Evaluating the correlation between chemical and sensory compounds in Blaufränkisch and Cabernet Franc wines

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Abstract

The positive physiological effects of the bioactive compounds of red wines have been known for a long time. Besides that, the polyphenolic compounds of red wines represent one of the most important factors for oenology. With a special chemical analysis, we discover the relationship between chemical and sensory compounds. In this way, we explore which compounds influence sensory properties. The phenolic compounds are the quality attributes of the wine. The analysis of phenolic compounds was carried out in two red wines: Cabernet Franc and Blaufränkisch. The aim of this study was to analyse the chemical and organoleptic characteristics of these two wines and evaluate the connection between the two parameters. In addition, we also examined the influence of the polyphenolic content on sensory perception. The experiment was carried out in a cool climate wine region in Eger, Hungary, in vintage of 2008. We investigated the profile of phenolic contents in new and aged wines. Total polyphenolic content, anthocyanin, leucoanthocyanin and catechin were evaluated by spectrophotometer. Stilbenes were identified and quantified by high-performance liquid chromatography.

Introduction

Since Hungary's EU accession a lot of changes have occurred in agriculture, including the grape and wine industry. In this sector, the organization of vineyards, the restructuring, renewal, felling of old areas and the exact summary of varieties' composition appeared as the main objective. During these transformations the quality winegrowing and winemaking has come into the foreground opposite to the quantity centred yield. The economic and market needs require high-quality yield, but besides this, the production of unique products is emphasized.

The polyphenolic compounds of red wines are one of the most important factors for oenology. These compounds include phenolic acids (benzoic acids and cinnamic acids), the trihidroxystilbene-resveratrol, flavonoid phenols [catechin (C), leucoanthocyanin (LA) as well as monomers] and tannins (*e.g.*, procyanidins and anthocyanidin polymers).[1] These contents are quality attributes of wines which contribute to the colour, purity and sensory properties, such as flavour and astrigency.[2] Also, these compounds are not only a quality parameters for wines, they provide a wide range of beneficial health effects including antiviral, anti-inflammatory, anti-carcinogenic, anti-atherogenic activities.[3] Resveratrol, which is synthesised by some plants in response to adverse conditions such as pathogenic attack and environmental stress, is found in various food products.[4] The *French paradox* has suggested that trihydroxistilbene might be the major bioactive component in red wine.[5] Resveratrol has attracted considerable attention due to its cardioprotective and cancer chemopreventive activities, which provide a huge attendance in grapes wines and dietary products containing stilbene. Phenolic compounds cause the preventive properties of grapes and wines. The presence of phenolic compounds in wine is influenced by the following agents: variety of grapevine, viticulture practices,[6] different winemaking techniques, vintage effect,[7] the region where the grapes are grown[8] and the terroir. Each terroir is affected by climatic, geological and soil factors, and also by human activity. Each grape produced in a specific terroir reflects the locality in its chemical composition.[9] The objectives of this study were to determine the profile of total polyphenolics (TP), anthocyanins (A), LA, C and stilbenoids in new red wines in a cool climate wine region. After ageing we measured once more these wines in order to reveal how the phenolic compounds developed in the ageing wine, because these parameters influence the wine quality.

Materials and Methods

Conditions of harvest

Both Blaufränkisch (BF) and Cabernet Franc (CF) grapes were harvested in full ripeness with 20 and 21° sugar degree of the must. Harvest was on the October 15th 2008. This vintage was characterized by high sugar content in all of grapes. Vinification technology: processings have happened in microvinification. After destemming yeast (doses of 30 g/hL), fertilizer (doses of 20 g/hL), and sulphurous acid solution (doses of 1 mL/L) were added to the must. In case of all of wines the skin maceration time was 25 days. After the pressing, part of the new wines (NW) was bottled for analysis. The other part of wines [aged wines (AW)] was aged for one year in 25 L glass carboys, then analysis was performed on them again. The chemical analysis was carried out in the Budafok Laboratory of the Department of Oenology, Corvinus University of Budapest, Hungary.

Spectrophotometric determinations

Absorbance measurements were recorded on a MOM Spektromom 195 spectrophotometer. Total polyphenolic content in wine samples was determined by the Folin-Ciocalteu's reagent[10] and the results were expressed in mg/L of gallic acid equivalent. Anthocyanins were estimated according to Ribéreau and Stonestreet[11] and were expressed in mg/L. The content of LA were measured after heating the wine with 40:60 hydrochloric acid and butanol, containing 300 mg/L ferro-sulphate.[12] Catechin was determined using by the REBELEIN method,[13] after diluting the wine with alcohol and reacting with vanillin sulfuric acid reagent.

High-performance liquid chromatography analysis

Concentrations of stilbenes were determined by using high-performance liquid chromatography (HPLC) method with isocrat-

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ic elution with a HP Series 1050 device. The isocratic solvent consisted of 90% water, 5% methanol and 5% acetonitrile. All wines were analysed in terms of four stilbenes: trans-resveratrol, cis-resveratrol, trans-piceid and cis-piceid. This method was elaborated at the Department of Oenology of Corvinus University of Budapest.[14] The wine samples were analysed after filtration with 0.45 micrometer Sartorius laboratory (Göttingen, Germany) membrane filter. The circumstances of the HPLC-measurement were as follows: LiChrospher 100 CN (125 x 4 mm; 5 µm) (Merck, Darmstadt, Germany) column, 2 mL/min flow, 30°C temperature, 306 nm wavelength. The content of total resveratrol was expressed in mg/L of wines. Analysis was based on calibration with commercially available standards (Sigma Aldrich, St. Louis, MO, USA). Detection limit was 0.1 mg/L. Quantitation limit was 0.05 mg/L. The organoleptic analysis of the wines has been carried out by a five-man expert jury, using a hundred-point evaluation system.

Results and Discussion

Phenolic compounds and sensory analysis in Blaufränkisch

The BF is one of the most popular grape varieties in the wine district of Eger, Hungary. It is very important to investigate the phenolic content and sensory data in BF, because it is the basic grape variety for the Egri Bikavér Bleanding's wine.

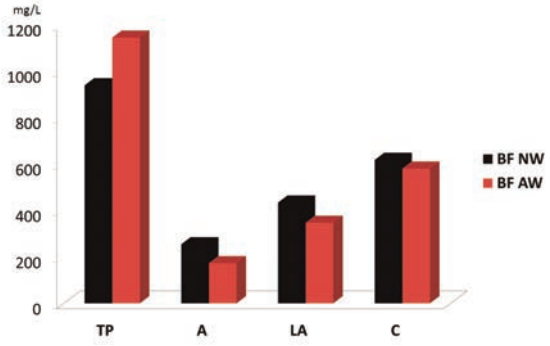

Figure 1. Phenolic compound in Blaufränkisch (BF) wines in vintage of 2008. NW, new wine; AW, aged wine; TP, total polyphenol; A, anthocyanin; LA, leucoanthocyanin; C, catechin.

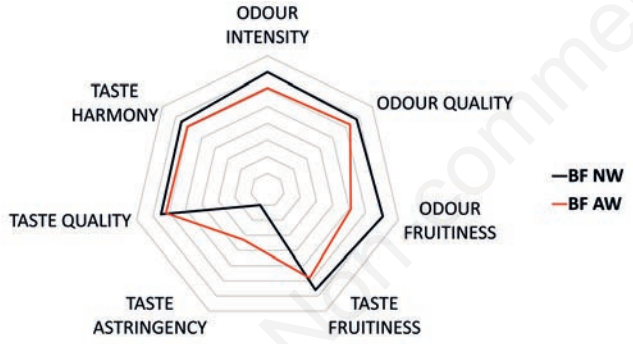

Figure 2. Profile analysis of Blaufränkisch (BF) in vintage of 2008. NW, new wine; AW, aged wine.

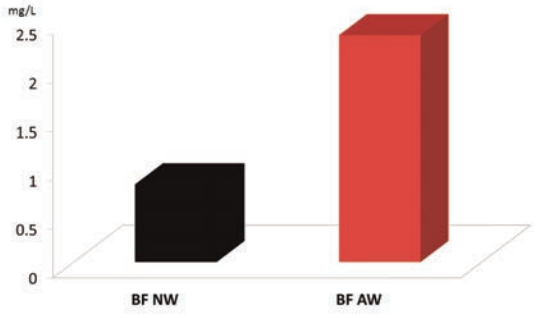

Figure 3. Total resveratrol content in Blaufränkisch (BF) in vintage of 2008. NW, new wine; AW, aged wine.

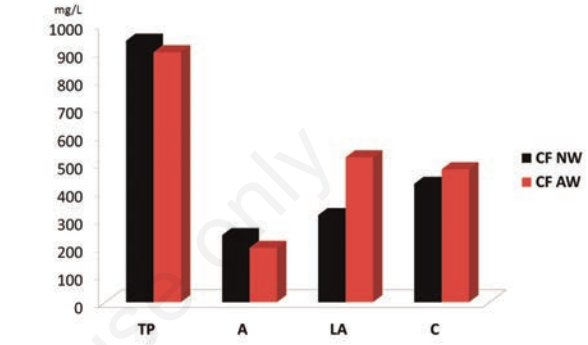

Figure 4. Phenolic compound in Cabernet Franc (CF) wines in vintage of 2008. NW, new wine; AW, aged wine; TP, total polyphenol; A, anthocyanin; LA, leucoanthocyanin; C, catechin.

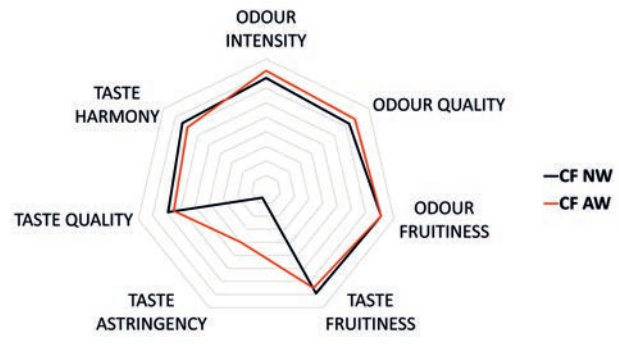

Figure 5. Profile analysis of Cabernet Franc (CF) in vintage of 2008. NW, new wine; AW, aged wine.

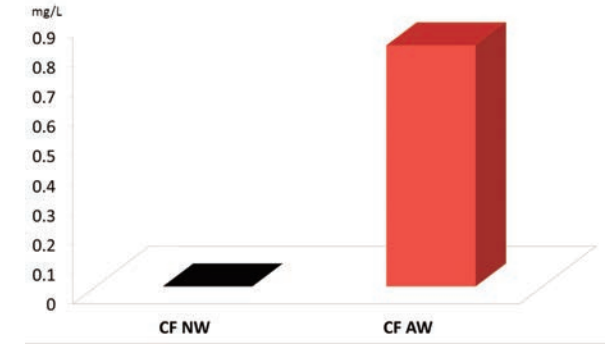

Figure 6. Total resveratrol content in Cabernet Franc (CF) in vintage of 2008. NW, new wine; AW, aged wine.

The results of the determination of flavonoid phenolic content are presented in Figure 1. This figure shows the NW and AW equally. The total polyphenol content in the NW is 940 mg/L, and in the AW the amount was increased to 1145 mg/L. The results did not represent significant difference between the NW and AW. Anthocyanins are the pigmented compounds; they are a family of phenolic compounds directly related to red wine colour[15] a major quality attributes of the wine. The A content ranged from 254.51 to 173.12 mg/L, which was comparable with the value of previous vintages.[16] In AW, the A content decreased. This difference is in agreement with previously published results.[16] The monomeric A were polymerized, and the colour got a new reddish brown shade. But there was no variance.

Catechins and LA belong to the most *perceptible* phenolic compounds. The C and LA were decrease. They have an important effect on the wines' taste and bouquet. They play a role in the formation of the wine's astringency and bitter taste. The results of the organoleptic analysis are in correlation with the chemical data. The jury has given higher values for the AW. Figure 2 shows the results of the profile analysis. Correlations between chemical and sensory analysis are also highlighted. According to the reviewers AW had better attributes than NW.

We determined cis-piceid, trans-piceid, cis-resveratrol and trans-resveratrol. Their sum makes the amount of total stilbens. We can see that in the ageing wine the total resveratrol content were higher. These results are presented in the Figure 3.

Phenolic compounds and sensory analysis in Cabernet Franc

In CF, the TP contents decreased from 939 mg/L to 898 mg/L, and A contents also decreased from 240 mg/L to 195 mg/L after one year ageing. According to Montéleone,[17] if the wines' fullness and the tartness grow, then it is in direct proportion with the increasing of the polyphenol components' concentration. The phenolic content is shown in Figure 4.

The C and LA concentrations influence the taste and aroma of red wines. The LA concentration affects the stability and organoleptic attributes of wine. These compounds are precursor of proanthocyanidins they are responsible for the development of the bitter taste. The LA and C amounts were increased. Supporting the literature data, there is a cross-correlation between the chemical and organoleptic parameters. The wine reviewers in AW were given higher values for attribute of astringency, which value correlated with chemical data. The results are presented in Figure 5. Stilbenoids are non-flavonoid compounds. Resveratrol exists in two isomer forms: cis and trans. Trans-resveratrol often appears in form of glucoside. The resveratrol is connected to the molecule of carbohydrate with β-glucoside bonding. They are called piceids.[16] We measured the total resveratrol, but in NW we did not detected resveratrol. In AW the value was 0.8 mg/L in vintage 2008. The total resveratrol content is shown in Figure 6.

Conclusions

Comparative study of chemical and sensory attributes was conducted for BF and CF wines from the Eger wine region (Hungary). Chemical analysis gives essential information of red wine characteristic; still, wine is a consumer good, accordingly, we had to do a sensory analysis. We can recognize the relationship between chemical and sensory parameters. Changes of phenolic compounds concentration in the new and ageing wines were determined.

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