

## Estimation of Radiation Doses, Hazard Indices and Excess Life Time Cancer Risk in Dry Legumes Consumed in Basrah Governorate/Iraq

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## Abstract:

The radioactivity levels of  $^{238}$ U,  $^{232}$ Th,  $^{40}$ K and  $^{137}$ Cs were determined in 13 brands of dry legumes (7 brands of lentils and 6 brands of beans) consumed in Basrah, Iraq. This paper showed a comparison of the gamma absorbed dose rates (D), annual effective dose equivalent (AEDE) and the excess lifetime cancer risk (ELCR) for various types of dry legumes (lentils and beans) measured by SAM940-2G operating with BNC 2"x2" gamma-ray NaI(Tl) detector along with thermoluminescence technique. For lentils samples, the minimum specific activity values of  $^{238}$ U,  $^{232}$ Th and  $^{40}$ K were 0.178±0.376 Bq/kg (at sample L1) and 233.321±0.055 Bq/kg (at sample L1) respectively, while the maximum values of the same isotopes were 2.594±0.119 Bq/kg (at sample L6), 13.672±0.247 Bq/kg (at sample L4) and 452.134±0.043 Bq/kg (at sample L5) respectively. The averages (±SD) of  $^{238}$ U,  $^{232}$ Th and  $^{40}$ K in all lentils samples. For beans samples, the minimum specific activity values of  $^{238}$ U,  $^{232}$ Th and  $^{40}$ K in all lentils samples. For beans samples, the minimum specific activity values of  $^{238}$ U,  $^{232}$ Th and  $^{40}$ K in all lentils samples. For beans samples, the minimum specific activity values of  $^{238}$ U,  $^{232}$ Th and  $^{40}$ K in all lentils samples. For beans samples, the minimum specific activity values of  $^{238}$ U,  $^{232}$ Th,  $^{40}$ K and  $^{137}$ Cs were 0.254±0.412 Bq/kg (at sample B3), 0.140±0.070 Bq/kg (at sample B2), 235.674±0.054 Bq/kg (at sample B2) and 0.010±0.829 Bq/kg (at sample B4) whereas the maximum values of the same isotopes were 1.043±0.412 Bq/kg (at sample B6), 2.994±0.141 Bq/kg (at sample B5), 429.390±0.044 Bq/kg (at sample B1). The averages (±SD) of  $^{238}$ U,  $^{232}$ Th,  $^{40}$ K and  $^{137}$ Cs in beans samples were 0.611±0.311 Bq/Kg, 1.114±0.930 Bq/Kg, 353.446±67.732 and 0.212±0.232 Bq/Kg, respectively. Various radiation hazard indics including the radium equivalent activity (Ra<sub>eq</sub>), the ingestion effective dose (H<sub>T,r</sub>), the internal hazard index (H<sub>in</sub>

Keywords: Radioactivity, Excess Life Time Cancer Risk, Thermoluminescence (TL), SAM940, Dry Legumes, Basrah Governorate

## **INTRODUCTION**

In Health Physics, radiation dosimetry is defined as the measurement of radiation levels that impact on a human health [1,2]. The world population is subjected to the different types of radiation sources including artificial radiation (15%) and natural radiation (85%) which contains food and drinks (11%). This may give a chance to the contamination of radioactive materials [2,3]. Natural occurring radioactive matter (NORM) is found in soil. In fact, NORM can be moved from soil to plants. Thus, each sort of food may have some amount of radioactivity in it. Most types of food have the following isotopes and their daughter products; uranium-238 ( $^{238}$ U), thorium-232( $^{232}$ Th) and potassium-40 ( $^{40}$ K) [4]. However, foodstuffs radioactivity can also be affected by man-made radiation. Caesium-137 (<sup>137</sup>Cs) which made through nuclear accidents and processes is an example of anthropogenic radionuclides [5]. Dry legumes (lentils and beans) are classified as foodstuffs that frequently consumed by inhabitants of Basrah, Iraq. Safe foodstuffs and consumer protection are responsibility of governments in all over the world [6,7]. This study is critical in determining the risk of radiation on human and essential in creating rules and procedures involving to radiation protection. It is critical for measuring the radiation levels that affect Iraqi population. That is because there is always a risk from the excessive exposure of the radiation. That is why the study is significant to be done. Radioactivity measurements in foodstuffs are extremely significant for monitoring radiation risks on human health [8]. This paper is aimed to create radiological baseline data of the hazard radiation in involved dry legumes (lentils and beans) samples in Basrah/Iraq. This aim to be achieved the radioactivity levels and radiation hazard indices of consumed lentils and beans types in Basrah, Iraq are essential to be calculated and investigated.

## MATERIALS AND METHODS Sample collections and preparations

Thirteen dry legumes samples including lentils and beans were selected and then all samples were purchased from central market and different supermarkets in Basrah governorate as showing in the Table 1.

Table 1: Significant	information	about all	lentils and	beans
samn	les involved	in this stu	dv	

Sample number	Sample code	Sample commercial name	Sample origin country
1	L1	Green Lentils/ Bil Bak	Canada
2	L2	Red Lentils	Egypt
3	L3	Hana	Iraq
4	L4	Zer	Turkey
5	L5	Nakhil	Turkey
6	L6	Altunsa	Turkey
7	L7	Nawras	Canada
8	B1	Nawras	Argentina
9	B2	Altunsa	Egypt
10	B3	Golden	Iraq
11	B4	Hana	Iraq
12	B5	Korjia	Ethiopia
13	B6	Zer	Kyrgyzstan