# Assessment of natural radioactivity levels and annual equivalent doses in some milk powdered samples for adults used in Baghdad

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**Abstract**

In this paper the specific activity of $^{238}U$, $^{232}Th$ and $^{40}K$ radionuclides were determined by sodium iodide enhanced by thallium NaI(Tl) detector and assessment the annual effective dose in samples of powder milk from different companies such as Almunaish, Seven Caw, Molty and Altunsa for adult available in Baghdad markets. The specific activity of $^{40}K$ has the greater value in all the samples which is in the range of allowed levels globally that suggested by UNSCEAR. The mean value of annual effective doses were 0.121, 0.314775 and 0.305 mSv/y for $^{238}U$, $^{232}Th$ and $^{40}K$ respectively.

**Key words**

*Natural Radionuclides, Powdered milk, Contamination, Ingestion, Annual effective Dose.*

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## تقييم مستويات النشاط الإشعاعي الطبيعي والجرعات المكافئة السنوية في بعض عينات الحليب المجفف للكبار المستخدمة في بغداد

**باسم خلف رجه**

قسم الفيزياء، كلية العلوم للبنات، جامعة بغداد، بغداد، العراق

**الخلاصة**

في هذا البحث تم تحديد الفعالية النوعية لنويدات اليورانيوم - 238، الثوريوم – 232 والبوتاسيوم – 40 بأستخدام كاشف ايوديد الصوديوم المطعم بالثاليوم NaI(Tl) وتخمين الجرعة المكافئة السنوية في نماذج من مسحوق الحليب المنعش وسبع بقرات ومولتي والتونسا للبالغين والمتوافرة في اسواق بغداد. معدل الفعالية الاشعاعية الناتج من البوتاسيوم – 40 هو الأعلى في جميع العينات التي تم دراستها. متوسط الجرعة الفعالة السنوية المحسوب هي 0.121، 0.314775 و 0.305 ملي سيفرت / سنة لـ اليورانيوم - 238، الثوريوم – 232 و البوتاسيوم – 40 على التوالي.

## Introduction

The purpose of the measurements of radiation in food and the environment is of principal importance in the prevention of radiation in order to protect humans from contaminated food and polluted environment as a result of nuclear activities [1], and thus protected food and the environment and appropriate non-contaminated with radioactive materials as a result of the disposal of these materials operations both during the process of nuclear activity or after it ends [2], thus identification and appropriate disclosure of the existence and nature of the radioactive material in food or environmental goals to take preventive measures or appropriate treatment through knowledge paths of

radioactive material from the source until they reach the food or the environment [3, 4].

The measurements of radiation in food and the environment, it is always advisable to be the amount of pollution in the food measure on the basis of measuring the amount of pollution in the different varieties of food each separately and based on the consumption pattern of these items where the process of analysis of the amount of the overview of the impact of the consumption of these types of radioactive materials, as well as to familiarity with the style of the production of these food items and the environment that produces it, and this includes familiarity with complementary operations of the production process or direct preparation before consumption [5, 6].

Food varieties such as milk, meat, grains, fruits, vegetables and others may be exposed to contamination with radioactive material process within the food chain start-up of the plant and soil until the final consumption and to find out how much of this pollution [7], it must be sampling of these items in addition to the samples of soil, water and air, for example milk substance and that is consumed on a large scale has been contaminated as a result of animal ureter grazing of herbs that have been polluted, directly as a result of loss of radioactive material directly or through its transition from the soil as a result of loss deposited in the depths or through contaminated breathing air or drinking contaminated water hence become the need to deal with more than a source of samples to be measured and analyzed to see how much the concentration of radioactive material in them [8, 9].

The aim of current work is measuring specific activity for $^{238}U$, $^{232}Th$ and $^{40}K$ in samples of powdered milk; Almunaish, Seven Caw, Molty and Altunsa in the local markets of Baghdad city in 2014 and the calculation of the annual effective dose resulting from the presence of these radioactive isotopes using a gamma spectrometry, NaI (Tl) detector, this work is necessary in the viewpoint radiation protection and the search for the presence of natural radioactive elements in food covered by the humans.

**Experimental part**

In this paper samples: Almunaish, Seven Caw, Molty and Altunsa for adults available in Baghdad markets were prepared in 1kg for each sample. Techniques that used to determine NORM in milk powdered samples, gamma spectroscopy with sodium iodide (NaI(Tl)) detector which are calibrated for a period of 3600 seconds, and completely isolated by lead shield [10].

**Radiation weighting factor**

The absorbed dose in tissue or organ in the relative biological effectiveness of radiation in causing indiscriminate effects at low doses is called equivalent dose. The radiation weighting factor for photons equal to 1 [11].

The annual intake *Int*. (Bq. $y^{-1}$) from taking milk for adult consuming 200 gm/day is considered by equation [11];

$$Int.\ (Bq.y^{-1}) = S.P\ (Bq/kg)\ X\ 365\ X\ intake\ of\ milk\ in\ one\ day \quad (1)$$

The annual effective dose AED. in Sv/y to the public can be given according to ICRP [12];

$$AED\ (Sv.y^{-1}) = CDC\ (Sv.Bq^{-1})\ X\ Int.\ (Bq.y^{-1}) \quad (2)$$

CDC is the coefficient of dose conversion for ingestion of radionuclide ($Sv \cdot Bq^{-1}$).

For adults, the coefficient of dose conversion CDC were recommended

for $^{226}Ra$, $^{232}Th$ and $^{40}K$ were $2.8 \times 10^{-7}$, $2.3 \times 10^{-7}$ and $6.2 \times 10^{-9}$ $Sv \cdot Bq^{-1}$ respectively [13]. The annual effective dose due to the intake were calculated by using Eq. (3).

**Results and discussion**

Specific activity of uranium-238 series, thorium – 232 and potassium – 40 in samples of powdered milk for adult are listed in Table 1.

***Table 1: The specific activity of $U^{238}$, $Th^{232}$ and $K^{40}$ in Bq/kg in all powdered milk samples.***

| Sample | U-238 Bq/kg | Th-232 Bq/kg | K-40 Bq/kg |
|---|---|---|---|
| Almunaish | 10.84 | 21.8 | 753.6 |
| Seven Caw | 3.74 | 5.35 | 716 |
| Molty | 3.57 | 20.16 | 795.82 |
| Altunsa | 5.54 | 27.68 | 430.33 |
| Average | 5.9225 | 18.7475 | 673.9375 |

Table 1 represents the average value of specific activity of $^{238}U$ were 5.9225 Bq/kg, the maximum value were 10.84 Bq/kg in Almunaish sample while the minimum value were 3.57 Bq/kg in Molty sample. The mean value of specific activity for $^{232}Th$ were 18.7475 Bq/kg, the maximum value were 27.68 Bq/kg in Molty sample while the minimum value were 5.35 Bq/kg in Seven Caw sample. The mean, maximum and minimum values of specific activity for $^{40}K$ were 673.9375, 795.82 and 430.33 Bq/kg respectively, the maximum and minimum value were appeared in Molty and Altunsa sample respectively.

Figs. 1, 2 and 3 show that the specific activities of $^{238}U$, $^{232}Th$ and $^{40}K$ in the different samples.

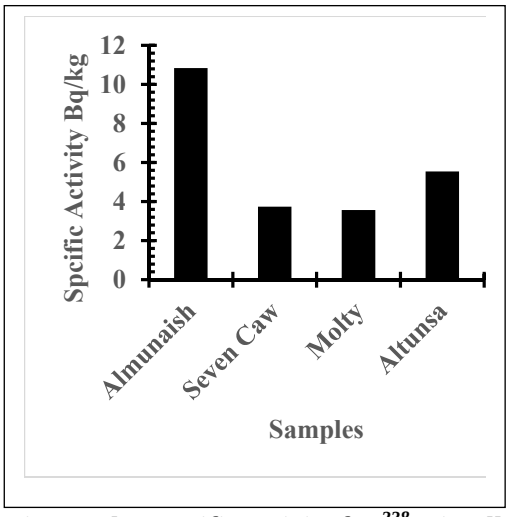


***Fig. 1: The specific activity for $^{238}U$ in all samples.***

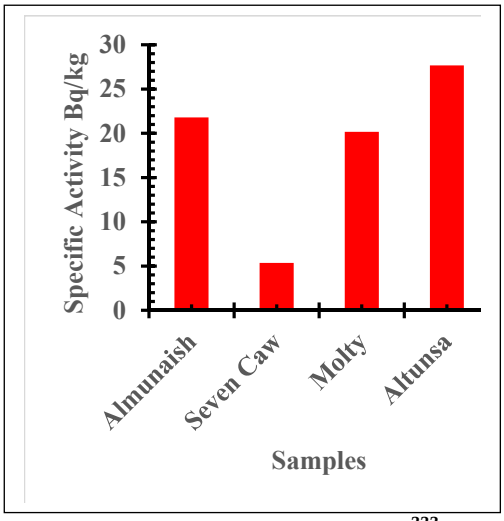


***Fig. 2: The specific activity for $^{232}Th$ in all samples.***

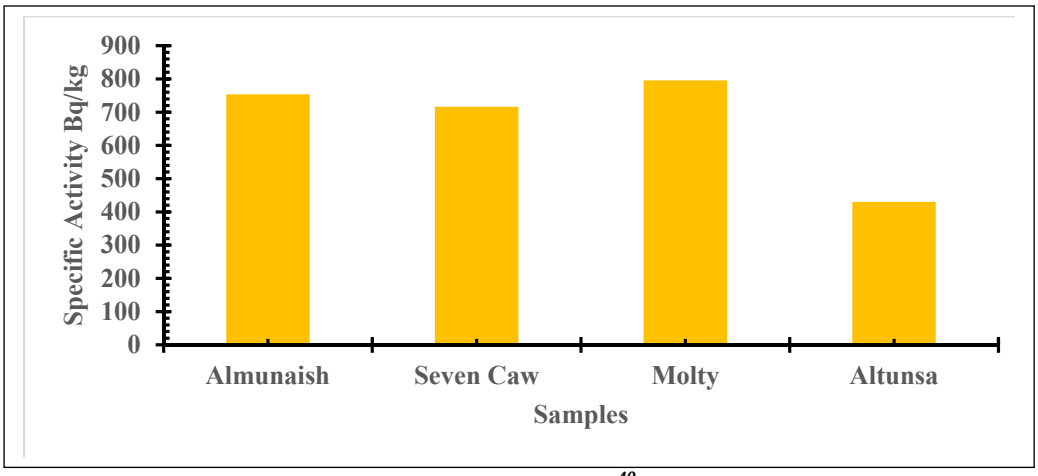


***Fig. 3: The specific activity for $^{40}K$ in all samples.***

The annual effective dose AED in mSv/y were calculated by Eq. (2) and listed in Table 2. Table 2 shows the maximum value of annual effective dose for $^{238}U$ series were 0.222 mSv/y in Almunaish powdered milk sample, the minimum value were 0.073 mSv/y in Molty sample while the average value were 0.121 mSv/y. The average values of annual effective dose for $^{232}Th$ series and $^{40}K$ were 0.314775 and 0.305 mSv/y respectively, the maximum and minimum values were 0.465, 0.09, 0.341 and 0.195 mSv/y in Altunsa, Seven Caw, Almunaish and Altunsa powdered milk sample respectively as shown in Figs. 4, 5 and 6.

***Table 2: The annual effective dose in all powdered milk samples.***

| Sample | AED mSv/y for U-238 | AED mSv/y for Th-232 | AED mSv/y for K-40 |
|---|---|---|---|
| Almunaish | 0.222 | 0.366 | 0.341 |
| Seven Caw | 0.076 | 0.09 | 0.324 |
| Molty | 0.073 | 0.338 | 0.36 |
| Altunsa | 0.113 | 0.465 | 0.195 |
| Average | 0.121 | 0.314775 | 0.305 |

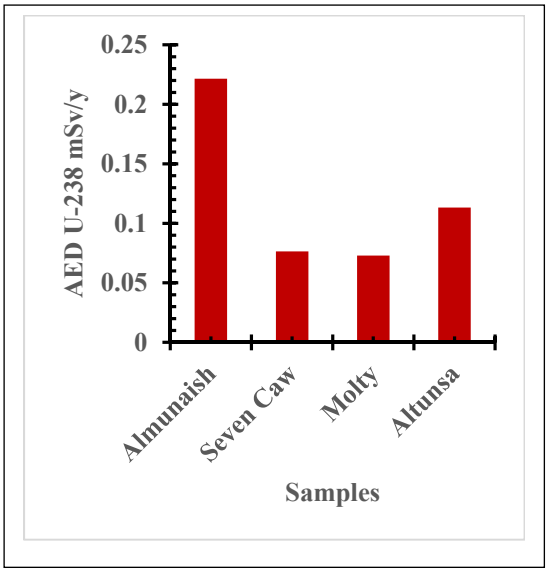


***Fig. 4: AED (mSv/y) for $^{238}U$ in all samples.***

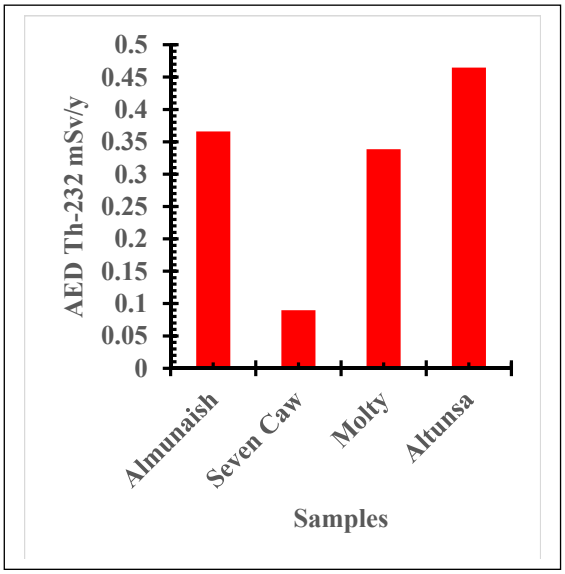


***Fig. 5: AED (mSv/y) for $^{232}Th$ in all samples.***

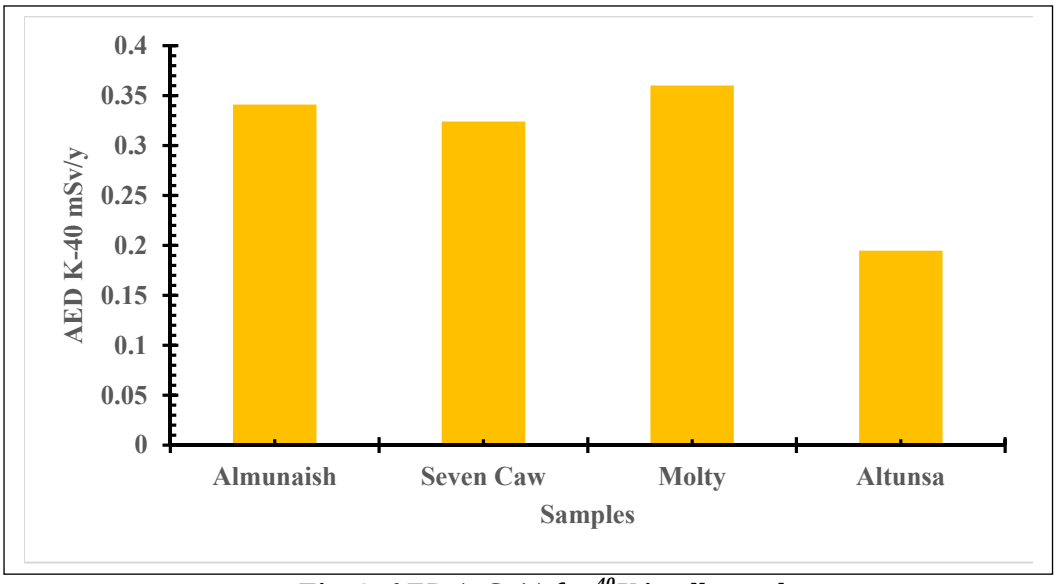


***Fig. 6: AED (mSv/y) for $^{40}$K in all samples.***

## Conclusion

Specific activity for $^{226}$Ra, $^{232}$Th and $^{40}$K in different samples of powdered milk were measured by NaI(Tl) detector. The average value of specific activity for radionuclide $^{40}$K was highest in all samples. The annual effective dose that accumulated from all isotopes were in the allowed levels globally.

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