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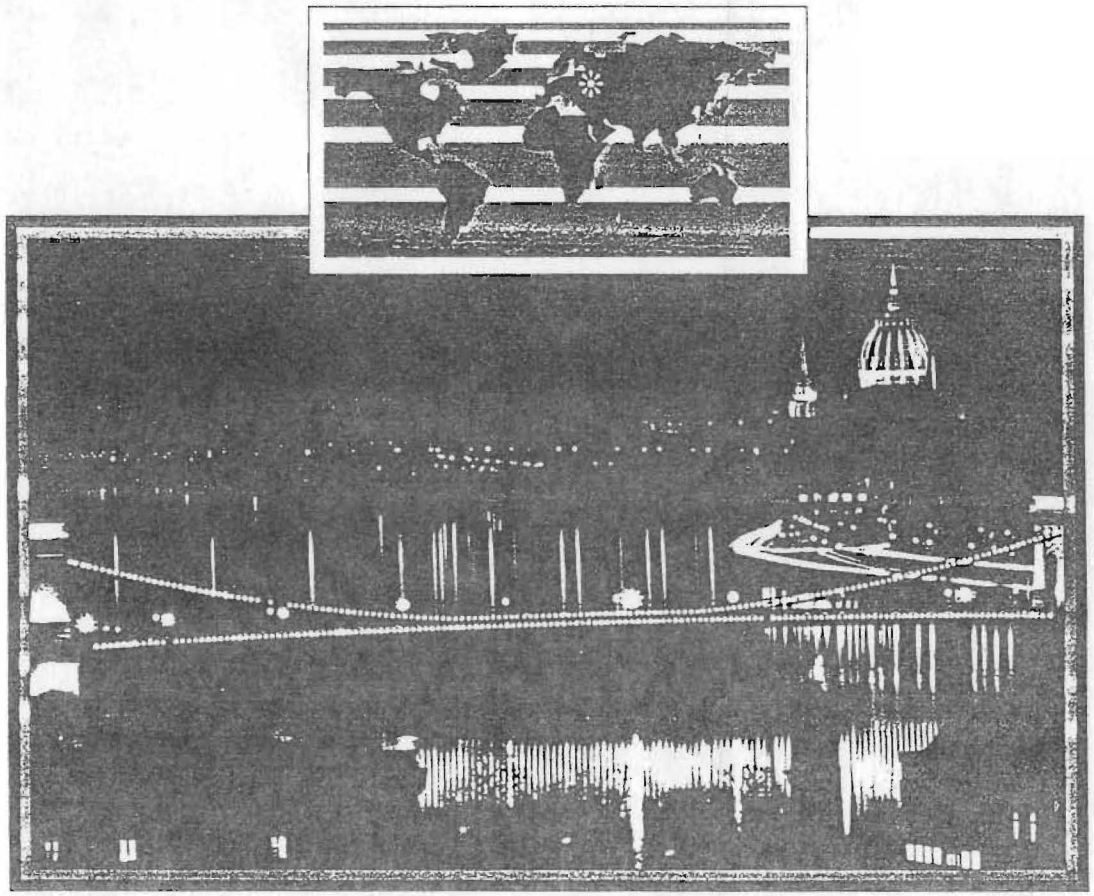

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SYMPOSIUM PROCEEDINGS

DETERMINATION OF LEAD AND OTHER HEAVY METALS IN WINE

Vera Jordanovska and Trajče Stafilov:

Institute of Chemistry, Faculty of Science, St. Kiril and Metodij University, Arhimedova 5, POB 162, 91001 Skopje, Macedonia; Tel.: 389 91 261 330

Abstracts

In this work an occurrence of different heavy metals (lead, copper, manganese, iron, chromium, nickel, zinc and cadmium) in different wine samples produced in three regions (Kavadarci-Tikves, Negotino-Povardarie and Titov Veles) in the Republic of Macedonia, has been presented. Samples of wines were and digested by acids. The investigated heavy metals were determined the applying of the atomic absorption spectrometry. The aim of the investigation was to gain data for presence of lead and some other heavy metals as toxic elements in the wines. The results pointed out that the content of these elements is in permitted limits. The content of lead, zinc and copper in the wines produced from the Titov Veles region is higher than in the wines from the other regions.

INTRODUCTION

Heavy metals are essential elements for plants and animals. Men received trace elements from food and beverage products. The most of the trace elements contained in alcoholic products were also discovered in the blood and some organs of the human body. If trace elements are insufficient (Fe, Co, Cu, Mn, Ni and Zn) the process of hematopoesis is disturbed. But the most of them, when they are present in higher concentration are toxic. Because of that, there is a necessity of precise and exact determination of heavy metals in various types of beverage products.

In this work the occurrence of some heavy metals (Pb, Cu, Mn, Fe, Cr, Zn, Ni and Cd) in different wine samples produced in three regions in the Republic of Macedonia (Kavadarci, Negotino and Titov Veles), are presented. Heavy metals were determined by applying of the atomic absorption spectrometry (AAS). The aim of the investigation was to gain data for presence of lead and some other heavy metals in the wines.

Table III.

Results from the determination of Pb, Cu, Mn, Fe, Cr, Zn, Ni and Cd in different type of wine samples taken from Negotino-Povardarie region, Republic of Macedonia (results are given in mg/L)

Type of vine	Year	Pb	Cu	Mn	Fe	Cr	Zn	Ni
NEGOTINO-POVARDARIE REGION								
WHITE WINES								
Traminec	1993	0.065	0.280	0.923	0.714	0.019	0.171	0.109
Shampain-Biser	1993	0.079	0.384	0.611	2.32	0.031	-	-
RED WINES								
Kratosija	1993	0.077	0.120	1.10	1.93	0.028	-	-
Rizling	1991	0.100	0.314	0.966	2.24	0.064	-	-
Negot. trpezno	1982	0.085	0.069	0.923	0.714	0.019	0.171	-
Antigona	1993	0.050	0.032	1.16	3.22	-	0.209	-

Table IV.

Results from the determination of Pb, Cu, Mn, Fe, Cr, Zn, Ni and Cd in different type of wine samples taken from Titov Veles region, Republic of Macedonia (results are given in mg/L)

Type of vine	Year	Pb	Cu	Mn	Fe	Cr	Zn	Ni	Cd
VELES REGION									
WHITE WINES									
Zhilavka	1993	0.252	0.550	1.37	1.93	0.018	-	0.355	0.006
Zhilavka	1993	0.094	0.524	0.934	2.60	0.035	0.199	-	-
Smederevka	1993	0.325	0.403	1.11	2.01	0.029	-	0.200	0.005
Smederevka	1993	0.169	0.157	1.09	2.84	0.049	0.222	-	-
Rizling	1993	0.135	0.492	1.04	2.48	0.035	0.161	-	-
Rkaticeli	1993	0.152	0.273	0.967	2.54	0.053	0.216	-	-
Home made	1993	0.273	0.028	0.024	0.302	0.004	0.206	-	-
RED WINES									
Merlo	1993	0.274	0.744	2.29	2.52	0.026	-	-	0.004
Merlo	1993	0.117	0.240	1.85	2.05	0.088	0.279	-	-
Vranec	1993	0.255	0.292	1.96	2.96	0.034	-	-	0.004
Vranec	1993	0.140	0.240	1.44	1.74	0.125	0.279	-	-
Vranec	1981	0.126	0.051	1.34	2.10	-	0.554	0.062	-
Hamburg	1971	0.100	0.301	1.24	3.51	-	0.609	0.062	-
Ovche Pole	1993	0.050	0.081	1.28	2.80	-	0.554	0.062	-
Home made	1993	1.03	0.018	0.893	0.443	0.022	0.206	-	-

Of the work reviewed in literature many methods for lead determination in beverage products are presented. Usually, a method of flame atomic absorption (FAAS) [1-4] and electrothermal atomic absorption spectrometry (ETAAS) [5], were used.

EXPERIMENTAL

Instrumentation

A Perkin-Elmer models 303 and 703 atomic absorption spectrophotometer equipped with a deuterium background corrector, HGA-72 graphite furnace and model 056 strip chart recorder were used. The corresponding element hollow cathode lamps were used as a source.

Instrumental condition for the determination of these elements by AAS are presented in Table I. Pb, Cu, Mn, Fe, Cr, Zn and Ni are determined by FAAS. Gas mixture of acetylene and air was used for flame AAS determinations.

Because of low concentration of Cd, it was ETAAS. Optimal instrumental conditions (temperature and time) for ETAAS determination are: drying: 110 °C, 20 s; charring: 300 °C, 20 s; atomize: 2000 °C 5 s. Argon was used as an inner gas.

Table I:
Optimal conditions for Pb, Cu, Mn, Fe, Cr, Zn, Ni and Cd determination by AAS

Element	Wavelength (nm)	Slit (nm)	Lamp current (mA)
Pb	283.3	0.7	10
Cu	324.7	0.7	15
Mn	279.5	0.2	10
Fe	248.3	0.2	30
Cr	357.9	0.7	10
Zn	213.9	0.7	15
Ni	232.0	0.7	25
Cd	228.8	0.7	4

Procedure for the heavy metals determination in wines

An aliquot of 50 cm^3 of wine sample in an open silica crucible was evaporated in a sand bath to a viscose residue. It was added 2 cm^3 of concentrated sulfuric acid and continued with the evaporation and finely on a electric plate until SO_3 fumes liberating. After that, the crucible was put in a furnace at about 500 °c for 2 hours. After cooling the residue was treated with 3 cm^3 of concentrated HNO_3 and evaporated on a sand bath. Then, crucible was put in the furnace at 500 °c for 1 hour. The obtained white ash was solved by heating with 3 cm^3 concentrated HNO_3 and a few drops of water. After cooling, the solution was filled up with deionized water up to 5 cm^3, filtered off and the amount of heavy metals were determined from the solution by FAAS and ETAAS.

RESULTS AND DISCUSSION

From the results given in Tables II and III it can be seen that the lead content in the wine samples from Kavadarci-Tikves and Negotino-Povardarie regions occurs in content lower than those permitted by Macedonian regulation (up to 0.3 mg/l). Namely, it ranges from 0.05 to 0.1 mg/L. In wine samples from the Titov Veles region (were the Pb-Zn smelting factory is placed) the lead content (Table IV) is also in the permitted limit but it is higher then in the wines from other regions - from 0.1 to 0.3 mg/L. But, in one Smederevka white wine the content of lead is 0.325 mg/L and in one sample of home made red wine, produced from vineyard near lead smelting factory, the concentration of lead is 1.03 mg/L. This increasing of the lead content in wines produced in Titov Veles region is connected with the presence of Pb-Zn smelter factory and with the pollution of the soils and grapes with ore dust in this area [6].

The content of the other investigated heavy metals (Cu, Mn, Fe, Cr, Ni, Zn and Cd) in wines from all three regions, are in permitted limits. The range of concentration of Mn, Fe, Cr, Zn and Ni in wine samples from all three regions is similar: for Mn, 0.5-2.3; Fe, 0.5-3.5; Cr, 0.01-0.1; Ni, 0.06-0.3; Zn, 0.1- 0.6 mg/L. Cadmium was determined in wines from Titov Veles region and the concentration ranges from 0.004 to 0.006 mg/L. The concentration of Cu varies from 0.05 to 0.1 mg/L in wines from Kavadarci region and it is lower than in wines from Negotino and Titov Veles regions (from 0.05 to 0.7 mg/L). Agricultural treatment of vineyard with copper containing agents have probably influence on this difference.

The results of previous investigations [4] of heavy metals in a few samples from these regions correspond to our results.

Table II.

Results from the determination of Pb, Cu, Mn, Fe, Cr, and Zn in different types of wine samples taken from Tikves-Kavadarci region, Republic of Macedonia (results are given in mg/L)

Type of vine	Year	Pb	Cu	Mn	Fe	Cr	Zn
TIKVES-KAVADARCI REGION							
WHITE VINES							
Smederevka	1992	0.050	0.025	0.691	2.19	0.036	-
Belan	1991	0.050	0.013	0.065	0.429	0.022	0.100
Semjon	1993	0.049	0.034	0.500	1.94	0.013	0.090
Aleksandria	1992	0.064	0.045	0.642	3.39	0.035	0.219
Temjanika	1993	0.072	0.023	0.478	2.32	0.029	0.093
RED VINES							
Kavadarka	1992	0.056	0.061	0.923	0.376	0.019	0.119
Tga za jug	1990	0.064	0.116	1.51	1.47	0.013	0.435
Aleksandria	1992	0.064	0.045	0.642	2.39	0.035	0.219

Conclusions

The obtained results for the content of investigated heavy metals from three regions in the Republic of Macedonia, pointed out that they are in the permitted limits, except in a few wine samples produced from Titov Veles region vineyards. It was found an evident difference in copper content in wines from Kavadarci and other two regions. It can be concluded that the content of heavy metals in wines depends on the pollution from the industry, from the agricultural treatment and from the meteorological conditions.

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