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IS WINE INDUSTRIALIZATION LOWERING NATURAL QUALITIES OF WHITE WINES?

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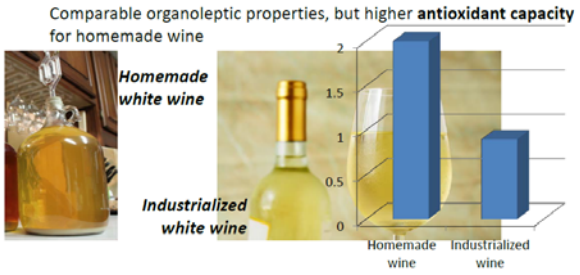
The antioxidant potential of white wines depends on their total phenols content, which is a direct consequence of the winemaking procedure (traditional versus industrial vinification procedures). A comparison of the antioxidant activity and phenols content of several bottled and home-manufactured white wines has been made. The bottled white wines had statistically significant lower levels of both total antioxidant activity (1.02 ± 0.24 mmol/L Trolox equivalents vs. 1.92 ± 0.58, $p < 0.005$) and total phenols content (242.60 ± 55.05 mg gallic acid equivalents/L vs. 350.48 ± 87.50, $p = 0.007$) when compared to the home-made ones. Moreover, in both groups we found statistically significant positive correlations between the total phenols content and the total antioxidant capacity. These results suggest that industrial producers could introduce a supplementary step in order to enhance the extraction of polyphenols during the industrial processing of white grapes.



INTRODUCTION

When coming to white wines, traditional winemaking presents significant differences from industrial vinification procedures.[1-6] One of the most important is that in the case of industrial vinification, the must is clarified before the fermentation starts and usually cultured yeasts are added to convert the must to wine. In the case of traditional winemaking, alcoholic fermentation is initiated by naturally occurring yeasts while the must is still unfiltered. Moreover, in industrial vinification processes, clarification of white wines is usually accelerated, using fining agents (*e.g.* bentonite) in order to promote the agglomeration and settling of solid particles, while this process takes place by natural sedimentation in the case of homemade wines.[7] Industrialized wines must therefore rely on sulfur dioxide addition as an antioxidant, in order to inhibit the growth of bacteria and yeast, either wise, Maillard reactions being involved, a browning process of white wines may occur.[8-12]

It is now commonly accepted that the antioxidant potential of wines (including white wines) is directly related to their phenols content.[13-17] Unfortunately, during industrial vinification, a large amount of phenols is discarded when grapes

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are crushed and only the juice is recovered and immediately processed for alcoholic fermentation.[3-7] In the traditional method, grapes are crushed and there is a gap of three to seven days before the juice is separated.[1,2] The fact that the phenols are left behind is confirmed by successful attempts of recovering them, for various purposes.[18] In the same time, it has been suggested that an increased extraction of grape skin phenols would improve the antioxidant capacity of the derived white wine.[19] For the determination of the antioxidant potential of wines, several methods have been used in the past, such as Trolox equivalent antioxidant capacity (TEAC), total radical trapping antioxidant parameter (TRAP) and ferric reducing-antioxidant power (FRAP), 2,2-diphenyl-1-picrylhydrazyl (DPPH) or 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid) (ABTS) assays, EPR spectroscopy or other spectrophotometric methods, and even biosensors-based techniques.[20-24]

Since TEAC method have proven to be a reliable one on numerous other occasions, we decided to use it ourselves in the present study, which is dedicated to a comparison of total antioxidant capacity and total phenols content between industrialized white wines and home manufactured white wines.[17,18,21,25-29] For this purpose we have compared a commercially available selection of white wines of the *Feteasca* cultivar, obtained from two vineyards in Panciu, respectively Murfatlar regions, with samples of homemade white wines, purchased from local producers in the same two regions that have used the same cultivars for their white wines.

RESULTS AND DISCUSSION

In order to perform this study we used a total of 21 samples of white wines organized in the two previously mentioned groups: (a) bottled wines and (b) home-manufactured wines. The bottled wine group contained 14 samples, while the home-manufactured wine group contained 7 samples.

Results for both total antioxidant capacity (TAC) and total phenols content (TPC) are summarized in Tables 1 and 2.

Table 1

TAC and TPC of bottled wines

Sample	Total antioxidant capacity[1]	Total phenols content[2]
1a	0.91	210.61
2a	0.97	218.07
3a	0.93	222.89
4a	0.79	188.46
5a	0.94	203.16
6a	0.88	218.73
7a	0.86	172.46
8a	0.90	200.53
9a	0.76	212.37
10a	0.99	321.21
11a	1.05	317.67
12a	1.35	338.19
13a	1.53	283.88
14a	1.43	288.10

[1] mmol/L Trolox equivalents; [2] mg GAE/L

Table 2

TAC and TPC of homemade wines

Sample	Total antioxidant capacity[1]	Total phenols content[2]
1b	1.54	297.46
2b	1.73	241.32
3b	1.51	306.45
4b	1.41	294.82
5b	2.05	404.57
6b	2.12	425.52
7b	3.09	483.19

[1] mmol/L Trolox equivalents; [2] mg GAE/L

Table 3

Comparison between the means of the study group (mean ± SD)

	Bottled wines	**Home-made wines**	***P*[3]**
Total antioxidant capacity[1]	1.02 ± 0.24	1.92 ± 0.58	< 0.005
Total phenols content[2]	242.60 ± 55.05	350.48 ± 87.50	0.007

[1]mmol/L Trolox equivalents; [2]mg GAE/L; [3]Mann-Whitney test

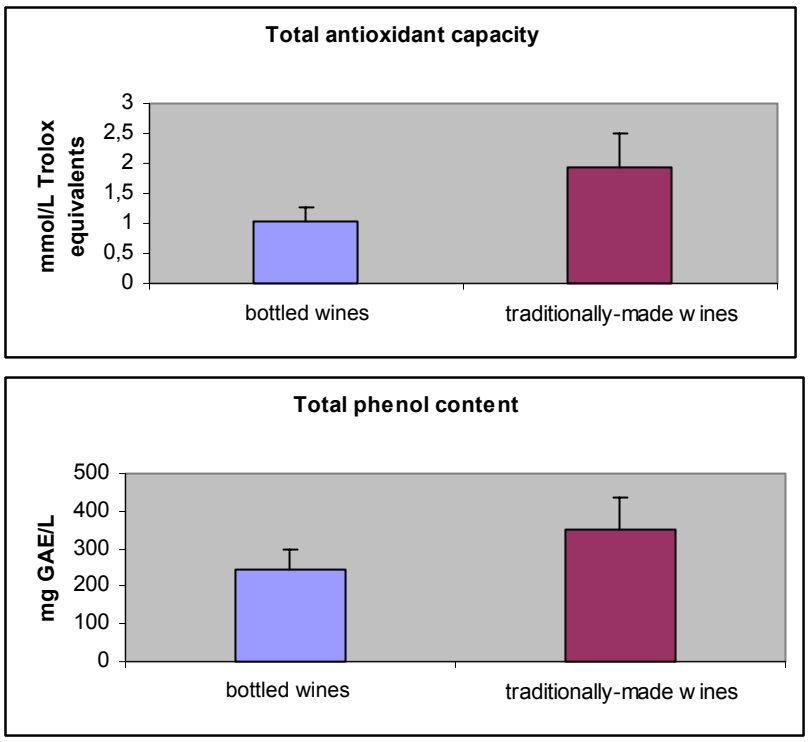

Fig. 1 – Total antioxidant capacity and total phenols content for bottled and homemade wines.

The differences between the means of the assessed parameters are presented in Table 3.

From Table 3 it can be seen that bottled wines have statistically significant lower levels of total antioxidant capacity (1.02 ± 0.24 vs. 1.92 ± 0.58, $p < 0.005$) and total phenols content (242.60 ± 55.05 vs. 350.48 ± 87.50, $p = 0.007$).

The Pearson correlation indicated that in both groups there is a statistically significant positive correlation between the total phenols content (independent variable) and the total antioxidant capacity (dependent variable). Thus, in the case of the bottled wines group we obtained $r = + 0.87$ and $p < 0.0001$, while in the home-manufactured wines group we obtained $r = + 0.87$ and $p = 0.012$.

As mentioned in the Introduction part, when it comes to white wines, there are several differences between the traditional and industrial vinification processes. In the industrial process, the freshly harvested grapes are technologically crushed and pressed. In this step part of the endocarp (pulp), the exocarp (skin) and seeds are discarded, and only the must is processed later on during the fermentation stage.

In the traditional process, the manually destemmed grapes are crushed and the heterogenous mixture is kept as it for an interval of three to seven days. The fermentation takes place while the must is still staying on the marc. Therefore, for a few days the grapes's exocarp is macerating in an aqueous/alcoholic solution, which has been proven previously to be a very effective media for the extraction of phenols from grapes' skin.[18] Thus, the major effect of the early presence of alcohol is to increase the phenols' concentration in the fermentating must, which is associated with the corresponding enhancement of the antioxidant capacity of the white wine. This assumption was confirmed upon discussion with the local producers from whom samples have been obtained: samples 5b, 6b and 7b came from wines for which the must and the marc stayed together for longer

periods (up to 8 days) than samples 1b-4b, for which the interval was 3 to 4 days, hence the clearly observable differences in antioxidant capacity and total phenols content. Indeed, an increased extraction of grape skin phenols as a method for improving the antioxidant capacity of the derived wines was proposed.[19]

EXPERIMENTAL

Chemicals and instrumentation

The following solvents and reagents were purchased from Sigma-Aldrich: ethanol, potassium persulfate ($K_2S_2O_8$), 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid) (ABTS), Folin-Ciocâlteu reagent, gallic acid, sodium carbonate (Na_2CO_3). All the reagents were Ph.Eur. (p.a.) grade. Spectrophotometric determinations were performed using a UV-Vis mini 1240 spectrophotometer (Shimadzu Corporation, Kyoto, Japan).

TEAC assay

The total antioxidant capacity was assessed using a previously described method.[30] Briefly, the $ABTS^{\bullet+}$ radical solution was obtained by mixing appropriate volumes of ABTS and $K_2S_2O_8$ in order to achieve final concentrations of 7 mM and 2.45 mM, respectively. The mixture was left to stand at room temperature, protected from the light, for 12 h. Before use, the $ABTS^{\bullet+}$ stock solution was diluted with ethanol to a final absorbance of 0.70 ± 0.02 at 734 nm. To a volume of 990 µL of this diluted solution were added 10 µL of sample or Trolox solution prepared in ethanol. The absorbance was recorded exactly after 1 minute. An appropriate solvent blank was run for each assay. The results were calculated using a calibration curve made with Trolox solutions with concentrations ranging from 0.5 mM to 2.5 mM. The percentage of inhibition of absorbance at 734 nm was calculated for each Trolox solution and plotted as a function of concentration. Also, the percentage of inhibition of absorbance was calculated for each sample. The results were expressed as mmol/L Trolox equivalents. All determinations were performed in duplicate.

Total phenols content

The total phenols content was carried out by the Folin-Ciocâlteu method.[31] A volum of 500 µL of sample or standard (gallic acid) was mixed with 5 mL of the Folin-Ciocâlteu reagent and 4 mL of Na_2CO_3 1M solution. The absorbance was recorded at 746 nm. The results were calculated using a calibration curve made with gallic acid solutions with concentrations ranging from 20 mg/L to 140 mg/L. The results were expressed as mg of gallic acid equivalents (GAE) in 1 mL wine. All determinations were performed in duplicate.

Statistical analysis

Statistical analysis was performed using GraphPad Prism 5 Software. Results are expressed as mean ± SD (standard deviation). Due to the low number of samples non-parametric tests were used. The Mann-Whitney test was used to evaluate the differences between the two groups. The correlation between total phenols content (independent variable) and the total antioxidant capacity (dependent variable) was assessed using Pearson correlation factor (r). The results were considered to be statistically significant if $p < 0.05$.

CONCLUSIONS

Traditionally-manufactured white wines are reacher in phenols, therefore presenting a superior antioxidant capacity than the bottled white wines. This is a direct results of the traditional method for obtaining homemade wines, in which the marc and must spend several days together. The early fermentation, through the formation of ethanol, allows a better extraction of phenols from skin and pulp.

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