

# Influence of Ionizing Radiation on the Venom of Bee *Apis Mellifera L. Caucasia*

Sh.A. Topchiyeva, F.Z. Mammadova

Institute of Zoology of Azerbaijan National Academy of Sciences  
Pass.1128, block 504, Baku, AZ 1073, Azerbaijan

Received: April 3, 2014

Accepted: May 14, 2014

---

## ABSTRACT

Experimental studies have revealed the effect of gamma-radiation on the waste products of the honeybee *Apis mellifera L. Caucasia*. Determination of content and activity of the radionuclides and in the products of ability to live of bee *Apis mellifera caucasia* was conducted at  $\gamma$ -spectrometer "Canberra" with a plenary Ge-detector.

Higher activity of  $U^{238}$  and  $K^{40}$  isotops was determined in the products of life honeybee *Apis mellifera L. Caucasia*. Terms of radiation sterilization venom of bees and their metabolic products will be offered to pharmaceutical companies manufacture products based on them.

**KEYWORDS:** *Apis mellifera L. Caucasia*, bee, venom, environment,  $\gamma$ -radiations.

---

## 1. INTRODUCTION

Environmental contamination gets recently more menacing character and is accompanied by heavy irreversible consequences for all live on the Earth. The pollution of biosphere by technogen pollutants of the industrial plants conducts to saturation of an atmosphere toxic substances, which in turn influence on pharmacological properties of biologically active materials, produced various insects. Pharmacological properties of biologically active substances of insects under influence of ecological factors strongly vary. Among 50000 toxicant insects a bee was received recognition as source of biologically active materials. Melliferous bee *Apis mellifera L. Caucasia* is widely spread in Azerbaijan. Products of its vital activity are venom, wax, honey, parent milky, propolisum, bee-bread. The basic toxic substance is mellitin, molecular weight 2840. Important components: apamin, phospholipase  $A_2$  [1, 2, 3].

All growing interest to an apitherapy promotes to the scientific approach to application of bee-growing yields having the important value in conservation of health of the man, and also more penetrating study of physicochemical properties of yields of vital activity of bees and beekeeping. The bee's venom and its composite substances: apamine, mellitin, till 10 groups phospholipase and hyaluronidase, methionine, cystine, mineral salts and some other compounds. However chemical composition precisely is not fixed and in study of this valuable yield of vital activity of bees, for a pharmaceutical industry is unlimited and there are many more unknowns aspects. Venom of bees renders not only local action, but also promotes a lot of processes inside organisms. The apitherapy helps the man in struggle with many diseases, mobilize of force of a nature for support of health of the man. It is possible to receive poison 4 times for a season and therefore to collect about 2 gram of bees venom from family. Important value has increase in a period of storage of venom, and also products of ability to live of bees [4, 5].

Rachinsky A., Tobe S.S., Feldlaufer M.F. studied influence of JH biosynthesis in the honey bee (*Apis mellifera L.*): developmental changes in sensitivity to JH precursor and allatotropin. The analysis of in vitro activities of the involved enzymes, O-methyltransferase and methyl farnesoate epoxidase, remained inconclusive [6].

Nocelli R.C., Roat T.C., Cruz-Landim C. venom gland of queens of *Apis mellifera* was examined through light and transmission electron microscopy and subjected to electrophoreses analyses. The secretion produced was birefringent under polarized light and of the electrophoresis analysis of glandular extracts revealed five main protein bands. In mated queens, the venom gland exhibited a high degree of degeneration. Its secretion of the birefringent under polarized light and one of the basic protein bands were not detected by electrophoreses separation at electrophoregram product [7].

Many questions on influence of  $\gamma$ -radiation and other ionizing radiation on a live organism and venom of bees are important for technology of radiating sterilization of medical products on the basis of venom of bees *Apis mellifera L. Caucasia*.

Research of biological effects radiating on the venom of bee, are actual and represent fundamental value from the point of view of finding-out of mechanisms of action, and working out of preventive measures from possible harmful influence.

## 2. The purpose of research.

The purpose of research is studying of influence of gamma radiation on of venom of *Apis mellifera L. Caucasia*.

---

\* **Corresponding Author:** Sh.A. Topchiyeva, Institute of Zoology of Azerbaijan National Academy of Sciences, Pass.1128, block 504, Baku, AZ 1073, Azerbaijan. Email:shafiga.topchiyeva@mail.ru,

### 3.MATERIALS AND METHODS.

Determination of content and activity of the radionuclide's and quantity of heavy metals in the products of ability to live of bee *Apis mellifera* L. *Caucasica* as well as, in the tests of soil, plant and water, taken from the habitation place of the bees under study, was specified at "Canberra"  $\gamma$ -spectrometer with a plenary Ge-detector.

Uranium-ion concentration in solution was determined on gamma-spectrometer of Canberra (USA) Company with high purity germanium detector (HP Ge). Activities of uranium isotopes are determined according to the following peaks on gamma-spectrometer.

### 4. RESULT AND DISCUSSION

Uranium-ion concentration in solution was determined on gamma-spectrometer of Canberra (USA) Company with high purity germanium detector (HP Ge). Activities of uranium isotopes are determined according to the following peaks on gamma-spectrometer. Activity of  $^{235}\text{U}$  was determined according to gamma peak with 185.7 keV energy and 54, and activity of  $^{238}\text{U}$  isotope according to gamma peak with 1001.03 keV energy and 0.59% yield of metastable  $^{234}\text{Pa}$  isotope which is its daughter nucleus. It should be mentioned that activity of  $^{238}\text{U}$  isotope in the solution before sorption can be determined on gamma-spectrometer.

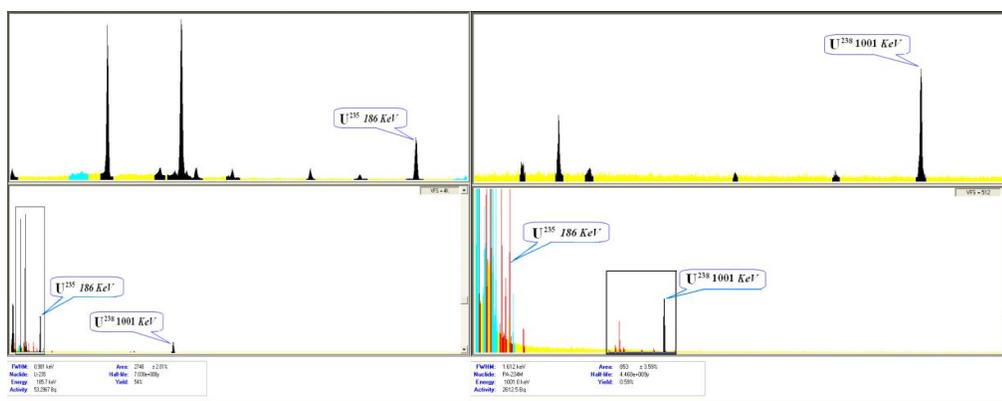


Fig. 1. Spectra of Uranium-ion concentration in solution

As chemical properties and sorptive powers of protactinium and uranium elements differ and radioactive disequilibrium among  $^{234}\text{Pa(m)}$  and  $^{238}\text{U}$  isotopes in the solution after sorption, the activity of  $^{238}\text{U}$  isn't possible to be determined according to the activity of  $^{234}\text{Pa(m)}$  isotope (fig. 1).

Radiation activity of elements in samples of products of ability to live of melliferous bee *Apis mellifera* L. *Caucasica* collected in the Ganja-Gazakh region of Azerbaijan republic on fig.1 „Canberra“  $\gamma$ -spectrometers with HP Ge detector. It was determined the activity of radionuclide's ( $\text{K}^{40}$ ,  $\text{Ra}^{226}$ ,  $\text{Th}^{232}$ ,  $\text{Cs}^{137}$ ,  $\text{U}^{235}$ ,  $\text{U}^{238}$ ) in the samples of products of ability to live of melliferous bee *Apis mellifera* L. *Caucasica*, soil, plant and water samples taken from the Shirvan region of the Azerbaijan Republic.

For measurement of radiation of activities element, following operations was fulfilled: 1) Petri dishes was weighed; 2) Petri dishes with samples was weighed; 3) the weights of the enumerable sample on a difference of weights was found out; 4) chemical dishes with samples in the device gamma –spectrometer “Canberra” was placed, the cover was closed with leadprotection and the radiation activities of sample was measured. Statistical data processing was carried out by the software gamma-spectrometer "Canberra".

In table 1 the results of analysis of natural radionuclide's in samples of products of ability to live of melliferous bee *Apis mellifera* L. *Caucasica*, taken from the investigated regions is given.

Table 1.

Results of analysis of natural radionuclide's in samples of venom of bee *Apis mellifera* L. *Caucasica*

Element, mBk/g	1	2	3
$\text{Cs}^{137}$	MDA=0.315	$1.7 \pm 0.6$	$0.47 \pm 0.16$
$\text{Ra}^{226}$	$2.40 \pm 0.85$	$5.31 \pm 0.89$	$1.40 \pm 1.27$
$\text{Th}^{232}$	$1.78 \pm 0.09$	$2.70 \pm 0.54$	$1.03 \pm 0.45$
$\text{K}^{40}$	$25.8 \pm 1.5$	$54.8 \pm 8.1$	$10.8 \pm 1.7$
$\text{U}^{235}$	$3.01 \pm 0.05$	$10.1 \pm 0.09$	$17.18 \pm 0.95$
$\text{U}^{238}$	$60.5 \pm 1.2$	$203.0 \pm 1.8$	$345.3 \pm 2.24$



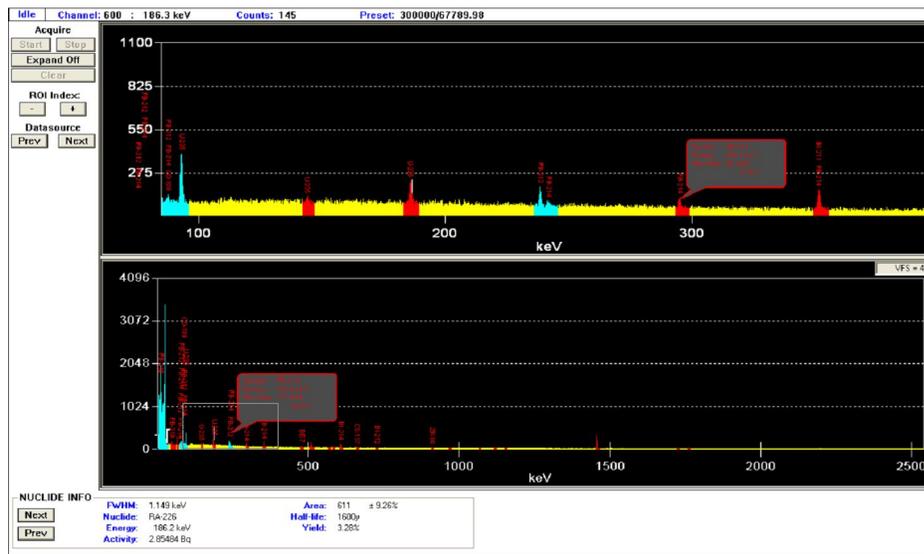


Fig.4. Spectra of radionuclides in samples of products of ability to live of melliferous bee *Apis mellifere* Caucasia

In fig.5 and fig.6 the spectra of radionuclides in the plant and water samples were presented. As you see from the spectra, the activity of  $Pb^{212}$  element in the composition of the investigated plant and water is insignificant.

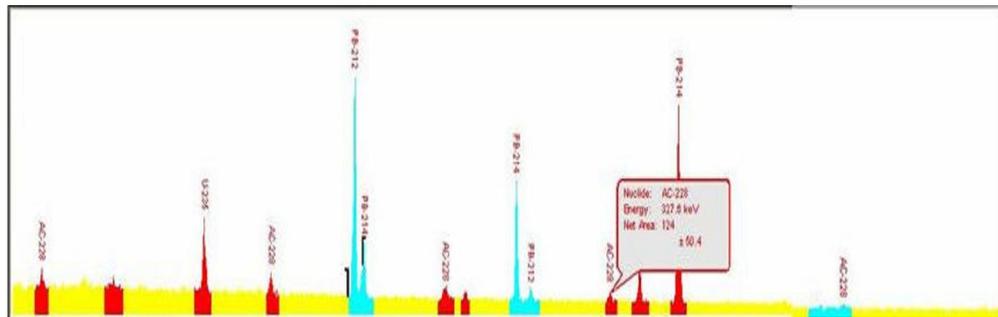


Fig.5. Spectra of radionuclides in the plant samples

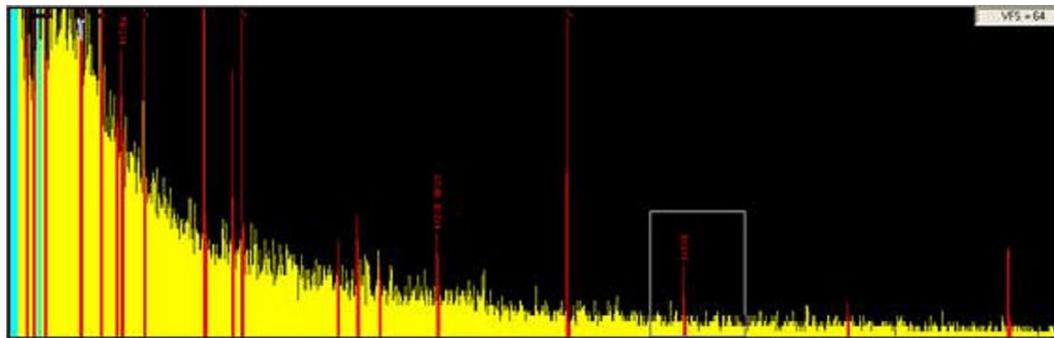


Fig.6. Spectra of radionuclides in the water samples

Local contamination areas were revealed. The topsoil (0-5cm) is more contaminated by natural radionuclides. A considerable  $K^{40}$  isotope activity was revealed in the soil samples, on the base of which it can be assumed that the presence of radioactive elements in the sample is connected with their presence in soil which is the habitation area of these insects (table 2).

Table 2.  
Radionuclide's activity on the composition of the sample

Sample	pure soil	Soil 2	Plant	Water
Radionuclide	$K^{40}$	$Bi^{212}$	$Pb^{212}$	$Pb^{212}$
Radiation activity, Bk /kg	-	2.497	0.135	-

The effect of radiation on the waste products of the honey bee *Apis mellifera* L. *Caucasica* was revealed. Activities  $U^{238}$  and  $K^{40}$  isotopes was determined in the products of the honey bee *Apis mellifera* L. As a result, conducting scientific research revealed the effect of radiation on biologically active products synthesis bees. The impact of environmental pollutants on biochemical parameters metabolic products of bees, in turn, reflected on the pharmacological properties of the venom. It is essential for pharmaceutical companies in the manufacture of drugs based on the venom of bees.

## 5. CONCLUSION

Analyzing the literature data it should be noted the lack of scrutiny of the problem . So a new line of research appeared after the discovery that animals could be partially protected against deleterious effects of ionizing radiation by administration of certain specific chemical compounds.

Since 1949, a great deal of research has been conducted on the radioprotective action of chemical substances which reduce mortality if administered to mammals prior to exposure to a lethal dose of radiation. This fact is of considerable importance since it permits reduction of radiation-induced damage as well as provides prophylactic treatment for damaging effects caused by of radiotherapy [8].

Varanda, E. A. et all (1992) animals (Wistar rats) weighing about 100 g were injected intraperitoneally with different venom concentrations (1.0 or 0.5  $\mu$ -l) 1 or 24 h before, or 30 min after being submitted to 3 or 4 Gy of gamma radiation, and sacrificed 24 h after the last treatment. A decrease in the frequency of chromosome aberrations, and fragments in particular, as well as in the number of cells with aberrations was observed in the experiments in which venom was administered 24 h before irradiation, and the effect more marked at the higher venom concentration (1  $\mu$ -l/100 g weight) [9].

Gamma radiation is a technique that can be used to decrease the number of microbiological problems associated with food and increase the shelf life of certain products. This study was to verify the effect of gamma radiation with source of cobalto-60 (10 kGy) on some parameters used in honey quality control. The physicochemical parameters analyzed were: moisture, HMF, free acidity, pH, sugars and ash. The results showed that gamma radiation, in the dose(10 kGy) , did not cause significant physicochemical alterations. [10]

Thus, as a result of the lead researches the followings were revealed:

- influence of gamma-radiations on venom of *Apis mellifera caucasica*;
- influence of ecological factors on qualitative and quantitative structure of venom honeybee;
- influence of gamma radiation on biochemical characteristics of venom bee that is in turn reflected and on their pharmacological properties.

The obtained data are important in the identification of as bee venom, as well as their metabolic products.

## REFERENCES

1. Krylov V., Koriagin A., Sinelchicov A. The XXXIV International apicultural Congress. Apimondia Publishing Hous Bucarest, Romania. 1995: 390.
2. Pikayev A.K., Modern radiating chemistry. A firm body and polymers. Applied aspects. A science, Moscow, 1987: 448.
3. Bankov V.I., 2004, Electromagnetic information processes of biosphere. Ekaterinoburg, 208p.
4. Topchiyeva Sh.A., Mammadova F.Z. Study the effects of environmental pollutants (oil) on the waste products of the honeybee (*Apis Mellifera* L. *Caucasica*) by gas chromatography. Bulletin of Zaporizhyya National University. 2012, №2, p. 35-40.
5. Topchiyeva Sh.A., Mammadova F.Z. Effect of gamma radiation on the produkt life of honeybees (*Apis mellifera* L, *Caucasica*). J. Bulletin of Zaporizhyya National University. 2012. №3, p. 66-71.
6. Rachinsky A., Tobe S.S., Feldlaufer M.F., 2000, Terminal steps in JH biosynthesis in the honey bee (*Apis mellifera* L. ): developmental changes in sensitivity to JH precursor and allatotropin. *Insect Biochem. Mol.Biol.*, 30(8-9): 729-737.
7. Nocelli R.C., Roat T.C., Cruz-Landim C., 2006, The venom gland of queens of *Apis mellifera* (Hymenoptera, Apidae): morphology and secretors cycle. *J. Micron.* 37(8): 717-723.
8. VARANDA E. A., TAVARES D. C., 1998, Mechanisms and radioprotective agents including honey bee venom. *Journal of Venomous Animals and Toxins. Botucatu.* 4 (1)
9. Varanda, E. A.; Takahashi, C. S.; Soares, A. E. E.; Barreto, S. A. J., 1992, Effect of *Apis mellifera* bee venom and gamma radiation on bone marrow cells of Wistar rats treated in vivo. *J. Revista Brasileira De Genetica.* 15(4): 807-819.
10. Bera A., Almeida-Muradian L.B., Sabato S.F., 2009, Effect of Gamma Radiation on Honey Quality Control. *J. Radiation Physics and Chemistry,* (78): 583-584.