Management of Maceration-Fermentation Technologies Regarding the Antioxidant Profiles of Some Wines from Iasi Vineyard

GABRIELA IGNAT[1], CINTIA COLIBABA[1]*, CARMEN LUIZA COSTULEANU[1], ANDREEA ALEXANDRA TIMOFTE[1], ION SANDU[2,3], IOAN MORARU[1], GEORGE UNGUREANU[1]*, COSTICA BEJINARIU[3,4]*

[1]Ion Ionescu de la Brad University of Agricultural Sciences and Veterinary Medicine of Iasi, 3 M. Sadoveanu Alley, 700490 Iasi, Romania

[2]Alexandru Ioan Cuza University of Iasi, ARHEOINVEST Interdisciplinary Research Platform, 22 Carol I Blvd., 700504 Iasi, Romania

[3] Romanian Inventors Forum, 3 Sf. Petru Movila St., 700089 Iasi, Romania

[4] Gheorghe Asachi Techical University of Iasi, Faculty of Science and Engineering Materials, 67 Dumitru Mangeron St., 700050 Iasi, Romania

The vine contains, in addition to sugars and acids, important amounts of phenolic compounds that accumulate in the solid parts of grapes (clusters, seeds) and skin. The quantity and quality of phenol compounds depends on both the plant and the technology of grape processing. Their high chemical reactivity makes them participate in chemical processes, especially oxido-reduction and condensation. At the same time, these substances have antioxidant qualities that delay the oxidation of wine components. Phenolic compounds also have interesting biological properties. Recent medical research attributed to phenolic compounds from grapes, juice and wines, especially red ones, remarkable sanogenic qualities, due in particular to their antioxidant action when it comes to polyphenols, cardiovascular protection, antiviral, antihistaminic, anti-cancer, anti-inflammatory, etc.This study analyses the management of various maceration-fermentation processes and their influence on the antioxidant capacity of some wines from Iasi vineyard, but also their correlation with specific phenol compounds. The management of winemaking technologies can produce wines with high antioxidant potential, a plus for an increasingly demanding consumer.

Keywords: phenolic compounds from grapes, polyphenols, metabolites, tannins, chromatographic system

At plant level, these secondary metabolites are involved in defence mechanisms in response to the attack of pathogens. Some bitter or astringent compounds limit the pleasant taste and digestibility of some plants, while others are synthesized and used in phenomena such as lignification of the cell wall, to limit the penetration of pathogens. Tannins, by complexing with polysaccharides, can strengthen the structure of cell walls. Polyphenols can also, by their colour, play a role in pollination mechanisms.

Phenolic compounds play an important role in the production of wine, being involved in defining its organoleptic characteristics, like firmness, roundness, astringency and even velvety taste, playing a substantial part in the formation of their typical characteristics [1].

High chemical reactivity makes the polyphenols especially to participate in chemical processes, notably oxido-reduction and condensation. At the same time, these substances have antioxidant qualities which, in fact, delay the oxidation of the wine components, process that would result in reaction products that would adversely alter its olfactory-gustative properties. Thus, polyphenolic compounds are among the first substances that oxidize, consuming oxygen. Through such properties, coupled with bactericides ones, polyphenolic compounds contribute to preserving the colour and taste of wine, with special regards of the red wine [2].

Phenolic compounds also occur in the transformations that take place during the treatments, as well as during maturation and aging of wines, including by means of polycondensation [3].

Phenolic compounds also generate unwanted processes in grape juice and wine, such as: colour browning by oxidation of ortho-diphenols, catalysed by enzymes; the formation of volatile phenols with unpleasant odour by the metabolism of phenolic acids by yeasts; the fixation of SO_2 by polyphenols, resulting in exceeding the SO_2 doses to be administered in wine .

Significant is also the contribution of phenolic compounds to the wine value [4]. Compared to other fruit and vegetable processing processes (boiling, baking) during which phenolic compounds are destroyed, wine-making maintains them. As a result, the consumer benefits from them, and still in a pleasant form, wine turning also into a nutritional success.

Polyphenols also have interesting biological properties. Their study is important not only in areas such as oenology, but also in human health. Recent medical research attributed to phenolic compounds from grapes, juice and wines, especially red ones, remarkable sanogenic qualities, due in particular to their antioxidant action when it comes to polyphenols, cardiovascular protection, antiviral, antihistaminic, anti-cancer, anti-inflammatory, etc. [5]. As a result, consumer preference for red wines has grown.

Experimental part

Material and method

The used grape varieties are as follows: Feteasca regala-Fr, Feteasca alba-Fa, Chardonnay-Ch, Sauvignon blanc-Sb, Babeasc neagra-Bn, Feteasca neagra-Fn, Cabernet Sauvignon-CS, Merlot-M. These were harvested in 2011

* *email: cintia.colibaba@gmail.com; ungurgeo@uaiasi.ro; costica.bejinariu@yahoo.com*

from V. Adamachi farm of the USAMV Iasi. The grapes were processed as follows: - for white wines: p-prefermentative, c-classical variant; - for red wines: c-classical maceration, r-rototanks maceration, t-thermomaceration, m-microwave maceration.

The most accurate and rapid method for determining resveratrol is HPLC [6-12].

The Trolox assay was performed as described by Miller et al. Metmyoglobin is activated to ferryl metmyoglobin when exposed to hydrogen peroxide and, when incubated with ABTS, forms the long-lived ABTSÿ + radical. This radical, which is blue-green in colour, is scavenged by any antioxidants that are present in solution. When antioxidants are added at the start of the reaction, the delay in the increase in absorbance is measured, and a greater delay corresponds to more antioxidant activity. Wine samples were decolorized by making a 0.5% (w/v) activated carbon slurry, which sat for 10 min before being vacuum filtered through a Buchner funnel and Whatman filter paper.

Results and Discussions

Phenolic compounds, through their wide range of properties, also bring health benefits due to their antiradical capacities, when wine is consumed moderately [13-16].

The values of the antiradical capacity of white wines are shown in the figure 1. At Feteasca regala wines the values are of 0.91 mM trolox (Fr-c) and 1.39 mM trolox (Fr-p); at Feteasca alba wines the values are of 0.56 mM trolox (Fa-c) and 0.85 mM trolox (Fa-p); at Chardonnay wines the values are of 0.53 mM trolox (Ch-c) and 0.65 mM trolox (Ch-p); Sauvignon blanc wines the values are of 0.43 mM trolox (Sb-c) and 0.52 mM trolox (Sb-p). Greater antiradical capacities are found in wines obtained from the native varieties Feteasca regala and Feteasca alba.

Figure 2 shows the antiradical capacities of red wines. At Babesca neagra wines the values are between 1.27 mM trolox (Bn-t) and 1.52 mM trolox (Bn-c); at Feteasca neagra wines the values are between 1.20 mM trolox (Fn-t) and 1.45 mM trolox (Fn-c); at Cabernet Sauvignon wines the values are between 1.20 mM trolox (CS-t) and 1.46 mM trolox (CS-c); at Merlot wines the values are between 0.55 mM trolox (M-t) and 0.96 mM trolox (M-c).

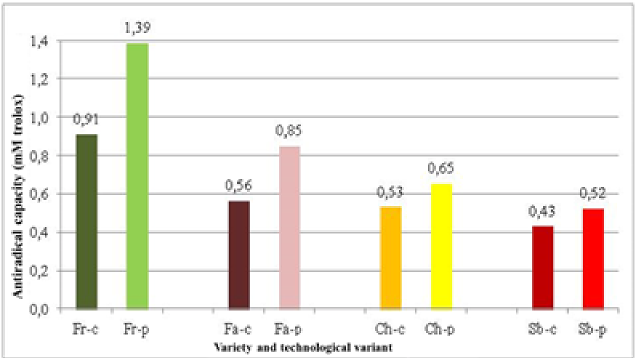

Fig. 1. Antiradical capacity of white wines, obtained by different technologies

Higher antiradical capacities are given by a higher amount of phenolic compounds with antiradical character. We note that these higher values predominate in technological variants that did not use heat treatments, i.e. classical maceration-fermentation and maceration-fermentation in rotary tanks. This means that heat-induced technological variants (thermal maceration, microwave maceration) destroy or inhibit some of these antiradical compounds, or reduce their extraction from the skin and seeds. We can also say that the grape variety also has a major influence on the level of accumulation of these compounds.

In addition to phenolic acids, a group of substances called stilbens are found in grapes. Representative for this group of substances is resveratrol, compound, with many benefits over health [17-22].

Resveratrol is a polyphenolic microconstituent that is formed in the skin of grapes in response to fungal attack of *Botrytis cinerea*, behaving like a phytoalexin, and the chemical structure has proven to be a 3,5.4'-trihydroxystilbene [15, 16, 23].

It is present in very small quantities in both white and red wines. It does not influence the quality of the wines, but it has beneficial effects on the body, protecting it from cardiovascular diseases. Its presence in grapes and wine holds a variety characteristic, so it is used to establish the authenticity of wines.

Figure 3 shows the content of resveratrol in white wines obtained by different technologies. At Feteasca regala wines the resveratrol contents were of 2.44 mg/L (Fr-c) and 2.47 mg/L (Fr-p); at Feteasca alba wines of 2.55 mg/L (Fa-c) and 2.64 mg/L (Fa-p); at Chardonnay wines of 2.51 mg/L (Ch-c) and 3.04 mg/L (Ch-p); at Sauvignon wines of 2.43 mg/L (Sb-c) and 2.55 mg/L (Sb-c). It is noted that the white wines obtained by the prefermentative maceration show higher values of this compound than the values obtained by the classical variant, due to the longer contact period of the must with the solid parts, which leads to a better extraction of resveratrol from the grapes' skins.

Figure 4 shows the resveratrol content of red wines obtained by using different technologies. At Babeasca neagrã wines the values of resveratrol content are between 2.78 mg/L (Bn-r) and 3.03 mg/L (Bn-m); at Feteasca neagra wines the values are between 2.55 mg/L (Fn-r) and 2.96 mg/L (Fn-c); at Cabernet Sauvignon wines the values are between 2.54 mg/L (CS-m) and 2.65 mg/L (CS-c); at Merlot wines the values are between 2.64 mg/l (M-m) and 2.91 mg/L (M-t).

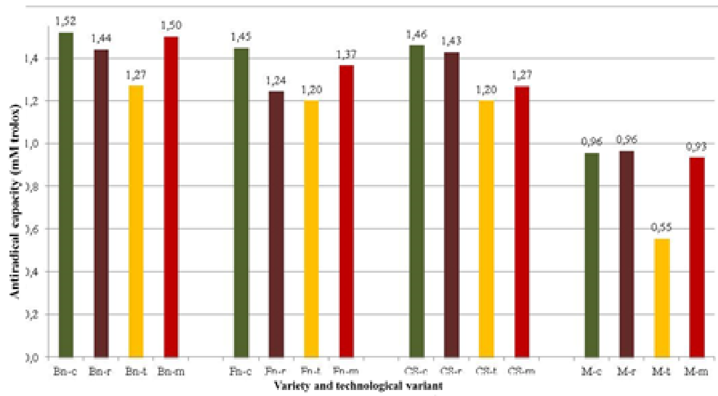

Fig. 2. Antiradical capacity of red wines, obtained by different technologies

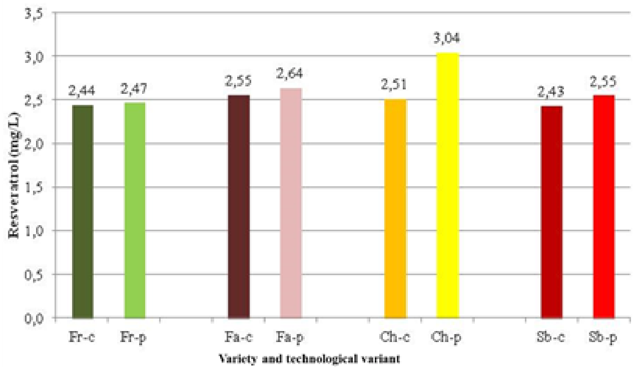

Fig. 3. Resveratrol content of white wines obtained by different technologies

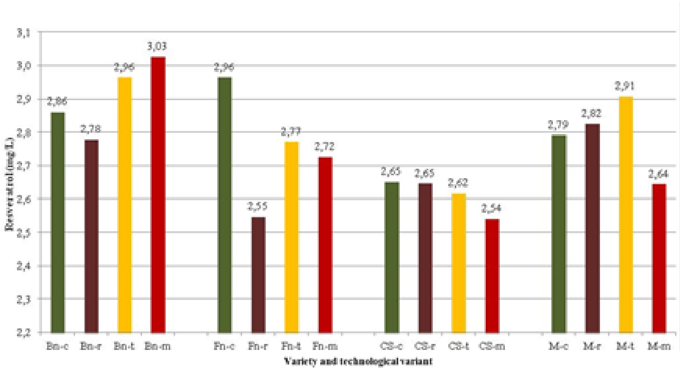

Fig. 4. Resveratrol content of red wines obtained by different technologies

Conclusions

In white wines, the technology of extraction of resveratrol was found to be in contrast to red wines where the determinism induced by the grape variety was more evident.

The management of extraction technology influences the antiradical capacity values by the fact that a longer duration of grape juice contact with solids leads to a better extraction of phenolic compounds of antiradical character, and this is the case for the prefermentative variant in white wines. Heat-inducing technology (thermal-maceration, microwave maceration) destroys or inhibits some of the antiradical compounds or, in red wines, reduces their extraction from the skin and seeds. The vine varieties influence the content of phenolic compounds of antiradical character through the accumulation potential. Bãbească neagrã wines are notable with the highest antiradical capacities.

The management of wine production technology, especially during the extraction phase, has to be better studied in order to obtain sound scientific data which can only then be put into practice.

References

1. POPA, A., Secretul vinului bun, Ed. Alma, Craiova, 2008, p. 298.
2. SACCHI, K.L., BISSON, L., ADAMS, D.O., American Journal of Enology and Viticulture, **56,** no. 3, 2005, p.197**.**
3. KALLITHRAKA, S., SALACHA, M.I., TZOUROU, I., Food Chemistry Journal, **113**, 2009, p. 500.
4. KINSELLA, J.E., FRANKEL E., GERMAN, B., KANNER, J., Food Technology, **47,** 1993, p**.** 85.
5. YADAV, D.N., PATKI, P.E., SRIHARI, S.P., SHARMA, G.K., BAWA, A.S., International Journal of Food Properties **13**, no. 1, 2009, p. 142.
6. KOLOUCHOV, I., KOV, H., MELZOCH, K., FILIP, V., SMIDRKAL, J., Food Chemistry, **87,** no. 1, 2004, p. 151.
7. VIAN M., TOMAO V., GALLET S., COULOMB P., LACOMBE J., Journal of Chromatography. A, **1085**, no. 2, 2005, p. 224.
8. RODRIGUEZ-DELGADO M., GONZALEZ G., PEREZ-TRUJILLO J., GARCIA-MONTELONGO F., Food Chemistry, **76**, no. 3, 2002, p. 371.
9**.** IGNAT, G., BALAN, G., SANDU, I., COSTULEANU, C.L., VILLE, S.T.S., Rev. Chim. (Bucharest), **67**, no. 8, 2016, p. 1560.
10. RADU, C.D., PARTENI, O., SANDU, I.G., LISA, G., MUNTEANU, C., LUPU, V.V., Rev. Chim. (Bucharest), **67**, no 1, 2016, p. 199.
11. PAVEL, S., HOPF, H., JONES, P.G., LUPU, V.V., BIRSA, L.M., Rev. Chim. (Bucharest), **67,** no. 4, 2016, p. 683.
12. CASTELLARI, M., SARTINI, E., FABIANI,A., ARFELLI, G., AMATI, A., Journal of Chromatography A, **973**, 2002, p.221.
13. MORARU, I., PhD Thesis, USAMV Iasi, 2014.
14. MICHAEL, B., DI PIETRO, CHARLES, W., BAMFORTH, Jornal of Institute of Brewing, **117**, no.4, 2011, p. 547.
15. DI PIETRO, M.B., BAMFORTH, W.C., Jornal of Institute of Brewing, **117,** no. 4, 2011, p. 547.
16. PEREIRA, G.E., GAUDILLERE, J.P., PIERI, P., HILBERT, G., MAUCOURT, M., DEBORDE, C., MOING, A., ROLIN, D., Journal of Agriculture and Food Chemistry, **54,** 2006**,** p**.** 6765.
17. THIMMAPPA, S. ANEKONDA, THIMMAPPA S. ANEKONDA, Brain Research Reviews**, 52**, no. 2, 2006, p. 316.
18. RAKICI O., KIZILTEPE U., COSKUN B., ASLAMACI S., AKAR F., International Journal of Cardiology, **105**, no. 2, 2005, p. 209.
19. AVRAM, S., DANCIU, C., PAVEL, I., ZINUCA I., CEAUSU, R.A., AVRAM, S., DEHELEAN, C., RAICA, M., Rev. Chim. (Bucharest), **67** no.2, 2016, p.382.
20. ANTOCE, A,O., Rev. Chim. (Bucharest), **63**, no.9, 2012, p.859.
21. SCHMUTZER, G., AVRAM, V., COMAN, V., DAVID, L., MOLDOVAN, Z, Rev. Chim. (Bucharest), **63,** no.9, 2012, p.855.
22. ANTOCE, A.O., NAMOLOSANU, I., Rev. Chim. (Bucharest), **62**. no. 6, 2011, p. 593.
23. CHIRITA, P., ASAFTEI, I.V., SANDU, I., SARBU, L.G., LUPU, V.V., Rev. Chim. (Bucharest), **68**. no. 1, 2017, p. 147.

Manuscript received: 04.07.2017