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## Sensorial and spectrophotometrical analyze of the hydroalcoholic extracts of oak from different geographical origins

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### Abstract

In this work was made the sensorial analyse of the hydro alcoholic extracts of different types of oak: *Quercus petraea* L., *Quercus robur* Libel, which are growing in France, East Europe (Moldavia, Romania, Ukraine) and of white American oak (*Quercus alba*) in union with spectrophotometrical analyse. Proceeding from the sensorial analyse, the examined samples of East European oak are characterized by the predominance of caramel–candy flavour, in comparison with the spice flavour specific for the American and French oak.

**Key words:** oak wood, sensorial analyse, spectrophotometrical analyse, wine, spirits.

### Resumé

Dans ce travail a été fait l'analyse sensorielle des extraits hydroalcooliques de differents types du bois de chêne *Quercus petraea* L., *Quercus robur* Libel, qui poussent en France, en Europe de l'Est (Moldova, Roumanie, Ukraine) et du bois de chêne Américain (*Quercus alba*) et en même temps on a fait l'analyse spectrophotométrique. Conformément à l'analyse sensorielle, les échantillons examinées de l'Europe de l'Est sont caractérisés par la prédominance des arômes de caramel, en comparaison avec les arômes épicées spécifiques pour le chêne Français et Américain.

**Mots-clés:** bois de chêne, analyse sensorielle, analyse spectrophotométrique, vin, boissons alcooliques.

### Rezumat

În lucrarea prezentată s-au efectuat analize senzoriale ale extractelor hidroalcoolice a lemnului de stejar de diferite specii: *Quercus petraea* L., *Quercus robur* Libel, care cresc în Franța, Europa de Est (Moldova, România, Ucraina) și a stejarului alb american (*Quercus alba*) în cumul cu analizele spectrofotometrice. Analizele senzoriale au demonstrat că probele din stejar est-europene se caracterizează preponderent prin nuanțe de caramelă în aromă, spre deosebire de nuanțele de condimente caracteristice pentru speciile de stejar american și francez.

**Cuvinte-cheie:** lemn de stejar, analiză senzorială, analiză spectrofotometrică, vin, băuturi alcoolice.

## 1. Introduction

The maturation is necessary for producing wines and some alcoholic beverages of high quality. During maturation and ageing processes in oak wood vessel the hydrolysis, extraction and oxidation are passing slowly, by the time modifying the taste and flavour properties with apparition of vanilla, coconut, spice and smoke hues.

The elements of environment, the regions of growing and botanical speciation of the oak have an important impact on the accumulation of the extractive substances.

The studying of the oak wood impact from different geographical origins on the sensorial properties of alcoholic beverages has not only a theoretical interest but also a practical one.

Therefore, the work recommends the spectrophotometrical analyse of hydroalcoholic extracts from oak in combination with sensorial estimation.

## 2. Materials and Methods

A number of 73 samples of French oak (*Quercus petraea* L. and *Quercus petraea* Liebl. species), 17 samples of Moldavian and Romania oak (*Quercus petraea* L. and *Quercus petraea* Liebl. species) and 45 samples of American oak (*Quercus alba*) were used in study.

A quantity of 0.5 g of oak shavings was soaked in model wine solution (alcohol 10%, 5 g/L of tartaric acid) for duration of 20 days. The samplings were performed for 1, 2, 3, 5, 7, 9, 11, 14, 17 and 20 days. The absorbance of liquid samples was recorded at Langer spectrophotometer (Germany, version 1.05) in range of 200–700 nm with 1 nm step, using model wine solutions as control sample.

Statistical treatment of results (Principal Component Analysis and Analysis of Variance) was carried out using SPSS 10 for Windows software.

## 3. Results and discussion

Typical UV-visible spectrum (200–700 nm) of oak model wine extract is presented in figure 1.

One can observe a plateau between 250 and 280 nm, and a peak at 310 nm. The plateau corresponds to absorbance of total phenolic substances due to the absorbance of their aromatic rings in this range. The peak of 310 nm could be attributed to condensation products of phenolic substances (Labrousche, 2005).

The principal component analysis (PCA) was performed in order to establish the wave length of the most representative absorbencies. In the analysis we used a data set of different soaking durations; the absorbencies of each wave length were used as variables.

The 2-dimentional PCA plot of variables is presented in figure 2.

The first and second principal component axes explain 94% of total variation, the explanatory power of other axes being very weak. Furthermore the majority of variables are rather good correlated with first principal component axe.

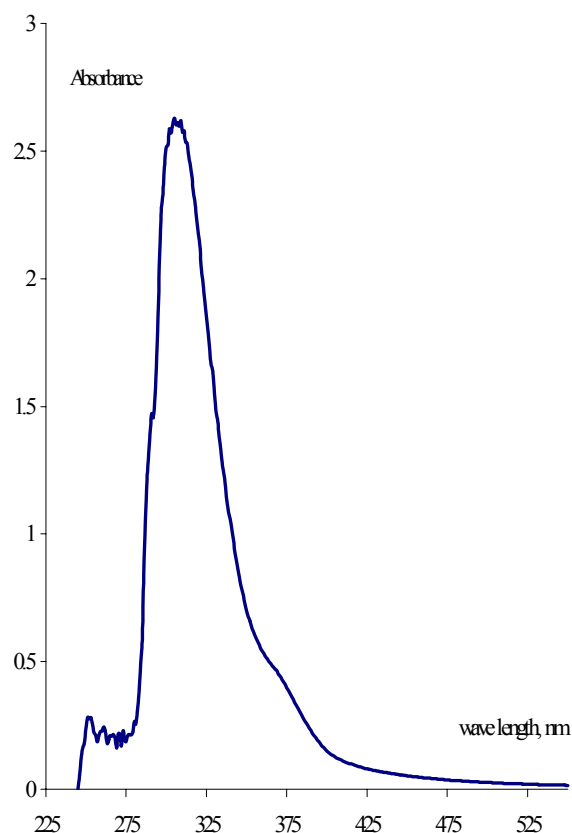
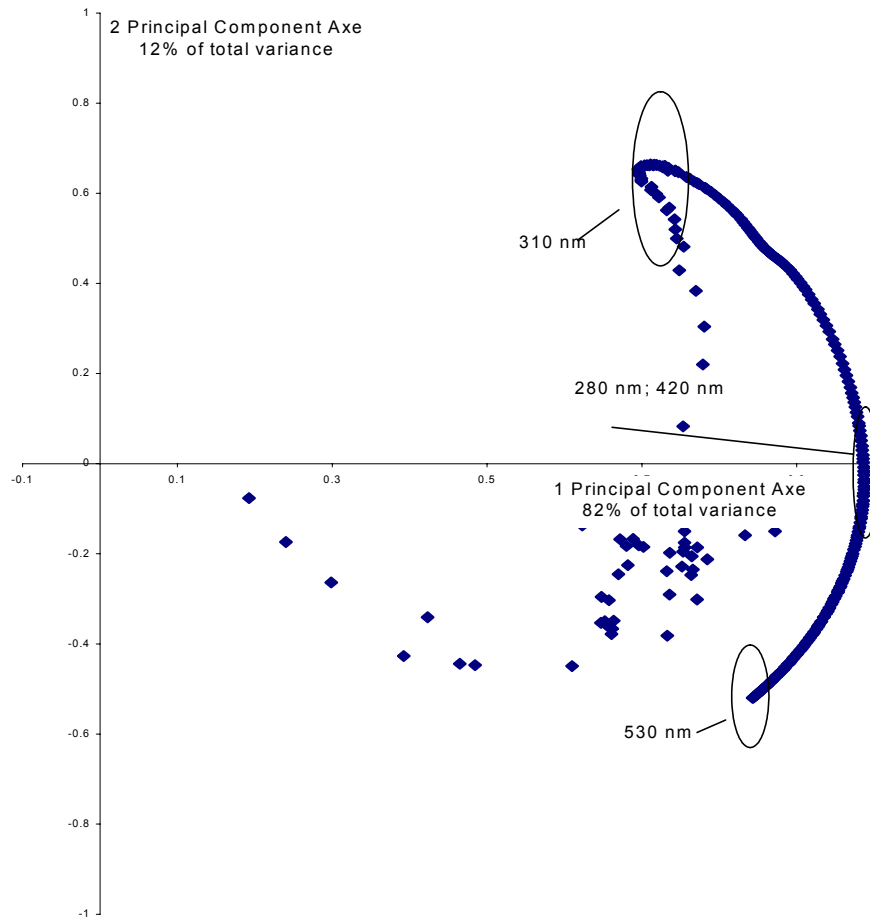


Figure 1. Typical UV visible spectrum of oak model wine extract.

Nevertheless we choose for further analysis the 3 classes of variables in order to provide the best description of spectrometric data:

- 1 class – variables highly correlated with first principal component axe (correlation coefficient 0.95–0.99) and almost uncorrelated with second principal component axe. The typical variables of this class are absorbencies at 280 and 420 nm.
- 2 class – variables middle-highly correlated with first principal component axe (correlation coefficient 0.7–0.8) and middle-highly correlated with second principal component axe (correlation coefficient 0.7–0.8). The typical variable of this class is absorbencies at 310 nm.
- 3 class – variables middle-highly correlated with first principal component axe (correlation coefficient 0.7–0.8) and middle-highly anti-correlated with second principal component axe (correlation coefficient (-)0,7 – (-)0.8). The typical variable of this class is absorbencies at 530 nm.



**Figure 2.** The 2-dimensional PCA plot of variables.

The physical significances of absorbencies of selected wave lengths are following: 280 nm – absorbance of total phenolic substances; 310 nm – absorbance of condensed forms of phenolic substances, 420 nm – contribution on yellow-brownish hint of colour of model wine and 530 nm - contribution on red hint of colour of model wine. Regarding the rather low values absorbencies at 530 nm, we can ignore this contribution on red colour for the real red and even white wines being in contact with oak wood. Thus the absorbencies at 530 nm were excluded in further analysis.

The studying of the kinetic of oak wood extraction by the typical kinetic curve of extraction is presented in figure 3 and in tables 1 and 2.

Analysing this plot, one can conclude that extraction of wood components responsible to absorbance at 280, 310, 420, 530 nm is rather quick and after approximately 5 days the chemical composition of oak extracts is stable. Therefore in further analysis

we compared absorbencies (280, 310 and 420 nm) of oak extracts of different origin (East Europe, France and USA) and species (*Quercus petraea*, *Quercus petraea* Liebl., *Quercus alba*) after 5 days of extraction.

The one-way analysis of variance (factor origin) and one-way analysis of variance (factor species) were performed. The results are given in tables 1 and 2.

**Table 1.** Factor origin

Wave length, Nm	Mean absorbencies			F (probability)
	East Europe	France	USA	
280	0.2690 <sup>a</sup>	0.2203 <sup>a</sup>	0.2503 <sup>a</sup>	2.81 (0.065)
310	2.2365 <sup>a</sup>	2.1118 <sup>a</sup>	1.7590 <sup>a</sup>	2.75 (0.069)
420	0.09640 <sup>a</sup>	0.1030 <sup>a</sup>	0.06927 <sup>b</sup>	4.49 (0.014)

Note: Means with same letters are not significantly different.

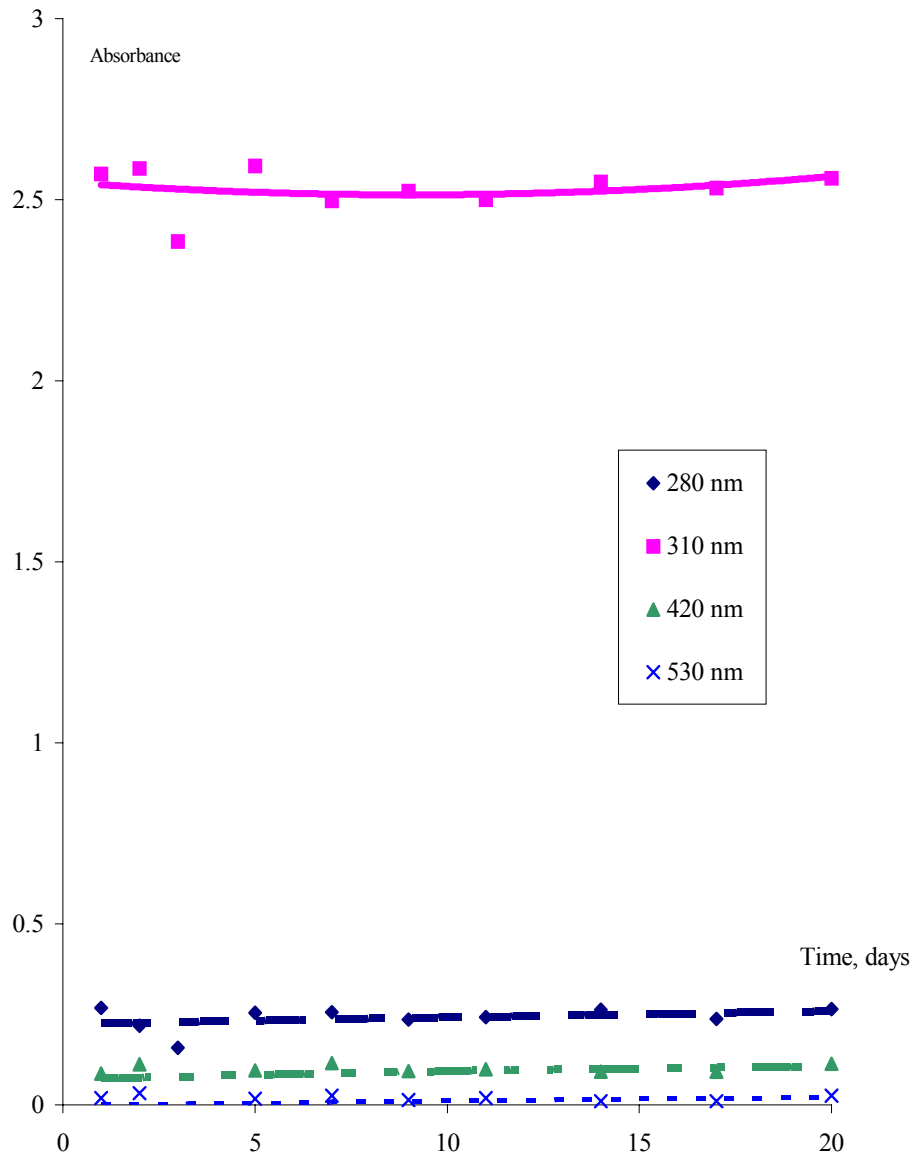


Figure 3. Kinetic curves of extraction

Table 2. Factor species

Wave length, Nm	Mean absorbencies			F (probability)
	<i>Quercus robur</i>	<i>Quercus petraea</i>	<i>Quercus alba</i>	
280	0.2365 <sup>a</sup>	0.2263 <sup>a</sup>	0.2503 <sup>a</sup>	0.70 (0.499)
310	2.1813 <sup>a</sup>	2.1065 <sup>a</sup>	1.7590 <sup>a</sup>	2.66 (0.075)
420	0.02033 <sup>a,b</sup>	0.02446 <sup>b</sup>	0.01227 <sup>a</sup>	4.46 (0.014)

Note: Means with same letters are not significantly different.

#### 4. Conclusions

One can observe that there is no significant difference in absorbencies at 280nm and 310 nm for different origins and species of oak wood. On the other hand one can see that different oaks have significantly different contribution at yellow-brownish hint of model wine. European oaks from France and East Europe have significantly higher absorbencies at 420 nm that American oak. At the same time European species distinguish between them as well, absorbance of *Quercus petraea* extracts being a bit higher than *Quercus robur*.

That means that model wines aged in presence of European oak wood have significantly more intense yellow-brownish hint of colour than wines aged using American oak wood. However this finding concerns only direct extraction of yellow-brownish pigments from oak to wine and doesn't deal with interaction between oak phenolics and wine phenolics or oxidation phenomena, which take place in real wines.

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