CORRELATIONS OF SENSORY DATA WITH THE ANALYTICAL POLYPHENOLIC COMPOSITION OF GREEK WINES

CORELAŢII ÎNTRE DATELE SENZORIALE ŞI COMPOZIŢIA POLIFENOLICĂ ANALITICĂ A VINURILOR GRECEŞTI

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Abstract*: The purpose of this study was to measure the astringency of selected Greek red wines and to assess the relationship between sensory and chemical data. Nine red wines produced by three native Greek grape varieties (Agiorgitiko, Xinomavro and Mandilaria) were used and their astringency and bitterness was assessed by a trained panel. In addition, their astringency was estimated chemically employing the ovalbumin precipitation method. The sensory data showed that Mandilaria was the most astringent variety whereas Agiorgitioko the least. Statistical analysis of the results indicated that the chemical data obtained for astringency significantly correlated with the sensory determinations. In addition significant correlations were obtained between sensory data and wine polyphenolic composition.*
Key words: native Greek grape varieties, astringency, polyphenolic composition

Rezumat*: Scopul acestui studio este de a analiza astringenţa unor vinuri greceşti şi de a evalua relaţia dintre datele senzorilae şi cele chimice. Nouă vinuri roşii obţinute din soiuri tradiţionale greceşti (Agiorgitiko, Xinomavro and Mandilaria) au fost utilizate, astringenţa lor fiind analizata cu metoda precipitării ovalbuminei. Datele senzoriale arată ca Mandilaria a fost soiul cu astringenţa cea mai mare, iar Agiorgitioko cu astringenţa cea mai redusă. Analiza statistică indică faptul că rezultatele analizelor chimice se coreleaza significant cu determinările senzoriale. În plus, corelaţii significante au fost obţinute între datele senzoriale şi compoziţia polifenolică a vinurilor.*
Cuvinte cheie : soiuri tradiţionale greceşti, astringenţă, compozişie polifenolică

INTRODUCTION

The oral sensation referred to as “astringency”, and most commonly described as “drying”, “roughing” and “puckering” is a primary mouth-feel attributed in red wine. The perception of astringency is a highly dynamic process, changing continuously during ingestion and especially following expectoration or swallowing (Noble, 1995).

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Wines that are astringent are termed “tannic”. Wine tannins are polymeric pigments formed by polymerization of flavan-3-ol subunits (Vidal et al., 2003). These polyphenolic compounds form complexes with salivary proteins. Protein-tannin complexes result in the precipitation and/or aggregation of salivary proteins causing them to lose their lubricating properties. The chemical binding between polyphenols and salivary proteins is due to both hydrophobic interactions and hydrogen bonding. The propensity to form precipitates is dependent on the relative concentration of the polyphenol and protein substrates (Gawel, 1998).

The purpose of the proposed research was to measure the astringency of Appellation of Origin Wines originating from three major red varieties (Xinomavro, Mandilaria and Agiorgitiko) cultivated in Greece. In addition, it was of interest to assess the relationship between sensory and chemical data. The outcomes of such studies might provide wine industry an analytical and objective method to estimate astringency of red wines. Finally, exploiting the possible correlations between sensory astringency parameters and the corresponding polyphenolic concentration of the wines would be of practical interest to winemakers since they could improve control over extraction or pressing process and thus improve the quality of the produced wine.

MATERIAL AND METHOD

Panelists: Twelve healthy subjects participated in the experiment. All the subjects were experienced wine assessors and they were all familiar with the simple T-I computerized technique used in the experiment (Kallithraka et.al 1997).

Wines: Nine red Appellation of Origin wines were assayed during this study. Three cultivars were studied (*V. vinifera* species): Agiorgitiko, Xinomavro and Mandilaria. Agiorgitiko cultivar were grown in Nemea (Peloponnesus), Xinomavro in Goumenissa (North Greece) and Mandilaria in Paros (Cyclades islands).

Sensory assessment: Judges were presented with samples of 10 ml, at room temperature. At time 0s they placed the entire wine sample into their mouth, swirl it for 15 s, and expectorated. A computerized T-I method was used to rate astringency by manipulating a marker using a mouse on a unstructured line scale of 100 mm length, anchored at either end by 0= none and 100 = extreme.

HPLC determination of anthocyanins: Analyses were performed, as in Kallithraka, Mohdaly, Makris & Kefalas (2005).

HPLC determination of individual phenolics: The individual polyphenolic constituents were determined by HPLC. The chromatography apparatus used was an HP 1090, coupled with an Agilent 1100 diode array detector. The column was a Spherisorb ODS 2, 250 x 4 mm, 5 μm. The chromatographic conditions are described in Makris, Psarra, Kallithraka, & Kefalas, (2003).

Total phenols: Total polyphenol concentration was determined with the Folin-Ciocalteau assay (Arnous, Makris & Kefalas, 2001).

Ovalbumin precipitation method: The analysis was performed according to Llaudy, Canals, Canals, Rozes Arola & Zamora (2004) using ovalbumin as precipitation agent and tannic acid solutions as standards.

RESULTS AND DISCUSSIONS

Phenolic composition of the wines. The results related to the determination of phenolic compounds in the wines studied are presented as summaries of the concentrations of the individual phenols determined by HPLC: total anthocyanins (TA), total catechins (TC), total hydroxycinnamates (TH), total phenolic acids (TPA) and total flavonols (TF) in figure 1.

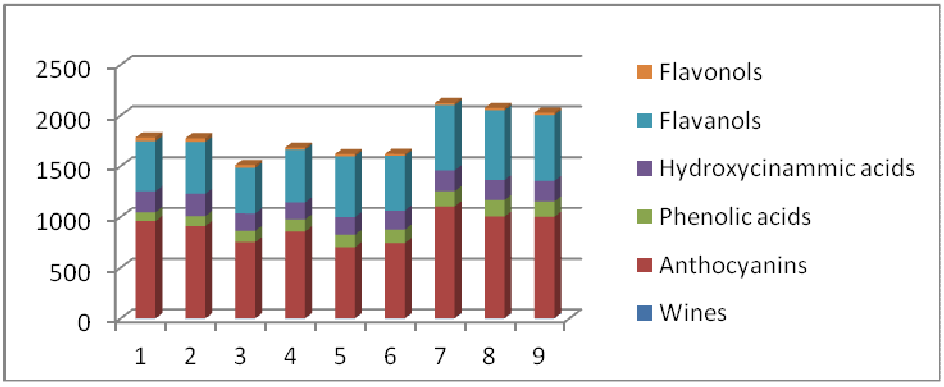

Fig. 1 - Phenolic composition of the wines studied (wines 1-3 are made by Agiorgitiko, 4-6 by Xinomavro and 7-9 by Mandilaria varieties)

Sensory determination of astringency. The T-I data (*Imax, Tmax*) for the 12 panelists and the 9 wines tested are presented in Figure 2. Mandilaria wines were scored more astringent on average (78.7) than the wines made by the other two varieties. The less astringent wines were those made by Agiorgitiko (average 58.3 and 53 respectively). The highest time needed to reach astringency's maximum intensity was also observed for Mandilaria wines (31.9 s) followed by Agiorgitiko (29.83 s). Xinomavro wines showed the lowest Tmax (26.23 s).

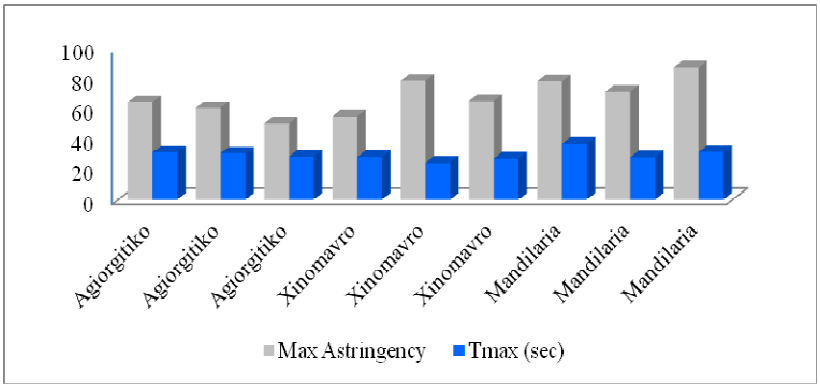

Fig. 2 - Sensory parameters of the wines

Estimation of chemical astringency. The addition of ovalbumin to the tannic acid solutions resulted in tannic acid precipitation. The relationship between these two parameters was logarithmic in agreement with Llaudy, Canals, Canals, Rozes Arola & Zamora, (2004). In addition, the slopes obtained from the logarithmic equations and the corresponding tannic acid concentrations were linearly related (r^2=0.9821).

Figure 3 shows the relationship between the astringency of the wines assessed by the panel (sensory) and the calculated values of their corresponding tannic acid concentrations (chemical). This graph confirms the clear relationship between the results obtained by the analytical method and the sensory analysis (r^2=0.9328).

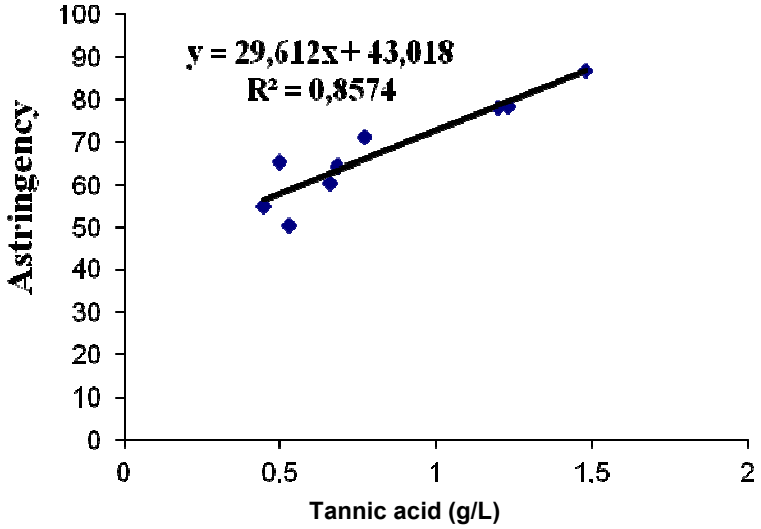

Fig. 3 - Relationship between chemical estimated astringency (tannic acid concentration g/L) and sensory assessed astringency

Correlations with wine polyphenolic compositions. Linear correlations were obtained by relating mean maximum Intensity of astringency (I_{max}) and time to maximum intensity (T_{max}) scores of astringency with the corresponding wine phenolic composition (tab. 1). Maximum intensity of astringency was significantly correlated with total wine phenols and total catechins. Hydroxycinnamic acids and flavonols were not found to be related with any of the astringency sensory parameters.

Furthermore, anthocyanins were not found to contribute to astringency maximum intensity in agreement with Landon, Weller, Harbertson & Ross,

(2008). However, a significant correlation was obtained between T_{max} of astringency and the concentration of wine anthocyanins (table 1).

Table 1

Pearson's correlation coefficients obtained between polyphenolic composition of the wines examined and sensory data

	Total Phenols	Total Anthocyanins	Total Catechins
Imax Astringency	0.8601	n.s.2	0.8351
Tmax Astringency	n.s.2	0.8351	n.s.2

[1]Correlations are significant at the 0.01 level (two-tailed)
[2]Correlations are not significant at the 0.05 level

Anthocyanins in wines can undergo chemical reactions to form tannin-like polyphenolic compounds. Because these compounds can act as electrophiles or nucleophiles at wine pH, both anthocyanin-flavanol and flavanol-anthocyanin adducts can be formed (Vidal et al., 2004). Given the current model for astringency, a reduction in flavanol hydrophobicity (by incorporation of anthocyanins into their structure) would result in a delay in flavanol-protein interaction and resulting precipitation.

The existence of soluble complexes between salivary proteins and polyphenols in vitro, at mouth temperature and at pH typical of resting saliva, is well documented by Gawel (1998). It is also well documented that π-electrons of anthocyanins can form such complexes with copigments and produce bathochromic and hyperchromic effects. It is thus possible that the formation of such soluble complexes between anthocyanins-flavanols-proteins might retard the development of the astringency sensation as a result of increased viscosity or due to the reduced availability of the astringent compounds. Further experiments are needed to study these complex phenomena and related them to sensory perception.

CONCLUSIONS

Mandilaria variety appeared to be the most astringent among the three Greek varieties studied. Chemical assessment of astringency was highly correlated with the obtained sensory data. Wine flavanols were strongly correlated with the intensity of astringency and bitterness while anthocyanins were related with T_{max} of astringency. It was hypothesized that the pigmented polymers of flavanols may lead to a delay in flavanol-protein precipitation.

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