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Evaluation of U^{238} and Th^{232}radionuclide activitiesin kidney gallstone belonging to cancer patientcompared with normal one by ɣ-ray spectrometry and EDS

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Abstract
Radionuclide activities (U^{238} and Th^{232}) in the normal person kidney gallstone and another one with cancer disease have been determined experimentally by ɣ-ray spectroscopy and EDS measurements.U^{238} and Th^{232}concentrations were found to be very high in the kidney gallstone belonging to cancer patient indicating a strong radionuclide-cancercorrelation. The IR and SEM were also investigatedin order to study the effect of kidney gallstone water washingin reducingthe organic and inorganic contaminates.

Keywords: Kidney gallstone, radionuclide, gamma ray, EDS, FT-IR, cancer.

1. Introduction
Most kidney stones in human body form due to a combination of environmental and genetics factors [1].Risk factors include being overweight, food and water, certain medications, shortage in drinking fluids [2].Urinary stones are classified by their location in the kidney (nephrolithiasis), ureter (ureterolithiasis), or bladder (cystolithiasis), or by their chemical composition (uric acid, calcium-containing, struvite, or other compounds) [1-2].Manmade and natural radionuclides are two sources of radiation in our broad environment which are the main sources of radiation exposure to human beings. The natural sources are more due to the primordial radionuclides, mainly U^{238} and Th^{232} and their decay products as well as K^{40} [3]. These radionuclides are present in various amounts around anywhere in the environment,including our bodies[4-6]. Naturally occurring radionuclides and particularly their decay products are transported in both surface water and groundwater. As a result, these radionuclides may enter the food chain through irrigation waters, and the water supply through surface water streams and groundwater. Gamma radiation, emitted from such naturally occurring radionuclides present in all soils, and radon represent the main external exposure to human body [6-10].Strong associations between different types of cancer (especially lung and kidney) and high concentration or long time contact to gamma radiation emitted fromU^{238} and Th^{232}have been reported [11]. The high-linear energy transfer gamma particles emitted by U^{238} and Th^{232} can directly attack genomic DNA to cause mainly DNA damages[12-13] which lead to severe problems as well as cancer cells growth [14]. The health risks to humans are real, but the level of risk involved is not clearly defined. This is because we do not yet know enough about the activity concentration of these radionuclides in the environment and there have been no epidemiological studies quantifying the risk from all natural radionuclides in drinking water.Studies of water and soil radioactivity provide reference data in observing possible future impact and associated radiological risk to human health [10-15].

After entering the human body, radionuclides are typically accumulated in the skeleton, liver, kidney and soft tissues. Because kidney stones consist in cumulative way and need long time to grow up, it is expected to have implications for the presence of contaminations, especially radioactive ones. Therefore, the main purpose of this work is to compare, at the same conditions, the radiation levels of kidney gallstone of a healthy person with that of a cancer patient. The activity concentration of the radionuclides in the U^{238} and Th^{232} decay chains were determined by employing both gamma-ray spectrometry and EDS measurements.

2. Materials and methods

2.1. Sample collection and treatment

The kidney gallstone samples were collected from An-Najah National University hospital.The bulk samples were washed carefully several times with distilled water to remove the organic surface contaminants. The samples were placed in plastic pouches and stored in refrigerator at -18 ^{o}C. Upon use, a piece of the stone was taken, grindedandthen dried in an oven at 100 ^{o}C for about 3 h.

2.2. Apparatus

The activity concentration of radionuclides in the U^{238} and Th^{232} decay chains were determined using (1.5″ ×2″) sodium iodide detectorhosted in the Radiation Physics Laboratory. The samples were placed symmetrically on the top of the detector and measured for a counting time of 20 h. A homemade Marinelli beaker was used in the measurements.

The net area under the corresponding peaks in the energy spectrum was computed by subtracting counts due to background from the total area of the peaks. From the net area, the activity concentrations of radio nuclides in thesamples were obtained using the following equation [12]

$$\mathbf{C=N/E \times M \times t \times P}$$

where C is the activity concentration of the radionuclidesin the sample given in $Bqkg^{-1}$, N is the net peak area at given energy, E is efficiency of the detector for -ɣ-energy of interest, M is the sample mass (kg), t is total counting time (s) and P is the emission probability of radionuclide of interest.

3. Results and discussion

3.1.Objective of the work

The overall objective of this work is to collect new information on the occurrence of natural radioactivity in kidney stone of healthy and cancer patients. In order to achieve these aims we focus on:

1. To investigate the occurrence of U^{238} and Th^{232}radionuclides in healthy person kidney stone and compare it with thatof a person having cancerusing **ɣ**-ray spectrometry.
2. To investigate EDSdifference between normal (healthy) and cancer kidney stones.
3. To investigate FT- IR and SEM in evaluation of the organic and inorganic contaminants in both samples
3. To study the effect of drinking water washing on the reduction of both organic and inorganic contaminants.

3.2 Comparison of radionuclide activity in kidney stoneof a healthy person and a cancer patient

In this work kidney stones from cancer patient (as in Figure 1) and healthy person were collected. The radiation level of U^{238} and Th^{232} were evaluated using gamma-ray spectrometry. The activity concentrations of radionuclide U^{238} and Th^{232} in both samples are given in Table 1 and illustrated in Figure 2.

Figure 1.Photograph of smooth surface human kidney stone suffering from cancer.

Table 1: Specific activity of U^{238} and Th^{232} in $Bqkg^{-1}$ in healthy and cancer kidney human stones.

Sample	Sample weight (g)	Activity concentration U^{238} ($Bqkg^{-1}$)	Activity concentration Th^{232} ($Bqkg^{-1}$)
Healthy kidney human stone	**6.200**	**0.03**	**0.003**
Cancer Kidney human stone	**6.178**	**56.8**	**1.289**

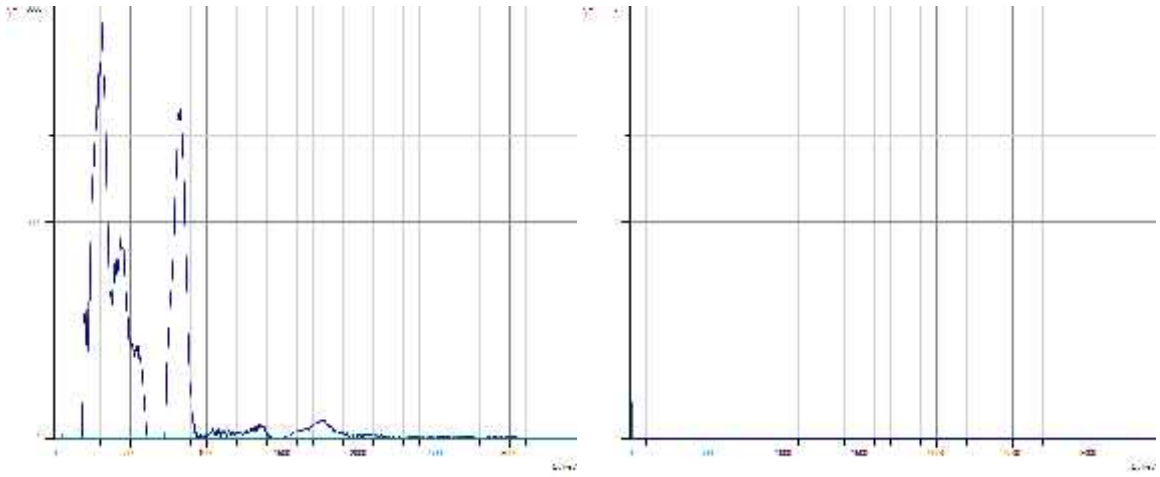

Figure2. Natural ɣ–ray spectra of kidney stone belonging to cancer patient a) and healthy person b) using NaI detector.

3.3 EDS measurements of cancer human kidney stone compared with normal one

To identify the chemical compositions of the cancer human kidney stone and compare with thatof a normal one,both stones were subjected to EDS measurement.As shown in Figure 3, the EDS spectra of both healthy and cancer infected kidney stones contain peaks of C, O, Al, Si, S, and Ca.In addition to aforementioned peaks, the sample from the cancer infected person revealed peaks corresponding to Th and U at 3.1 and 3.2 keV, respectively [16, 17].

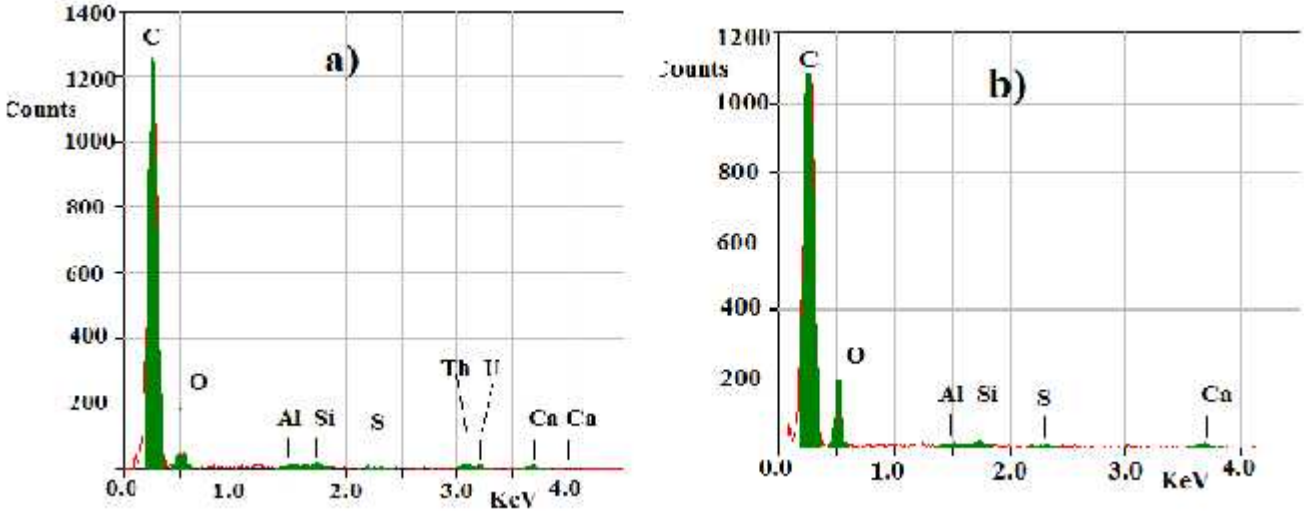

Figure 3.EDS spectra of cancer human kidney stone a) compared with normal one b).

3.4 FT-IR measurements

Organic compounds which mostly contains C-H function groups can be easily recorded by IR at high bond vibrationfrequencies3400-2700 cm^{-1}, while inorganic metal oxide can be also detected by IR but at low bond vibrationfrequencies1100-400 cm^{-1}. It is very interesting to subject the kidney stone of person who has developed cancer to IR study inorder to evaluate their organic and inorganic constituents. The results of such a study are depicted in Figure4. As expected,organic compounds (broad peaks at 3300 cm^{-1}belonging to carboxylic COOH and C-H aliphaticfunction groups at 2900-2700 cm^{-1}) are observed.In addition, metal oxide (MOx) contaminants between 1000-400 $cm^{-1}$are also observedas can be seen in Figure 4a. By washing the same sample with excess amount of drinking water (3 times) it was found that the organic contains can be totally washed (no bond vibrations frequency at 3400-2700 cm^{-1}), while the MOx cannot be totally washed as can be seen in Figure 4b.

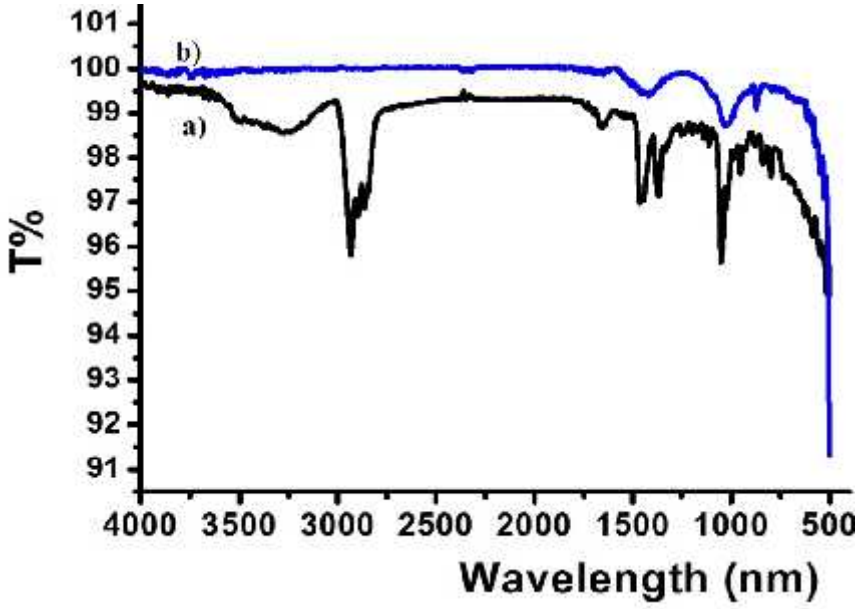

Figure 4. FT-IR spectra of cancer human kidney stone a), after washing 3 times with drinking water b).

3.5.Scanning Electron Microscopy (SEM) measurement of inflected sample before and after washing

The SEM imagesof the kidney stone sample of a person who has developed cancer,before and after washing with drinking water, were investigated as seen in Figure 5.It is clear that the shape (from rod to fluffy) and the size (regular to irregular) of the particles were changed upon washing with water indicating that organic contents can be washed out by water while inorganic ones are notremoved by simple washing as seen in Figure 5a and b, respectively.

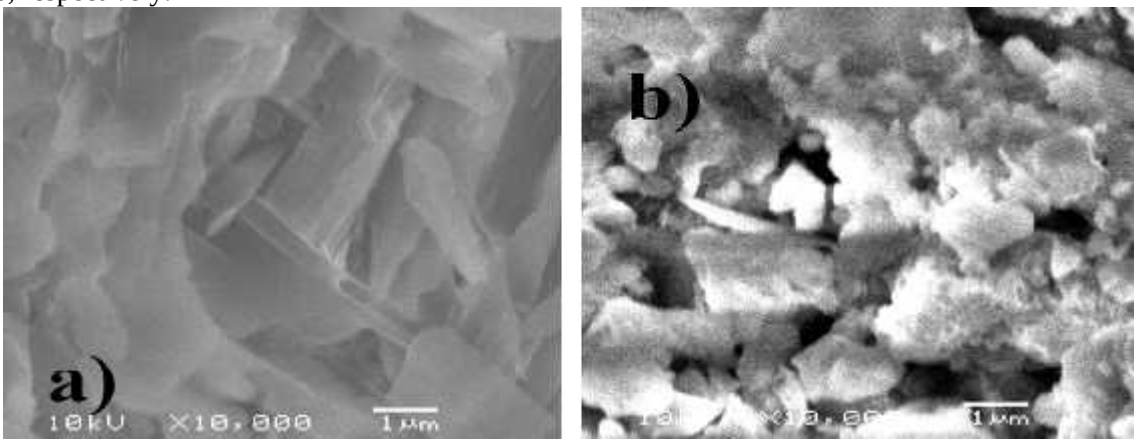

Figure 5.SEM image of kidney stone sample of person who has developed cancer before a) and after 3 times washing with drinking water b).

Conclusions

1- Average concentrations of natural radionuclides (U^{238} and Th^{232}) in cancer patient kidney stone are found to be higher by a factor of 1893 for U^{238} and 430 for Th^{232}, as compared to normal person kidney stone. This may be the main reason behind the emergence of cancer cells.
2- EDS is a suitableand fast technique to detect ^{238}U and ^{232}Th occurrence.
3- FT-IR and SEM measurements confirmed the possibility that organic compounds can be washed out from kidney by drinking more fluids, while metal oxide inorganic compounds can't.

References

1. D'Amico, G.*Q. J. Med.* 64 (1987) 709.
2.Qaseem, A.; Dallas, P., Forciea, A., Starkey, S. *Ann. Internal.Med.* 161 (2011) 659.
3.Taskin, H., Karavus, M., Ay, P., Topuzoglu, A., Hindiroglum, S.,Karahan, G.*J.Enviro. Radio.*100 (2009) 49.
4.Auvinen, A., Kurttio, P., Pekkanen, J., Pukkala, E., Ilus, T., Salonen, L. *Cancer Causes and Control.*13 (2002) 825.
5.Auvinen, A., Salonen, L., Pekkanen, J., Pukkala, E., Ilus, T., Kurttio, P. *Inter. J. Cancer.*114 (2005) 109.
6.Aieta,M., Singley, E., Trussell, R., Thorbjarnarson, K., McGuire, J. 79(1987) 144.
7. Castro-Torres, I., Cárdenas-Vázquez, R., Velázquez-González, C., Ventura-Martínez, R., De la O Arciniega, M., Naranjo-Rodríguez, E., Martínez-Vázquez, M., *Eur. J..Pharma.*, 765 (2015)*366.*
8. Liang, X., Li, W., Zhao, B., Zhang, L., Cheng, Y., *Eur.J. Radio.*, 84 (2015) 1835.
9. Kulvatunyou, N., Watt, J., Friese, R., Gries, L., Green, D., Joseph, B., O'Keeffe, T., Tang, A., Vercruysse, G., Rhee, P., *Amer. J. Surgery*, 208(2015) *981.*
10. Singh, T., Gupta, S., Shrivastav, B., Tiwari, P.*Gene*, (2015) in press.
11. Taylor, D., Taylor, S.*Rev. Environ. Health.*12 (1997)147.
12.Sethi, K., El-Ghamry, N., Kloecker, H.*Clinical advances in hematology& oncology.* 10 (2012) 157.
13.Samet, M., Avila-Tang, E., Boffetta, P., Hannan, M., Olivo-Marston, S., Thun, J. *J. American Association for Cancer Research*15 (2009) 5626.
14. Rosanna, P., Salvatore, C. *Current pharmaceutical design* 18 (2012) 3889.
15. Brenner, R., Boffetta, P., Duell, J., Bickeboller H., Rosenberger A., McCormack V. *American Journal of epidemiology* 176 (2012) 573.
16.Gaafar, I. *Open Journal of Geology*, 4 (2014) 108.
17.Akinci, A., Artir,R. *Materials Characterization.*59 (2008) 417.