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Radionuclides in Honeybee Propolis (*Apis mellifera* L.)

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Bees and its products may be used in the monitoring of environmental pollution of insecticides, heavy metals and radioactive elements, due to its capacity to reflect immediately the environmental condition (Tonelli et al. 1990).

Propolis has been used as an alternative medicine. Bees produce propolis from the secretions of trees, flowers, leaves and pollen. Villanueva et al. (1970) compared substances of the propolis with the material in the resin of some trees and evidenced that the propolis originates from these substances.

Radioactive particles may be concentrated in the soil, contaminating the plants, insects and its products and, consequently, man as well (Matsunagaa et al. 1998; Barisic et al. 1999). Researches with natural products are increasing and it is important to warn for possible risks in the use of bee-contaminated products for human consumption.

The goal of the present research work was to investigate the presence of radioactive particles, mainly on cesium-137, in propolis samples produced in Brazil (Botucatu/SP and Goiânia/GO), Italy (Friuli-Venezia Giulia region) and Bulgaria (Sofia).

MATERIALS AND METHODS

Brazilian propolis was collected in Goiânia (Goiás State) in an apiary 20 km far from the accident of 1987, and in Botucatu (São Paulo State) in the apiary located on Lageado Farm, UNESP. Bulgarian propolis was given by Dr. Vassya Bankova, Institute of Organic Chemistry with Centre of Phytochemistry, Sofia, Bulgaria. Italian propolis was obtained from Friuli-Venezia Giulia region (Udine, Ontognano, Castions di Strada and Carnia). Propolis was produced by honeybees *Apis mellifera* L., by scrapings of hive.

Cesium-137 concentration was determined by gamma-ray spectrometry, using a low background hyper pure germanium (HPGe) semiconductor detector system coupled to a Waxstation 3100 DEC channel analyser. The spectra were recorded and analysed with a personal computer using Nuclear Data ND9900 software. Propolis samples were analysed in 500 mL plastic container during 24hours and radioactivity results were expressed in Bq/kg.

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RESULTS AND DISCUSSION

Brazilian samples from Botucatu (SP) and Goiânia (GO) did not contain cesium-137. Natural radioactive particles such as potassium-40 (156.40 and 89.95 Bq/kg, respectively) and berilium-7 (3.53 and 2.75 Bq/kg, respectively) were observed (Table 1).

Artificial ionizing radiation produced in Brazil and several countries represent a permanent risk to the environment and to man, since the generation of nuclear residues has been a serious world problem. Death of four people and contamination of hundred ones occurred in Brazil (Goiânia, Goias State) after a cesium capsule release to the environment in 1987 (Anjos et al. 2000).

However, the absence of cesium-137 in a propolis sample from Goiânia doesn't discard a possible contamination, since it was showed the cesium-137 presence in the soil in the proximity of the accident area (Anjos et al. 2000). Propolis may have been produced in a region with low or absent contamination, what difficulties the radioisotope identification.

Propolis from Botucatu was not contaminated, since it was produced in a region without radioactive problems and it was used as a negative control of the analyses.

Italian samples showed radioactive particles: Udine: cesium-137 (2.44 Bq/kg), potassium-40 (176.91 Bq/kg) and berilium-7 (19.29 Bq/kg); Ontognano: cesium-137 (2.55 Bq/kg) and potassium-40 (140.16 Bq/kg); Castions di Strada: cesium-137 (1.50 Bq/kg), potassium-40 (94.56 Bq/kg) and berilium-7 (9.58 Bq/kg); Carnia: cesium-137 (4.77 Bq/kg) and potassium-40 (125.81 Bq/kg) (Table 1).

Chernobyl accident (1986) was one of the most serious accidents occurred in the world involving nuclear reactors. The great amount of radioactive material released in the atmosphere caused relatively high contamination levels in several countries of the European continent. This contamination occurred immediately after the accident or accross of the years, and the contamination of plants species which cesium-137 and other gamma particles occurred by its soil presence, contaminating of several alimentary sources, as well as of honey (Tonelli et al. 1990; Barbattini et al. 1991; Handa et al. 1997).

Cesium-137 presences in the propolis sample from Friuli-Venezia Giulia region suggest that this particle was in the soil (Table I). Cesium-137 distribution is not homogeneous and depends on the soil type, root physiology, biochemical characteristics, dynamic uptake and its distribution on various plants organs (Nimis et al. 1988; Barbattini et al. 1991). However, these results suggest that cesium-137 is absorbed by plants and is deposited in the resin that will be collected by bees to produce propolis.

The higher level of propolis contamination by cesium-137 (14.33 Bq/kg) was observed in the Bulgarian sample. It was also observed the presence of potassium-40 (122.33 Bq/kg) (Table 1). Data in literature regarding contamination in Bulgaria are

rare. In the propolis sample analysed it was found a high cesium concentration, suggesting that this country was very affected by Chernobyl accident (Table 1).

Table 1: Radioactive concentration (Bq/kg) of cesium-137 (Cs-137), potassium-40 (K-40) and berilium-7 (Be-7) in propolis samples from different geographical regions (Brazil, Italy and Bulgaria).

Geographic origin	Radioactive particles (Bq/kg)		
	Cs-137	K-40	Be-7
Botucatu - Brazil	0.0	156.40	3.53
Goiania - Brazil	0.0	89.95	2.75
Udine – Italy	2.44	176.91	19.29
Ontognano - Italy	2.55	140.16	0.0
Castions di Strada - Italy	1.50	94.56	9.58
Carnia – Italy	4.77	125.81	0.0
Sofia - Bulgaria	14.33	122.33	0.0

Potassium-40 and berilium-7, presents in the propolis samples, are natural particles originated from soil and solar ray fission, respectively (Anjos et al. 2000).

Several researches studied the honey as radioactive contamination indicator from a region. However, the honey cesium-137 concentration shows a great variation, since it is dependent on the plant specie for nectar collection (Tonelli et al. 1990; Giovani et al. 1991; Giovani, 1994), and propolis contamination dates are rare.

Cesium-137 as a radioactive particle is of great importance for the humans, due to its half-life about 30 years and high toxicity. Its effects in man are immediate and accompanied of nauseas, headaches, burns and death. In the case of contamination with low doses, the effects appear after 15 years of the first contact as genetic alterations and cancer (Handa et al. 1997; Kezic et al. 1997). Cesium-137 concentration found in propolis samples does not cause a direct risk for health, since it is under the tolerated level. However, the radioactive particles can to accumulate in the human body for 70 – 140 days, promoting lesion or genetic alterations in the man.

The results suggest that propolis may be an environmental contamination indicator for by radioactive particles. Additional research must be conducted to understand the soil-plant-bee-propolis chain.

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