Natural Radioactivity concentration of peanuts in Osmaniye-Turkey

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Abstract. The peanut is grown in Osmaniye where located in southern Turkey. Due to it is grown underground, the measurements of natural radioactivity of peanuts become important. For this reason some peanut samples have been collected from different places of Osmaniye and the measurements of natural activity concentrations for ^{40}K, ^{226}Ra and ^{232}Th in some peanuts samples have been carried out using a NaI(Tl) gamma-ray spectrometer. Activity of ^{40}K was measured from its intensive line at 1460 keV, for ^{226}Ra activity peak from ^{214}Bi at 1760 keV and ^{232}Th activity, peak from ^{208}Tl at energy of 2610 keV was used.

Keywords: Natural Radioactivity, Peanut, NaI(Tl) gamma-ray spectrometer, Osmaniye
PACS: 29.30.Kv, 34.50.Bw

INTRODUCTION

Natural radioactivity arising from natural sources is the main contribution to the annual dose received by the world's population, exposure resulting from radionuclides inherent in the earth's crust and from cosmic rays. The terrestrial radionuclides are ubiquitous, belonging to the ^{238}U and ^{232}Th series and their decay products as well as single decay radionuclides, particularly ^{40}K. Gamma radiation emitted from such naturally occurring radionuclides in all ground formations represents the main external exposure to human body [1]. The knowledge of concentrations and distributions of the radionuclides in these materials of the radionuclides is of interest since it provides useful information in the monitoring of environmental radioactivity. Natural environmental radioactivity and the associated external exposure due to gamma radiation depend primarly on the geological and geographical conditions, and appear at different levels in the soils of each region in the world [2-4].

Osmaniye is located in the Eastern side of Mediteranean Region. It holds the climatic characteristics of the same region and arises with Middle Taurus Mountains from west to North and with Amonos Mounations in East and West-east parts and is situated between 35^{o}.52'-36^{o}.42' east longitudes and 36^{o}.57'-37^{o}.45' north latitudes. In this study, the natural radioactivity concentrations ^{40}K, ^{238}U (^{226}Ra) and ^{232}Th in some peanut samples collected in Osmaniye have been investigated.

2nd International Advances in Applied Physics and Materials Science Congress
AIP Conf. Proc. 1476, 245-248 (2012); doi: 10.1063/1.4751603

EXPERIMENTAL DETAILS

In this study, peanut samples have been collected from 5 different places of Osmaniye region of Turkey. In Figure 1 the location of Osmaniye in Turkey in which samples were collected has been shown. After collection of samples, they were crushed and dried until 100^{o}C in an oven for about 24 h. The dried samples have been filled in a cup which is sealed tightly with a thick tape around its neck to limit any gas escape from it, and stored for four weeks to get secular equilibrium to be achieved between ^{238}U and its progeny [5].

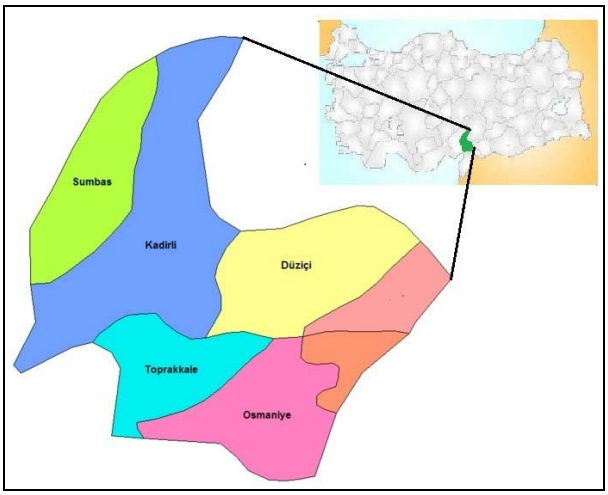

FIGURE 1. Schematic view of the experimental setup

The radioactivity ^{226}Ra, ^{232}Th and ^{40}K in the peanut samples was determined using a gamma ray spectrometry [6] consisting of a 3"x3" NaI(Tl) detector connected to a 16384 channel multi channel analyser (MCA). Before measurement the system should be calibrated. This is done using ^{137}Cs and ^{60}Co radioactive sources, which produce γ-ray energy of 662, 1173 and 1332 keV, respectively. The γ-ray spectrum obtained from the mentioned source and related fit has been displayed in Figure 2.

The spectrum is analyzed using the Genie2k obtained from Canberra. The measurement was based on recording natural radioactivity quantities of three natural long-live elements: ^{226}Ra, ^{232}Th and ^{40}K which are considered the photopeaks at 1760, 2610, 1461 keV respectively, in the natural γ-ray spectrum [5]. The samples were counted for a period of 40000 s and the spectra are analyzed for the photopeaks of ^{226}Ra, ^{232}Th and ^{40}K. A typical spectrum obtained for this kind of measurement has been shown in Figure 3, where ^{226}Ra, ^{232}Th and ^{40}K peaks can be clearly seen.

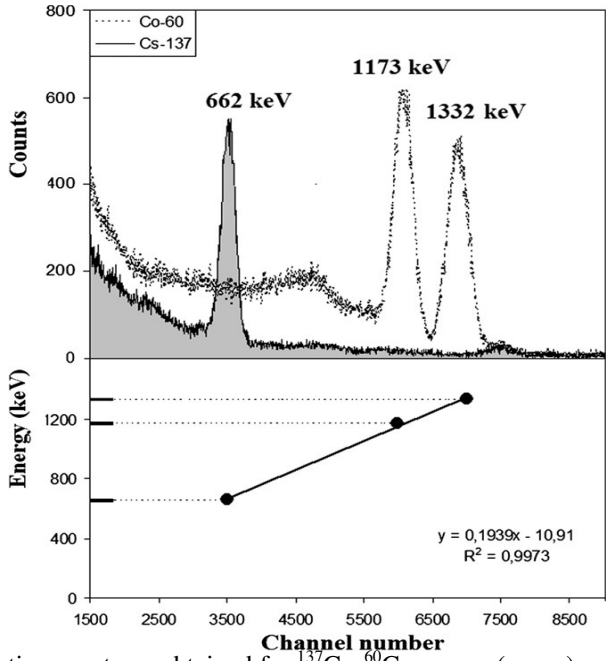

FIGURE 2. Calibration spectrum obtained for ^{137}Cs, ^{60}Co source (upper) and related fit (lower).

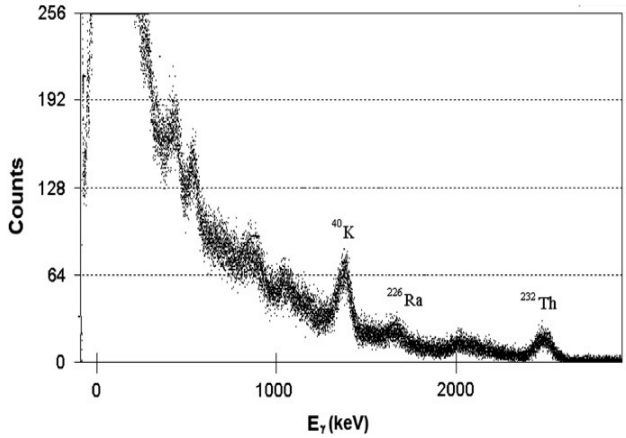

FIGURE 3. A typical gama spectrum for

The activities for the natural radionuclides were calculated using the following relation [7]:

$$A = \frac{NPA}{\varepsilon . \gamma . t . m} \qquad (1)$$

where A is the activity of the radionuclide in Bq/kg, N is the net peak area under the most prominent photo peaks calculated by subtracting the respective count rate from the background spectrum obtained for the same counting time. The net count rate in the measurement is calculated from the background subtracted area of prominent gamma ray peaks. ε is the detector efficiency of the specific gamma ray, γ the absolute transition probability of gamma decay, t the counting time (s) and m the mass of the sample (kg).

RESULTS AND DISCUSSION

The activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K in five different peanuts grown in different places of Osmaniye (Turkey) have been measured. The results have ranged, from 21,678-67,214 Bq/kg for ^{226}Ra, from 6,891-24,396 Bq/kg for ^{232}Th and from 193,274-273,884 Bq/kg for ^{40}K. The obtained results have been displayed in Figure 4.

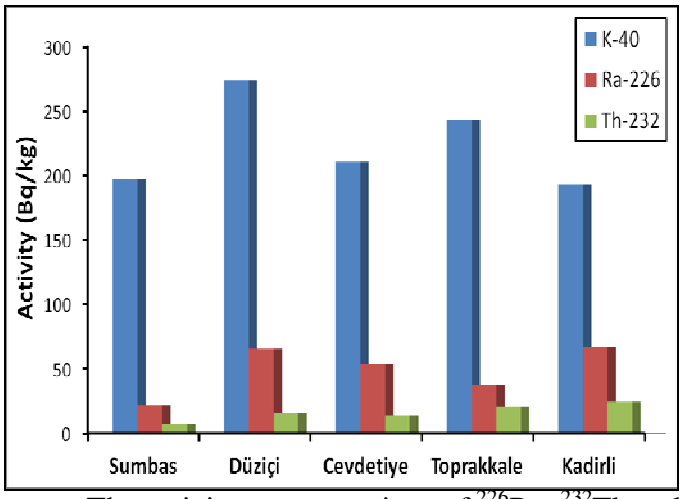

FIGURE 4. The activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K

REFERENCES

1. Santawamaitre, T., Malain, D., Al-Sulaiti, H.A., Matthews, M., Bradley, D.A,. Regan, P.H., 2010. Study of natural radioactivity in riverbank soils along the Chao Phraya river basin in Thailand. Nuclear Instruments and Methods in Physics Research A 652, p:920–924.
2. Abbady, A., Ahmed, N.K., El-Arabi, A.M., Miche, R., El-Kamel, A.H., Abbady, A.G.E., 2006. Estimation of radiation hazard indices from natural radioactivity of some rocks. Nuclear Science and Techniques 17 (2), p:118–122.
3. El-Arabi, A.M., Ahmed, N.K., El-Kamel, A.H., 2000. Gamma spectroscopic analysis of powdered granite samples in some Eastern desert's areas. In: Proceedings of the Fifth Radiation Conference, 5–9 November 2000, Cairo, Egypt.
4. Abd El-mageed, A.I., El-Kamel, A.H., Abbady, A., Harb, S., Youssef, A.M.M., Saleh, I.I., 2011. Assessment of natural and anthropogenic radioactivity levels in rocks and soils in the environments of Juban town in Yemen. Radiation Physics and Chemistry 80, p:710–715.
5. Akkurt, I., Oruncak, B., Gunoglu,K., 2010. Natural radioactivity and dose rates in commerciallyused marble from Afyonkarahisar – Turkey. International Journal of the Physical Sciences Vol. 5 (2), p:170-173.
6. Akkurt, I., Mavi, B., Akyıldırım, H., Günoglu, K., 2009. Natural radioactivity of coals and its risk assessment. International Journal of Physical Sciences Vol. 4 (7), p:403-406,
7. Armani, D., Tahtat, M., 2001. Natural radioactivity in Algerian building materials. Appl. Radiat. Isotopes 54, p:687-689.