

# STUDY OF PHENOLIC COMPOUNDS IN CABERNET SAUVIGNON RED WINES OBTAINED IN IAȘI VINEYARD BY SIX DIFFERENT MACERATION-FERMENTATION TECHNIQUES

## STUDIUL COMPUȘILOR FENOLICI DIN VINURILE ROȘII CABERNET SAUVIGNON OBȚINUTE ÎN PODGORIA IAȘI PRIN DIFERITE TEHNICI DE MACERARE FERMENTARE

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**Abstract.** *Black grapes contain a significant quantity of phenolic compounds responsible for color, which are transmitted into wines during the maceration-fermentation processes. The present paper's objectives are to monitor the extraction level, concentration evolution and analysis of these phenolic compounds in conjuncture with six different maceration-fermentation procedures used – classical maceration, ROTO-tank maceration, cryomaceration, microwave maceration, thermomaceration and ultrasound maceration. By approaching modern analytical methods, the correlation of studied phenolic compounds concentration variation with the maceration-fermentation technique will be facilitated. In order to underline this correlation, grapes from Cabernet sauvignon variety were used, harvested at technological maturity from Iași-Copou vineyard; the grapes were processed into wine and the obtained products were physical and chemical analyzed for the different phenolic compounds responsible for color. The results reflect the extraction degrees for the analyzed compounds from the obtained wines. This study represents a continuance of a previous one, which aims to describe the various proficiency levels in grape phenolic extraction methods applied to black grapes.*

**Key words:** maceration, polyphenol, extraction

**Rezumat.** *Strugurii negri conțin o cantitate însemnată de compuși fenolici responsabili de culoare, care se transferă în vinuri în timpul procesului de macerare-fermentare. Obiectivele prezentei lucrări sunt de a monitoriza gradele de extracție, evoluția concentrației și analiza acestor compuși fenolici în condițiile a șase metode de macerare-fermentare utilizate – macerație clasică, macerație în tancuri ROTO, criomacerație, termomacerație și macerație cu ultrasunete. Prin utilizarea metodelor moderne de analiză, se va realiza corelația dintre concentrațiile compușilor fenolici analizați cu variantele tehnologice de macerare-fermentare utilizate. Pentru a evidenția această corelație, au fost utilizați struguri din soiul Cabernet Sauvignon, culeși la maturitate tehnologică din podgoria Iași-Copou; strugurii au fost vinificați și vinurile astfel obținute au fost analizate din punct de vedere a compușilor fenolici responsabili de culoare. Rezultatele reflectă gradele de extracție ale compușilor fenolici din vinurile analizate. Acest studiu reprezintă o continuare a unui anterior, ce are ca scop să descrie diferențele randamente de extracție ale variantelor tehnologice utilizate.*

**Cuvinte cheie:** macerare, polifenoli, extracție

## INTRODUCTION

Red wines contain relatively high quantities of phenolic compounds (anthocyanins, tannins, flavones and phenolic acids), thus differing from white ones. When compared to white aromatic wines, whose odor and taste are defined by many terpenic compounds, the red ones have a varietal aroma that is given by different compounds (like pyrazines in the case of Cabernet sauvignon) (Cotea V.D., Sauciuc J.H., 1998).

In order to obtain high quality red wines, highly colored and with good organoleptic traits, an optimum extraction method must be applied. The extraction of colored compounds and aromas from grape skins, its main deposit, is done in the pre-fermentative and even in the fermentation stages, though maceration (Cotea V.D., 1985; Pomohaci N. et al., 2000).

The results presented in this paper highlight the technological conditions that favor the phenolic compounds extraction from black Cabernet sauvignon grapes, in order to optimize the winemaking techniques. In addition, this study is just a part of a bigger research project that aims to analyze the degrees in which phenolic compounds from different sorts of black grapes are extracted into wines by using different maceration-fermentation methods. The results obtained in the previous stages of the project have also been published.

## MATERIAL AND METHOD

Research concerning the influence of different maceration-fermentation technological processes on the extraction degree for phenolic compounds from black grapes has been conducted in the Oenology Laboratory of the University of Agricultural Studies and Veterinary Medicine Iasi. Therefore, Cabernet sauvignon grape variety has been harvested from Copou vineyard, which was processed by using various maceration fermentation techniques: classical maceration, ROTO-tanks maceration, thermo-maceration, microwave maceration, ultrasound maceration and cryo-maceration.

The characteristics of each maceration-fermentation technique used are:

– Classical maceration: selected yeasts were added to the must, which was in contact with the skins for 3 days at 20°C; when the alcoholic concentration reached 9%, the must was separated from the skins and the fermentation process continued until all sugars were depleted (Cotea V.V., Cotea V.D., 2006);

– ROTO-tank maceration: selected yeasts were added to approximate 40 L of marc, which was maintained in rotating tanks for three days, and the phases separation was conducted when the alcoholic separation reached 9%; the fermentation process ended in glass containers until all sugars were depleted (Cotea V.D., 1985; Ribéreau-Gayon P., 2006).

– Microwave maceration: 5 kg marc underwent microwave irradiation for 10 minutes at 650 W power; the marc was then pressed; the fermentation process was conducted as stated above (Niculaua M. et al., 2008).

– Thermo-maceration: the marc was subjected to thermal treatment at 60-75 °C, for 30 minutes. A device for thermal treatment in must was used, with the following technical characteristics: tank capacity 20-40 kg, maximum temperature 80°C, maximum productivity 40 kg/hour, power 10 kW. The minimal threshold for marc thermal treatment is 50°C. After the thermal treatment, the fermentation process took place as in the above cases.

– Cryo-maceration: fresh grapes have been slowly frozen at -30°C and then a fast destemming and crushing process took place; selected yeasts were added to the warmed must at 12°C. The fermentation process took place as in the above cases.

– Ultrasound maceration: represents the easiest way to destroy the cellular wall and obtain the extract. Ultrasound cavitation builds powerful forces that mechanically destroy the cellular wall and improve the transfer. As the compound that must be solved is surrounded by an insoluble structure, in order to extract it, the cellular wall needs to be destroyed. Therefore, the destemmed grapes were subjected to this treatment for 15 minutes. This process is not widely used in black grape processing technology but it is successful in obtaining aromatic white wines.

Many technological operations used were common to all variants: crushing and total destemming, SO<sub>2</sub> treatment of the marc, (doses of 0,05 g/L) in order to insure antioxidant and antiseptic protection, proteolytic enzymes addition in order to increase fluid extraction, adding the same yeast to the must, *Saccharomyces oviformis* (S.C.D.V.V. Iasi collection) – characterized by a high alcoholigenous capacity, SO<sub>2</sub> resistance and non-foaming effect –, marc pressing using a low-capacity pneumatic press, alcoholic and malo-lactic fermentation (using endogenous lactic bacteria), oenological gelatin treatment (doses of 0,1 g/L), racking, filtration with a sterile filter and bottling (Țârdea C., 2007).

The obtained wines were analyzed: density, total acidity, volatile acidity, free and total SO<sub>2</sub> content, reducing sugar content, alcoholic concentration, and non-reducing dry extract. In addition, the phenolic compounds were analysed: total anthocyanins content, total polyphenolic index, Folin-Ciocalteu index. An UV-VIS Analytik Jena Specord 200 spectrophotometer was used (Compendium of International Methods of Wine and Must Analysis, 2008).

## RESULTS AND DISCUSSIONS

The main compositional characteristics of the obtained wines (samples 1-6) are shown in table 1, while the analyses results regarding polyphenolic compounds are stated in table 2.

From the first data series one can observe that if the same conditions were generated and same treatments applied to each of the samples, aside from the various maceration technique used, the physico-chemical parameters vary in a very small degree (alcohol concentration, SO<sub>2</sub> concentration, total acidity, remnant sugars and so on).

The obtained values (total polyphenolic index and anthocyanins concentration) from all the samples state that the highest concentration was achieved in the cases of thermomaceration and ROTO-tank maceration. Cryomaceration and ultrasound maceration produced the lowest values. The Folin-Ciocalteu index values reflect that the microwave maceration technique is better in obtaining wines with a higher degree of extraction levels concerning reductive polyphenols, other than anthocyanins.

Table 1

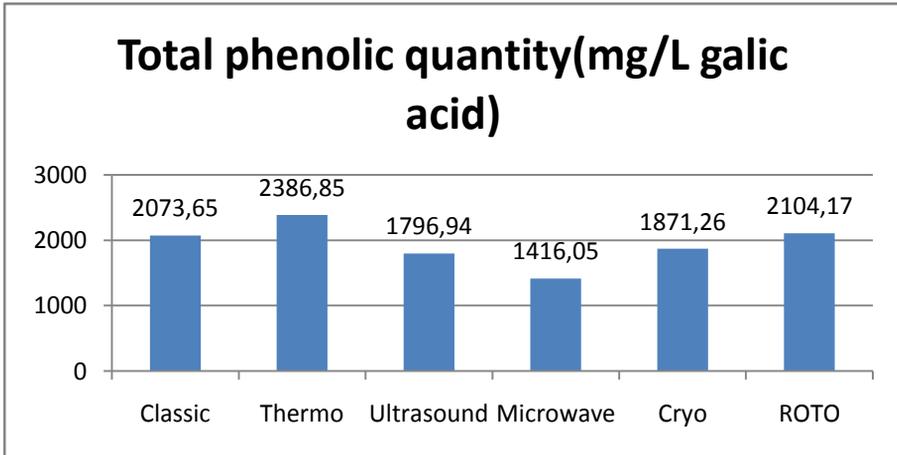
**Physical-chemical characteristics of wines obtained from Cabernet sauvignon grape variety through different maceration-fermentation procedures**

Sample	Alcohol (%)	T.A. (g/L)	V.A. (g/L)	Free SO <sub>2</sub> (mg/L)	Total SO <sub>2</sub> (mg/L)	Sugars (g/L)	Density (g/L)	T.D.E. (g/L)	N.R.E. (g/L)	pH
Classical maceration	13.6	6.11	0.61	28	71	4.12	0.9912	27.6	23.48	3.8
Thermo-maceration	13.6	6.41	0.57	31	75	2.35	0.9912	27.6	25.25	3.9
Ultrasound maceration	13.3	6.24	0.63	27	68	1.75	0.9904	24.8	23.05	3.8
Microwave maceration	13.34	6.06	0.57	33	79	1.81	0.9905	25	23.19	3.7
Cryo-maceration	13.4	7.32	0.61	29	89	3.15	0.9927	30.2	27.05	3.6
ROTO-tank maceration	13.4	6.15	0.51	32	65	3.45	0.9901	24.9	21.45	3.6

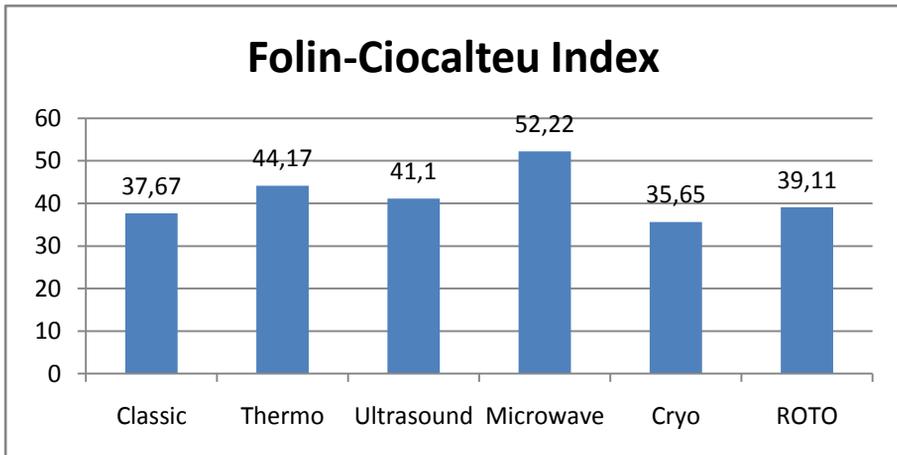
Table 2

**Phenolic indexes, Folin-Ciocalteu indexes and total anthocyanins quantities**

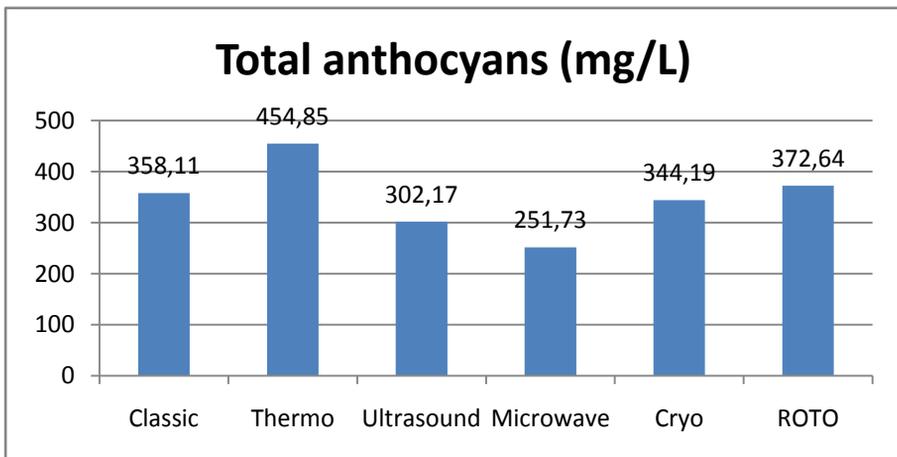
Sample	Total phenolic index	Total phenolic quantity (mg/L galic acid)	Folin-Ciocalteu Index	Total anthocyanins (mg/L)
Classical maceration	31,25	2073,65	37,67	358,11
Thermo-maceration	35,97	2386,85	44,17	454,85
Ultrasound maceration	27,08	1796,94	41,1	302,17
Microwave maceration	21,34	1416,05	52,22	251,73
Cryo-maceration	28,2	1871,26	35,65	344,19
ROTO-tank maceration	31,71	2104,17	39,11	372,64



**Fig. 1.** Total phenolic quantity



**Fig. 2.** Folin-Ciocalteu index



**Fig. 3.** Total anthocyan quantity

## CONCLUSIONS

By analyzing the overall results, one can state that the highest values were obtained when the marc was subjected to a heating process (thermomaceration or microwave maceration). Although these maceration techniques are very proficient in extracting phenolic compounds, they are not recommended all the time because the obtained wine has inferior organoleptic traits (because of the Maillard reactions that take place, giving the wine a “boiled” taste); this procedure is strongly recommended in the case of inferior grapes.

The ROTO-tank maceration proved to be an adequate technique, producing wines with superior phenolic characteristics, thus this procedure is recommended most of the time.

The two other methods (cryo-maceration and ultrasound maceration) produced inferior values concerning polyphenolic concentrations, compared to the others, but nonetheless the wines obtained are considered superior products.

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