Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 14, Issue 2, 2014
PRINT ISSN 2284-7995, E-ISSN 2285-3952

HEAVY METAL POLLUTION OF SOME COMPONENTS OF FLAVOURED WINES, NAMELY THE WINE VARIETIES AND HYDROALCOHOLIC MACERATES FROM PLANTS

Rodica Elena CULEA[1], Radiana TAMBA-BEREHOIU[1], Stela POPESCU[1], Ciprian–Nicolae POPA[2]

[1]University of Agricultural Sciences and Veterinary Medicine, 59 Marasti, District 1, 011464, Bucharest, Romania, Phone: +40 21 318 25 64/232, Fax: + 40 21318 28 88, E-mails: rodica.culea@gmail.com, radianatamba@yahoo.com, sazzpop@yahoo.com
[2]FARINSAN S.A. Gradistea, Comana, Giurgiu district, E-mail:cipnpopa@yahoo.com

Corresponding author: rodica.culea@gmail.com

Abstract

The aim of this research, in order to meet the quality standards of drinks derived from wines, was the establishment of heavy metals pollution (Pb , Cd and Cu) of some varieties of wine from the 2007 harvest, in the Ostrov vineyard, namely: Fetească Albă , Sauvignon Blanc and Riesling Italian. We also analyzed the heavy metal content of hydroalcoholic macerates of plants in 45 % and 60 % alcohol (2 recipes: recipe I with 16 plants taken from Romanian native flora and recipe II with 6 ingredients containing especially bitter substances), used subsequently to obtain flavoured and vermouth type wines from the studied varieties. Heavy metals were determined by atomic absorption spectrometry (AAS). The research results show that the Italian Riesling variety had the highest values for heavy metals, ie 51.9 ppb Pb, 1.60 ppb Cd and 12.2 ppb Cu. The less " polluted " variety of wine with Cd (0.10 ppb) and Cu (9.4 ppb) was Fetească Albă. Regarding the hydroalcoholic macerates, the one obtained from the plants in recipe I had a higher content of Pb , Cd and Cu (15.6 ppb Pb , 0.78 ppb Cd and 355 ppb Cu) and macerates in 60 % alcohol had higher concentrations of heavy metals as compared with the macerates in 45 % alcohol. In conclusion , although heavy metals were found in both wines and in hydroalcoholic macerates, the pollution with heavy metals did not exceed the limits allowed by law.

Key words: *Fetească Albă, heavy metal pollution, hydroalcoholic macerates of plants, Riesling Italian, Sauvignon Blanc.*

INTRODUCTION

Although there are certain regulations regarding the toxic potential of chemicals, many studies have revealed the presence of such “pollutants" in food [4]. Regarding the wines and wine-based drinks, we should emphasize that, beyond with physical and chemical parameters, the presence of toxic substances and their quantity determines their quality [5, 6, 7]. Among the toxic compounds mentioned by law, there are heavy metals which are known for the negative physiological effects produced in living organisms, when above certain concentrations (cardio-vascular, pulmonary, nervous system or bone damage, liver damage, cancer etc.) [2, 3].
Our research aimed determining the heavy metals (which are listed by specific health legislation on vine products, namely wine and plant hydroalcoholic macerates used to obtain flavored drinks), as Pb , Cd and Cu [3].
Lead and cadmium present in wine derive from soil, insecticides, yeast, equipment, storage containers, bottles, corks , herbs (flavored wines). Copper in wine appears particularly because of phytosanitary treatments with pesticides, by using copper sulphate present in equipment and storage containers or in herbs (in flavored wines). There are currently rather few studies on the determination of heavy metals present in the local wines, as well as in vermouth type flavored wines.
It is necessary a research on the effect of different macerating recipes on the nutraceutical qualities flavored wines, but also on the possible risks to consumer safety. Approach is warranted to support the processors of wine, given the need of increasing the neccessity of the

competitiveness of Romanian products on the EU market and the increase of their added value.

The originality of this work consists in directing research towards a toxicology study on the quantitative determination of heavy metals in order to establish the quality of treated food drinks (wines, flavored wines).

MATERIALS AND METHODS

In order to determine the heavy metals Pb, Cd and Cu, we used for analysis three samples wine from the Fetească Albă, Riesling Italian and Sauvignon Blanc. The analyzed samples were wines obtained from the SC Ostrov SA wine center, from wine production of the year 2007. Also, we analyzed four samples of plant hydroalcoholic macerates, used for flavouring the vermouth type wines. The four samples of macerates derived from two plant recipes derived from indigenous flora, which have been macerated in 2 hydroalcoholic solutions of different concentrations (ie 45% to 60%).

The mixtures of plants used for the two recipes are as follows:

- recipe I containing 16 plants (anise, caraway, thyme, yarrow, coriander, cloves, fennel, hyssop, rosehips, marjoram, mint, chamomile, nutmeg, wormwood, lemon balm, shock);
- recipe II containing six herbs (wormwood, anise, rosehips, nutmeg, orange peel, lemon peel) [3].

We prepared macerates by introducing the plant mixtures (own recipes) in alcoholic solutions of 45% vol (IA and IIA), respectively 60% vol (IB and IIB recipes), in alcohol / plant ratio of 10:1. The extraction of biologically active compounds was made by cold extraction, from plants stirred for 14 days at 22^0 C in the dark [2].

The scheme of obtaining four hydroalcoholic macerates samples is shown in Table 1.

After the maceration process followed the separation of plant extract by repeated pressing and filtering operations. The alcoholic extract we obtained was rich in bio-active compounds (dyes, terpene and derivatives thereof) and it was placed in storage containers.

Table 1.The scheme of obtaining alcoholic macerates

No.	Sample	Plants mixture (g)		Alcohol (ml)	
		Recipe I	Recipe II	45 % vol. alc	60 % vol. alc
1.	I A	45	-	450	-
2.	I B	45	-	-	450
3.	II A	-	45	450	-
4.	II B	-	45	-	450

The detection and dosage method of heavy metals in wine and hydroalcoholic macerates recommended by the OIV and used by us is based on atomic absorption spectrometry (AAS) in flame (FAAS - for determination of heavy metals in ppm range) and in the oven graphite (GFAAS - for determinations in ppb range) [1, 8, 9].

We used a Zeenat 700 Analytik Jena Germany atomic absorption spectrometer, double moduled, FAAS, GFAAS. The wine samples and macerates were acidified and readings were made at wavelengths characteristic for each analyzed element: 283,3 nm for Pb, 228.8 nm for Cd and 324.8 nm for Cu.

The measurements were carried out on liniar field. On the base of obtained values we draw the absorbance curve (correlation coefficient r = 0.997). The software of the equipment enables automatic display of the element concentration. The calculation method is based on the standard addition method [2].

RESULTS AND DISCUSSIONS

The values on the content of Pb, Cd and Cu in wine samples and macerates for subsequently preparating flavored wine and vermouth, are presented in Table 2.

From the obtained data we can notice that none of the basic wines (Fetească Albă, Italian Riesling and Sauvignon Blanc) exceed the maximum limits provided in the Romanian legislation regarding the content of Pb (up to 200 ppb), Cd (max 10 ppb) and Cu (max 1000 ppb) or in the international law Pb (up to 150 ppb), Cd (max 10 ppb) and Cu (up to 1000 ppb).

Table 2.Concetrations of Pb, Cd and Cu in basic wines and plants alcoholic macerates

Sample	Pb (ppb)	Cd (ppb)	Cu (ppb)
Basic wines			
Fetească Albă	29.8	0.10	9.4
Riesling Italian	51.9	1.60	12.2
Sauvignon Blanc	8.9	0.17	10.0
Alcoholic plant macerates			
Recipe I A (45%)	12.2	0.58	250
Recipe I B (60%)	15.6	0.78	355
Recipe II A (45%)	6.2	0.35	38.7
Recipe II B (60%)	9.6	0.25	63.9

In addition, the obtained data are much lower compared to the maximum, namely the 3 to 16 fold lower in the case of lead, from 6 to 100 times less than in the case of cadmium, up to 80 to 100 times lower in the case of copper.

Regarding the lead content, the highest value is recorded for the variety Riesling Italian (51.9 ppb), followed by Fetească Albă, while Sauvignon Blanc has the lowest content of Pb (8.9 ppb). Regarding the content of cadmium, the highest value recorded also the variety Riesling Italian (1.60 ppb), the lowest content of cadmium occurring in Fetească Albă (0.1 ppb). Copper content is seen that the highest value is found also in the Riesling Italian variety (1.60 ppb), while Fetească Albă has the lowest copper content (9.4 ppb).

Determination of lead, cadmium and copper in alcoholic macerates from plants indicates that they do not exceeded the maximum limits provided in the Romanian legislation for wine. Making a comparison between the samples obtained from two different recipes plant, it is observed that in the case of recipes IA (45 % alc.) and IB (60 % alc.), derived from the mixture of 16 plants, the content of lead, cadmium and copper is much bigger than in the case of II A macerate recipes (45 % alc.) and II B (60 % alc.), which contain citrus peel and a small number of herbs. This result is normal taking into account the fact that the first two macerates contain each 16 plants, compared to 4 plants for the macerates II A (45 % alc.) and II B (60 % alc.), herbal remedies coming with their intake of heavy metals; it is known that plants have the ability to accumulate heavy metals in tissues (situation due to their possible cultivation in areas with medium and high degree of pollution) .

Also, the content of lead, cadmium and copper was higher in the samples from the macerates with 60 % alcohol , demonstrating further that the extraction power production of the hydro-alcoholic solution with a higher alcohol content is bigger than in the case of alcohol 45 %.

Thus, we can say that although in the wine samples and the hydroalcoholic macerates prepared by us, the pollution with heavy metals (Pb , Cd and Cu) did not exceed the limits allowed by law, yet they are found in the final product, their source being as well the basic wines and the flavoring plants.

Since the oenological products represent a major sector of human consumption, the investigation field in this area is particularly important and practically unlimited.

The main research should focus on maintaining the quality of flavored wines from the perspective of the sustainable agriculture concept and on their particular nutraceuticals characteristics, in accordance with the European principles on healthy diet.

CONCLUSIONS

In the analyzed samples (3 wines basic 4 hydroalcoholic macerates), there were no exceedances of the maximum limits provided in the Romanian legislation for Pb, Cd and Cu;

In the three varieties of wines, the basic data on the content of Pb, Cd and Cu, shows that the variety Riesling Italian has the highest values for heavy metals : 51.9 mg / l Pb, 1.60 mg / l Cd and 12.2 mg / l Cu; The less "polluted" wine with cadmium (0.10 mg / l) and copper (9.4 mg / l), is derived from the Fetească Albă variety; The wine with the lowest lead content (8.9 mg /l) is derived from Sauvignon Blanc; The hydroalcoholic macerates IA (45 % alc.) and IB (60 % alc.), derived from recipes from the 16 plants have a higher content of Pb, Cd and Cu, towards macerates II A (45 % alc.) and II B (60 % alc.) derived from 4 plants and citrus recipes, fact which confirms that medicinal plants can accumulate heavy metals;

Heavy metal pollution in the analyzed samples did not exceed the limits allowed by law, which gives the user the opportunity to obtain flavored wines free of toxic potential.

ACKNOWLEDGEMENTS

This research work was carried out with the support of the analysis laboratory staff from the wine-growing centre Ostrov and the Biotechnology Faculty from University of Agronomical ScienceS and Veterinary Medicine Bucharest.

REFERENCES

[1]Artimon M., Dumitrescu V., Tănase I. G.., Pele, M., Nedelcu R., 2009, The optimization of the methods for Cu, Zn and Pb content determination in Roumanian wines by AAS after dry or microwave mineralization, Romanian Biotechnological Letters, 14 (2), 4319-4325.

[2]Barceloux, D. G., 2008, Medical toxicology of natural substances, New Jersey.

[3]Culea, R. E., 2009, „Flavouring compounds used for improving the quality of Albă superior wines, in Ostrov Wine Center", Doctoral Thesis, University of Agricultural Sciences and Veterinary Medicine, Bucharest.

[4]Danukar, S.A, Kulkarni, R. A., Rege, N.N., 2000, Pharmacology of medicinal plants and natural Products, Indian Journal of Pharmacology, vol 32, p 81-118.

[5]Gomez, M., Cerutti, S., Sombra, L., Silva M., Martinez L.,2007, Determination of heavy metals for the quality control in argentinian herbal medicines by ETAAS and ICP-OES, Food and Chemical Toxicology, Volume 45, Issue 6, June 2007, Pg 1060–1064.

[6]Hague, T., Petroczi, A., Andrews, P., Barker, J., Naughton D., 2010, Determination of metal ion content of beverages and estimation of target hazard quotients: a comparative study,Chemistry Central Journal 2010, 4:2.

[7]Rui, YK, Yu QQ, Jin YH, Guo J, Luo YB, 2007, Application of ICP-MS to the detection of forty elements in wine, PubMed - indexed for MEDLINE, College of Food Science and Nutritional Engineering, China Agricultural University, Beijing, 27(5):1015-7.

[8]Directory of commented Romanian standards / Methods of analysis, 1997, I.R.S. Romanian Institute for Standardization, Bucharest.

[9]Compendium of International methods of wine and must analysis, 2007, Organization Internationale de la vigne et du vin.