CONTENT OF HEAVY METALS AND RADIONUKLIDES IN GRAPES GROWN IN AERO POLLUTED AREA NEAR POWER PLANT „NIKOLA TESLA" IN OBRENOVAC

ZORAN BESLIC[1], SLAVICA TODIC[1],
LATINKA SLAVKOVIC[2], VELIBOR ANDRIC[2]

ABSTRACT: The content of heavy metals and radionuklides in grape berries of four cultivars (Vitis vinifera L.): Afuz-ali, Black muskat, SV 18-315 and Pinot noir was investigated. The samples for this analyze originated from four locality with diferent distant from storage site of ashes that was produced in power plant Nikola Tesla – Obrenovac. Knowing a dimension of airpollution in the industrial area which is living area too, we set a goal to investigate a content of this element in grape berries thet are table grape and source for processing. The obtained values was compared with values from Regulations of maximum levels for metals, metaloides and other contaminants in food (Yugoslav Official Register, N^o 5/92).

Key words: heavy metals, radionuklides, grape, power plant „Nikola Tesla", Obrenovac

INTRODUCTION

Production of 'Eco' food is a trend that became prevailing worldwide in the past few years. In recent times, our producers have also been trying to reach quality standards set by foreign market. On the other hand, we are witnesses of progressive threat to the living environment caused by outdated industrial technologies, ecological disasters, usage of numerous chemical substances in the protection and nourishment of fruit and grapevines. It is often emphasized that the food produced in our country automatically belongs to the 'healthy food' group while ignoring the fact of the level of pollution of certain areas. In relation to this, the paper shows the level of content of heavy metals and radionuclide in grapes that have been produced on four localities in the territory of Obrenovac Municipality, which is situated in the aero polluted area. Aero pollution of the area was created out of scattered ashes from storage site and of emission of great quantities of smoke particles produced by power plant 'Nikola Tesla' A and B.

[1] Faculty of Agriculture, Zemun
[2] Institute of Nuclear Sciences „Vinca", Belgrade

The aim of the paper was to determine the content of the above-mentioned toxic elements in grapes by measuring both the influence of the power plant and of the application of pesticides against diseases and pests.

MATERIALS AND METHODS

Obrenovac is one of the westernmost Belgrade municipalities located on either flat or slightly mountainous terrain among the Tamnava, Kolubara and Sava rivers. Taking into account the total surface of Obrenovac Municipality, 30781 ha is used in agriculture (i.e. 78,2%), with 5% of the orchards and 0,1% of the vineyards.

This region belongs to moderate continental climate with average air temperature ranging from 11,0 to 12,0^{o}C and total rainfall from 583mm to 783mm.

The power plant „Nikola Tesla" A and B is located in the suburbs of the Municipality, and installation „A" is located on the outskirts of the town. The influence of the power plant on aero pollution mostly depends on the direction of the wind. In Obrenovac region, the wind most often blows from the southeast. Every third day the wind blows from this direction except during the summer when it blows from the northwest, i.e. from the power plant towards the town thus releasing ashes from storage site and smoke from chimneys directly onto the town and the surroundings. Annual number of days with strong and stormy wind (6-8 bofors) is around 146 days, and wind of this strength is most often the reason of spreading the ashes onto the area.

There are between 17000 and 30000t of ashes and slag that are deposited on storage of the power plant storage site. Apart from this, through emission of smoke in the atmosphere, enormous quantities of smoke particles are released. This quantity surpasses maximum concentration for around 27 times (Sabovljevic et al., 2003), Tab. 1. The legally allowed maximum level of smoke particles that could be emitted in the atmosphere from any power plant installations with thermal energy of 300MW amounts to 50 mg/m^3, (Serbian Official Register, N^{o} 40/97).

Tab. 1. Content of ashes in smoke gas (mg/m^3) (Sabovljevic et al.,2003)

Block TENT	Power (MW)	Smoke particle
A1-A2	210	883-1353
A3-A6	305-308	79-290
B1-B2	620	29-95

The samples of grapes for analysis were taken from four sites that are at different distance from the power plant installations and ashes storage site. The first sample was taken from vines that are grown in the town garden. The second sample was taken from vineyard in the Urovac village that is about 2km away from the installation A. The grapes for third sample originated from Grabovac village that is around 10km away from both power plant and installation and is most polluted by ashes storage because of unfavorable wind. The fourth sample was taken from a vineyard in the Mislodjin village that is situated on the hill outside the town and this site is the most distant from the source of pollution.

- I sample – the town
- II sample – Urovac village
- III sample – Mislodjin v.
- IV sample – Grabovac v.

Grapes of two table grape varieties were used for the analysis: Afuz-ali and Muskat hamburg and two wine varieties: S.V. 18-315 and Pinot noir.

The content of radionuclide and heavy metals was determined by drying the whole grapes bunches on 80^{o}C to the state of dryness, and than were grinded into powder with electrical mixer. The sample was kept stable for 30 days before analysis.

The content of radionuclide ^{40}K, ^{137}Cs, ^{238}U, ^{226}Ra and ^{232}Th and heavy metals Pb, Cd, Hg, Ni, Zn and Fe was determined by the analysis. The resulting content in the grapes was obtained with method of atomic absorption spectrometry (Perkin Elmer models 5000, HGA-400/5000 and MHS-1/5000. The results are shown in mgkg^{-1} of fresh weight. The radionuclide was determined by -spectrometry (model Canberra 8k ADC MCA 35+).

RESULTS AND DISCUSSION

The concentration of radionuclide in the samples is shown in table 2. The content of ^{40}K ranges from 56 BqKg^{-1} (town area) to 67 BqKg^{-1} (Grabovac village). These values are within the parameters set by FAO (1989) according to which average values in the fruit and vegetables are between 50-150 BqKg^{-1}. The presence of ^{40}K in the fruit is a result of its absorption from the soil as natural substance.

The content of ^{137}Cs in fruit samples was between 0.05 BqKg^{-1} (Urovci village) and 0.3 BqKg^{-1} (town and Mislodjin v.). The average value of ^{137}Cs in the fresh fruit was up to 1,0 BqKg^{-1} as a result of radiation during Chernobyl catastrophe. After Chernobyl, average values of this element in Serbia in 1986 was 53,8 BqKg^{-1} in the fruit, with decreasing tendency, so the average values in 1999 were less than 0,2 BqKg^{-1} (Pantelic et al., 2000).

The values that may be considered negligible are: less than 5,0 BqKg^{-1}for ^{238}U, less than 2,3 BqKg^{-1} for ^{226}Ra and less than 0,3 BqKg^{-1} for 232Th, (Pantelic et al., 2000). In all samples of grapes, the determined values of radionuclide were in its natural concentration except for ^{232}Th that was in surplus, particularly in the town area (1,5 BqKg^{-1}) and Mislodjin village (3,2 BqKg^{-1}).

Tab. 2. Concentracion of radionuclides in the fresh grapes, (Bqkg^{-1})

Sample	^{40}K	^{137}Cs	^{238}U	^{226}Ra	^{232}Th
I	56	0,3	5,0	<5	1,5
II	64	0,1	<1	"	0,9
III	66	0,3	2,3	"	3,2
IV	67	<0,1	<1	"	0,5

The concentration of heavy metals is shown in table 3. The content of Pb was between 0,09 and 0,24 mgkg^{-1} in fresh grapes. These values are lower than what is

maximally allowed in relation to the content of Pb in fruits (1,0 $mgkg^{-1}$) approved by Regulations of Serbia on maximum levels of metals, metalloids and other poisonous substances in food (Yugoslav Official Register, N° 5/92) and are on the maximum level (sample IV) or higher (samples I, II and III) then prescribed by European Union according to which maximum quantity of Pb in fresh fruit amounts to 0,1 $mgkg^{-1}$ (CR EC No 466/2001).

Tab. 3. Content of heavy metals in the grapes, ($mgkg^{-1}$)

Sample	Pb	Cd	Hg	Ni	Zn	Fe
1	0,24	0,02	0,01	7,48	0,84	7,67
2	0,12	<0,01	<0,01	3,92	0,76	9,41
3	0,17	<0,01	<0,01	6,88	1,67	5,59
4	0,09	<0,01	0,01	3,85	2,49	7,04

The content of Cd in fresh fruit was from 0,001 to 0,05 $mgkg^{-1}$, and the highest level recorded was 0,01 $mgkg^{-1}$, (Leskosek-Cukalovic and Jovic, 1999). Level of Cd and Hg were lower than the maximum values prescribed by our Regulations according to which maximal level of Cd in fresh fruit is 0,05 $mgkg^{-1}$ and of Hg is 0,02 $mgkg^{-1}$. The largest determined level of Cd was in sample I (0,02 $mgkg^{-1}$), and of Hg in sample I and IV (0,01 $mgkg^{-1}$),Table 3.

The average concentration of Ni in small fruit that is grown in non-polluted regions is between 0,2 and 0,4 $mgkg^{-1}$ (Mijacika and Drazeta, 1997). The contents of Ni in the samples of Obrenovac area were between 3,8 and 7,5 $mgkg^{-1}$ which is about twenty times higher. A particularly high content of Ni was found in samples I (7,48 $mgkg^{-1}$) and III (6,9 $mgkg^{-1}$).

In the sample from Urovci village, the determined content of Fe was 9,41 $mgkg^{-1}$, while in the other samples the content of Fe was lower (5,59 - 7,04 $mgkg^{-1}$). Same authors determined content of Fe in small fruits from 3,5 to 4,4 $mgkg^{-1}$, (Mijacika and Drazeta, 1997). Content of Zn in fresh fruit is on average between 2,0 and 2,5 $mgkg^{-1}$, while in the analyzed samples, it was between 0,76 and 2,49 $mgkg^{-1}$ which is within average levels.

CONCLUSION

On the basis of analyzing the content of radionuclide and heavy metals in fresh grape cultivated on Obrenovac area, the following can be concluded:

The content of ^{40}K is within average values prescribed by FAO (1989). Concentration of ^{137}Cs in fresh fruit is from 1Bqkg-1 and is a result of radiation after Chernobyl catastrophe. Average concentration of ^{137}Cs is up to 0,3Bqkg-1.

In all the samples of grapes, determined values for ^{238}U and ^{226}Ra are within natural levels except for ^{232}Th, which had higher levels in all the samples, particularly in the locality of the town and the village Mislodjin. The highest concentration of ^{232}Th was found in the sample of the village Mislodjin.

The content of Pb is lower than the maximally allowed content of Pb in fruit (1,0 mgkg-1) prescribed by Regulations of Serbia on maximum levels of metals, metalloids

and other poisonous substances in food (Yugoslav Official Register, N^{o} 5/92) and are maximum or higher then prescribed by European Union according to which maximum quantity of Pb in fresh fruit amounts to 0,1 mgkg^{-1}.

In all the samples, level of Cd and Hg were lower than what are maximum values prescribed by our Regulations.

The determined content of Ni and Fe was higher than values determined by other authors, whereas the content of Zn was of average level.

REFERENCES CITED

Maximum levels for certain contaminants in foodstufs. Commission Regulation (EC) No 466/2001. L 77/1-13.

MIJAČIKA, M., DRAŽETA, L. (1997): Uticaj udaljenosti zagadjivača na sadržaj teških metala u plodovima jagode i kupine. Jugoslovensko vocarstvo, Vol. 31. Br.117-118, 129-133.

PANTELIĆ, G., PETROVIĆ, I., JAVORINA, LJ. (2000): Systematic examination of radioactive contamination in Yugoslavia. http://www.irpa.net/irpa10/cdrom/01128.pdf/

Pravilnik o količinama pesticida, metala, metaloida i drugih otrovnih supstancija koje se mogu nalaziti u namirnicama ("Sl. list SRJ" br. 5/92).

Radioactive fallout in soils, crops and food (1989): FAO Soils Bulletin 61.

SABOVLJEVIĆ I SAR. (2003): Toksikološka karta opštine Obrenovac. Centar za multidisciplinarne studije Univerziteta u Beogradu.