydroxycinnamate produced by plants, and tartaric acid, the principal organic acid found in grapes berries. Winemakers often measure caftaric acid levels as their primary method to estimate the oxidation levels of wine. The content of caftaric acid was obtained 11,78 mg/l in Traminer rose 2016 and 12,78 mg/l in Traminer rose 2017 which shows that oxidation level is good and wine variety is suitable for aging. The highest content 26,29 mg/l of (+) Catechin was found in Irsai Oliver variety in vintage 2018 and the lower content 16,58 mg/l was in the Traminer rose 2016 which shows, that aroma profile is much more higher in Irsai Oliver variety and also vintage plays role For example caffeic acid varied from 2,3mg/l in vintage 2016 to 11,38mg/l in 2018. 4-OH cinamic acid varied from 3,28 mg/l in 2016 to 4,13mg/l in 2018. Slovakian wines with PDO Južnoslovenská had to have minimum content of actual alcohol 10,5%obj., total content of acids is minimal 3,5g/l, sugarfree extrakt is minimum 16g/l and volatile acids maximum 1,1g/l, which all these wines achieved. See Table 1 & 2.

Table 1: Elemental parameters in 5 slovakian wines vintage 2016-2018

Wine	Alcohol %(V/V)	Total Acid G/L	Sugar G/L	Sugar Free Extract G/L	Extract G/L	Total SO2 Mg/L
Traminer rose2016	12,90±	6,55	6,6	24,6	31,2	128
Traminer rose2017	12,13	5,50	2,0	16,8	18,8	145
Pinot gris 2016	12,37	6,26	1,6	17,2	18,8	138
Pinot gris 2017	12,39	5,93	1,9	18,4	20,3	109
Irsai Olliver 2018	12,28	6,13	11,6	18,1	29,7	132

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Table 2: Results of polyphenol content in 5 Slovakian white wines vintage 2016-2018.

Wine	Volatile Acids G/L	Caftaric Acid Mg/L	Catechin Mg/L	Caffeic Acid Mg/L	4ohcinam Acid Mg/L	Gallic Acid Mg/L	Vanillic Acid Mg/L
Traminer rose2016	0,56±	11,78±	16,58±0,4	2,3±0,2	-	1,80±0,3	1,62±0,2
Traminer rose2017	0,49±	12,78±	18,01±0,3	5,6±	3,28±0,2	-	-
Pinot gris2016	0,20±	-	16,80±0,3	1,3±0,1	-	4,20±0,5	1,21±0,1
Pinot gris2017	0,36±	11,99±	17,12±0,4	2,4±0,2	3,14±0,3	5,63±0,4	1,80±0,2
Irsai Olliver2018	0,21±	13,97±	26,29±0,2	11,3±0,3	4,13±0,2	-	-

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Global warming could affect the aroma of wine and harvest time of later harvested varieties (Pinot gris and Traminer rose) is moving from the end of September to the end of August, so harvesting in earlier time (on the north hemisphere) shows lower acids and this affect aroma [8]. This changes grapes' sugar and acid levels, leading to lower-quality wines with higher alcohol content. The last six weeks of ripening are critical for flavour and colour development and sugar-acid balance, so we don't want to have too much heat at the end of the season before harvest. International research published in the prestigious journals is looking for the different grape varieties that may be able to better withstand climate change. In this work we confirm that the earlier variety IO is by content of phenolic compounds very near and comparable with later varieties Traminer and Pinot gris, which is in agreement with literature [7,9].

Conclusion

Polyphenols are organic substances, which have got in the structure benzene ring and HPLC is the best method to determine organic substances because of very fast separation and retention times, separation recovery, reproducibility and accurate data [10,11]. For the determination are used FID detector, UV-detector and/or Fluorescence detector (LFD). We used HPLC (LFD) detector with very good precision, peaks of samples were compared with peaks of standards and retention times. Wines were produced by OIV practices, no aroma faults were found by sensory analysis. The basic analytical parameters were in limits. The aim of study was to determine acids and phenolic compounds to compare the contents in the five Slovakian wines Traminer rose, Pinot gris and Irsai Oliver, to show their typicity and vintage differences. Our opinion is that the oenological practices in addition to the grape variety, vintage and the geographical origin contribute to the expression in the wine. Wines of these monitored varieties have always been considered rich in content and long-lasting. The typical aroma of Pinot gris is described with pear, apple, banana, apricot, caramel and citrus notes. For mature wines, bread flavours can be recognized [12,13]. Phenolic acids found in Slovakian wines are significant as in Czech Republic or Austria wines and could be compared.

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