

RADIOACTIVITY, POLLUTING AGENT AFFECTS QUALITY OF NATURAL BEE HONEY

Iuliana Bratu, Cecilia Georgescu

“Lucian Blaga” University Sibiu,

*Faculty of Agriculture Sciences, Food Industry and Environmental Protection
7-9, Dr. I Rațiu Street, 2400, Sibiu, Romania.*

Abstract

Following nuclear accident from Chernobyl (1986), several artificial radionuclides were released in the atmosphere. ^{137}Cs and ^{90}Sr will be present in the environment particularly due to their large half-life as much as due to accumulation and transfer processes. This work involved measurements of beta global radioactivity, the amount of ^{137}Cs and ^{40}K in honey and pollen samples from Sibiu and surroundings.

Key words: *honey, pollen, radioactive elements, beta global radioactivity.*

Introduction

Nuclear experiments in the atmosphere and other peaceful activities involving use of with nuclear materials determined a certain radioactive contamination of the environment with artificial radionuclides before Chernobyl accident.

Nuclear accident from Chernobyl, which affected also Romania, had a strong impact over the environment – water, air, soil, vegetation, and as a result over food stuffs (White, 1973). ^{137}Cs and ^{90}Sr are still present in the environment particularly due to their large half-life as much as due to accumulation and transfer processes (Furnică, 1988; Mănescu, 1981).

Radioactivity, part of our natural environment, in recent years suffered some changes caused by certain industrial activities or human errors- sometimes more polluting than the others. High levels of radioactivity have a very harmful effect to human body.

Natural radio nuclides are radioactive elements present in the environment, for example ^{238}U and ^{235}U , ^{232}Th , ^{40}K , and their descendants like ^{226}Ra , ^{222}Rn . Artificial radio nuclides are radioactive elements resulted from fission reactions, like ^{131}I , ^{132}I , ^{133}I , ^{137}Cs , ^{136}Cs , ^{134}Cs , ^{89}Sr , ^{90}Sr , ^3H and ^{152}Eu (***, 1994, 1995).

^{137}C , an artificial radionuclide, emits gamma and beta radiation and has a half-life of 30 years. It mainly contaminates leaves and flowers directly from atmosphere through a fine layer of dust but also through absorption from soil. Organisms process it in a very similar way to potassium (Mănescu, 1981). It was decided to assess the effect of the radioactive clouds produced by Chernobyl incident on natural honey and pollen.

Experimental

Analysis of beta global radioactivity, amount of ^{137}Cs and ^{40}K from acacia tree honey and mixed flower honey collected from Sibiu and limitrophe areas were made.

Honey samples were tested in Radiation Hygiene Laboratory from DSP Sibiu in 1986, 1993-2002. Pollen samples were collected as shown in table 1 and analysed in 2002.

To determine sample radioactivity, physical and radiochemical methods were used. Gamma spectrometry was used to determine concentration of radionuclides that emit gamma radiation, like ^{137}Cs , ^{40}K , ^{226}Ra , etc. The gamma spectrometer used was a multi channel analyser PCA – P Oxford USA with a scintillation detector and a Quantum Assayer analyser.

For beta global radiation measurements and radiochemical analysis, samples were calcinated, and then the ash was used for further analyses. Beta global measurements represent only an approximation of the radioactive contamination and they are pursued on a very small amount of sample. A Robotron 20050 spectrometer with scintillation detector produced in Germany was used for these measurements.

The amount of ^{137}Cs , from these samples was determined by radiochemical separation of radionuclides through acid wet extraction from calcinated samples.

^{137}Cs together with ^{40}K are retained by the ammonium phosphomolybdate by adsorption through ionic exchange. Separation of ^{137}Cs is made by dissolving the precipitate in an alkaline solution followed by precipitation as salt of hexachloroplatinic acid. Filtered in vacuum, the supernatant is removed, then after drying, samples are analysed with the Robotron spectrometer.

Results and Discussions

Atmospheric depositions, starting from May 1986, were the main source of contamination of flowers and therefore of pollen harvested by bees to produce honey. All pollen samples collected in the years specified in table 1 were analysed in 2002.

The results of Cs content from the samples collected in 1986 were calculated in 2002 using formulas below, using 30 years half-life.

$$\Lambda_{2002} = \Lambda_{1986} \cdot e^{-\frac{0.693}{T_{1/2}}(t)}, \text{ with } T_{1/2} = 30 \text{ years and } t = 16 \text{ years}$$

In table 1 can be seen that the activity (Λ) for pollen in 1986 was four times larger than in 2002. This is an evidence of how severe the radioactive contamination of plants was immediately after the Chernobyl incident.

Beta global radioactivity mainly represents the activity of ^{40}K , which comes together with K ion in nature at a ratio of 0.018% (1g of K has an activity of 27.4 Bq).

Table 1. Radioactive contamination of pollen

Sample	Year of harvest	Radioactivity of Pollen [Bq/kg]		
		β - global Λ_{2002}	^{137}Cs Λ_{2002}	^{137}Cs Λ_{1986} (calculated in 2002)
1	1986	9937	9311	10011
2	1986	8116	7760	8344
3	1990	35.90	<2	-
4	2002	9.35	<2	-

Regarding radioactive contamination of honey over the years specified in table 2, below, could be mentioned that the honey from 1986 was harvested before the Chernobyl accident. From table 2 above, it is obvious that those 6 years after the nuclear accident, the values of beta global radioactivity were below 15Bq/kg, having the same order of magnitude. Radioactive contamination with Caesium is low, but present mainly due to transfer from soil into flowers and leaves, considering the 30 years half-life.

It should also take into account the natural radioactive pollution of soil as a consequence of using fertilisers based on phosphorus obtained from rocks with a large content of Uranium, Radium. This phenomenon was studied before and it proved responsible for an

increase of natural radioactivity. An evidence for this phenomenon from our experiments is the increasing value of radioactivity ^{40}K presented in table 2.

Table 2. Radioactive contamination of honey

Year of harvest	Radioactivity of honey [Bq/kg]		
	β - global	^{137}Cs	^{40}K
Before the accident 1986	14.66	-	-
1993	10.48	0.075	7.56
1994	8.59	0.069	7.12
1995	11.30	0.075	7.36
1996	10.81	0.083	7.92
1997	15.63	0.090	11.15

Conclusions

Following the nuclear accident from Chernobyl, the honey harvested during the summer of 1986 was contaminated. Through various industrial activities, natural radioactivity is continuously changing mainly by introducing natural radionuclides in soil and atmosphere, particularly using phosphates, which induces radioactive contamination of honey. In order to monitor natural pollution, measurements of beta global radioactivity for radionuclides that emit beta and gamma radiation are necessary, ^{40}K and alpha global radioactivity for radionuclides that emit alpha and gamma radiations, like uranium, radium, and thorium.

References

- Furnică, G., Toader, M. (1988). Transferul radionuclizilor în lanțul alimentar uman, ca urmare a contaminării radioactive a mediului înconjurător, *Al VI-lea Congres de Igienă, Medicina Muncii, Medicină Socială*, București.
- Mănescu, S., Dumitrache, S., Cucu, M. (1981). *Igiena mediului*, Editura Medicală, București.
- White, J.W. (1973). Toxic honeys - Toxicants occurring naturally in foods, *Washington National Academy of Science*, 495-507.
- *** - *Radioactivitatea naturală în România*, Societatea Română de Radioprotecție, București, 1994.
- *** - *Radiația artificială în România*, Societatea Română de Radioprotecție, București, 1995.