

CONCENTRATION OF RADIONUCLIDES IN DIFFERENT TYPES OF BEE PASTURES AND IN HONEY IN SERBIA

GORDANA VITOROVIĆ*, IRENA PETROVIĆ ** and GORDANA PANTELIĆ**

*Department of Radiology, Faculty of Veterinary Medicine, 11000 Belgrade, Yugoslavia **Institute of Occupational Health and Radiological Protection Dr D. Karajović, 11000 Belgrade, Yugoslavia*

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The concentration of natural (^{232}Th , ^{226}Ra , ^{40}K) and man made (^{137}Cs) radionuclides was measured in flowers and honey samples, collected during 1994, from the main types of bee pastures in Serbia (Lime tree, Sunflower, Meadow and Acacia). The radionuclide activity was measured by gamma - spectrometry.

The results obtained show that activity of ^{137}Cs in flowers (2. 1-6..6 Bg/kg) and honey (0.22-0.38 Bg/kg) is very low. About 10-20 times higher level of ^{137}Cs activity was measured in flowers than in their honey. Similar relationships were found in the case of natural radionuclides, with the exception of ^{40}K . Eight years after the Chernobyl nuclear accident, the dominant radioactivity in flowers and honey, from analyzed bee pastures, is from natural radionuclides.

Key words: Radionuclides, honey, flowers

INTRODUCTION

Natural radionuclides have been present in the soil for thousands of years. The main sources of man made radionuclides are atomic weapon tests or nuclear accidents, when radionuclides spread into the atmosphere and are deposited into plants and the earth's surface. A few days after the Chernobyl accident, Horšić et al. (1987) found a high level of ^{131}J , ^{134}Cs and ^{137}Cs in the pollen and honey. Higher radioactivity was in pollen than in honey. Similar results were published by Bunzel et al. (1988) and Filipović-Vinceković et al. (1991). Several years after the Chernobyl accident the dominant radioactivity in plants and honey was from soil origin. Long-life radionuclides migrate from the soil through the root system to plants and are finally present in the flowers. According to Barišić et al. (1992) ^{137}Cs activity in honey depends only on the amount of soluble cesium in the soil. Đurić et al. (1988) estimated the content of natural (^{40}K) and some fallout radionuclides in different types of honey before and after the Chernobyl nuclear accident. They found that ^{40}K activity in honey ranged between 12,5-29,0 Bg/kg. The variations depended only on the origin and type of honey. Activity of ^{137}Cs increased rapidly immediately after the nuclear accident. Vitorović et al. (1994)

presented the results of their estimation of radionuclide activity in honey samples from different parts of Serbia, collected during 1993.

The aim of the present study was to estimate the relationships and levels of natural and artificial radionuclides in honey and flowers from different bee pastures in Serbia, eight years after the Chernobyl accident.

MATERIALS AND METHODS

The flowers and honey samples were collected during 1994. from four main bee pastures and types of honey in Serbia: Acacia (Šabac, Prokuplje), Lime-tree (Fruška gora), Meadow (Knić, Maljen) and Sunflower (Zrenjanin). Three samples of flowers and honey were used for measuring the concentration of natural (^{232}Th , ^{226}Ra , ^{40}K) and man made (^{137}Cs) radionuclides. The air dry flowers were ground and homogenized, while the honey samples were measured in natural form. They were placed in 250 ml cups. The cups were closed and samples were measured after four weeks, when the equilibrium between ^{226}Ra and ^{214}Bi had been reached. The samples were measured for 7200 s and the background for 200000 s. High resolution gamma spectrometry was employed for activity measurement of the samples. We used a low background HP Ge detector with a relative efficiency of 25% and energy resolution of 1,85 keV (1332,5 keV ^{60}Co), shielded with 10 cm lead. The standard for calibration was prepared in the same geometry (259 ml). Five radionuclides (^{54}Mn , ^{133}Ba , ^{152}Eu , ^{241}Am , ^{137}Cs) were dissolved in distilled water. The influence of the density of various samples was calculated and included as a systematic measurement error (5%).

RESULTS AND DISCUSSION

The radionuclide activity found in flowers (Bg/kg dry weight) and honey (Bg/kg fresh weight) are shown in table 1.

Levels of natural radionuclides were relatively high in flowers, especially ^{40}K and ^{226}Ra . The highest ^{226}Ra activity levels were in lime-tree (92.0 Bq/kg) and meadow (83.0 Bq/kg) flowers but ^{40}K concentration was higher in meadow (249.5 Bq/kg) and sunflowers (229.5 Bq/kg). The concentration of ^{137}Cs in the flowers was much lower and ranged between 2.1 – 6.5 Bq/kg.

In honey samples, from the same bee pastures, the concentrations of natural and man made radionuclides were significantly lower than in the flowers (Table 1). These relations are presented in table 2. Higher radioactivity was found in pollen than in honey by Horšić et al. (1987), Bunzel et al. (1988) and Filipović-Vinceković et al. (1991).

In flowers the highest level was obtained for ^{40}K , especially in sunflowers and meadow flowers. Đurić et al. (1988) showed that ^{40}K activity in samples of honey ranged between 12.5–29.0 Bq/kg and in our investigation it was 2.8–19.0 Bq/kg. The concentration of ^{137}Cs was low and ranged between 0.2–0.4 Bq/kg.

Table 1. Activity of natural and man made radionuclides in different flowers (Bq/kg dry weight) and honey (Bq/kg fresh weight)

Bee pastures	Samples	²³² Th	²²⁶ Ra	⁴⁰ K	¹³⁷ Cs
Acacia	Flowers	11.2 ± 1.7	27.5 ± 6.7	126.0 ± 18.9	3.6 ± 0.4
	Honey	0.8 ± 0.1	3.5 ± 0.6	2.8 ± 0.6	0.3 ± 0.04
Lime-tree	Flowers	14.7 ± 1.8	92.8 ± 12.9	138.1 ± 19.3	6.5 ± 0.9
	Honey	0.8 ± 0.1	4.0 ± 0.6	19.0 ± 2.5	0.2 ± 0.02
Meadow	Flowers	14.2 ± 1.7	83.0 ± 11.6	240.5 ± 36.1	4.7 ± 0.5
	Honey	0.9 ± 0.1	5.7 ± 0.7	13.6 ± 1.1	0.4 ± 0.05
Sunflower	Flowers	7.0 ± 1.1	48.0 ± 4.3	229.5 ± 21.2	2.1 ± 0.2
	Honey	0.8 ± 0.1	4.9 ± 0.3	3.2 ± 0.3	0.2 ± 0.01

Table 2. Radioactivity ratios of flowers to honey (F/H) and percent of activity in honey (% H) in relation to flowers

Bee pasture	Ratios	²³² Th	²²⁶ Ra	⁴⁰ K	¹³⁷ Cs
Acacia	F/H	14	8	45	14
	% H	7	13	2	7
Lime-tree	F/H	18	23	7	32
	% H	5	4	14	3
Meadow	F/H	16	15	18	12
	% H	6	7	6	8
Sunflower	F/H	8	10	72	10
	% H	12	10	1	9

In the nonaccidental situation the main radionuclides in honey and bee pastures flowers come from the soil and depend on the root system, type of soil and agrotechnical melioration. Because of that it will be interesting to correlate the levels of radionuclides in soil, honey, flowers and pollen from different bee pastures.

CONCLUSIONS

The presence of radionuclides in flowers and honey is a result of their uptake by plant root systems from the soil of bee pastures. The data obtained may provide us with the radiological situation of bee pasture areas. Significantly higher radioactivity was found in flowers than in the honey. This finding indicates that, in a nonaccidental situation, low levels of natural and man made radionuclides will be transferred from bee pasture flowers to honey.

Eight years after the Chernobyl accident the dominant radioactivity in flowers and honey, from the analyzed bee pastures, is from natural radionuclides.

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KONCENTRACIJA RADIONUKLIDA NA PČELINJIM PAŠNJACIMA I MEDU U SRBIJI

GORDANA VITOROVIĆ, IRENA PETROVIĆ I GORDANA PANTELIĆ

SADRŽAJ

U ovom istraživanju su prikazani rezultati gamaspektrometrijskih merenja aktivnosti prirodnih (^{232}Th , ^{226}Ra , ^{40}K) i proizvedenih (^{137}Cs) radionuklida u uzorcima cveta i meda, sakupljenih tokom 1994. godine, na glavnim pčelinjim pašnjacima Srbije (Lipa, Suncokret, Livada i Bagrem). Pored toga izvršena je i analiza odnosa koncentracije radionuklida u cvetu i medu.

Osam godina posle nuklearnog akcidenta u Černobilju, ustanovljen je nizak nivo aktivnosti ^{137}Cs u cvetu (2,1-6,6 Bq/kg) i medu (0,22-0,38 Bq/kg) na svim pčelinjim pašnjacima. Pri tome je odnos aktivnosti ^{137}Cs u cvetu prema medu bio oko 10-20 puta veći. Veći nivoi aktivnosti prirodnih radionuklida su izmereni i u uzorcima cvetova i u uzorcima meda, dok je odnos radioaktivnosti u cvetu prema medu bio sličan kao za ^{137}Cs . Na osnovu dobijenih rezultata, zaključeno je da, osam godina posle černobilskog akcidenta, dominantna radioaktivnost u medu i cvetu sa analiziranih pčelinjih pašnjaka, je poreklom od prirodnih radionuklida.