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CR-39 As A Tool For Uranium Concentration Calculation In Bio Assay Sample: Bladder Cancer As Case Study.

Shaymaa M Qaddoori[1]*, and Shafik S Shafik[2]

[1]Ministry of Science and Technology, Environmental and Water Directorate.
[2] University of Baghdad, College of Science, Dept. of Physics

ABSTRACT

A new born malformation, abortion of pregnant woman and cancer had been prevailing scarily in wide part of Iraq after using depleted uranium in I and II Gulf war. In this research CR-39 detector was used to measure uranium concentration (Uc) excretion in 24h urine samples of bladder cancer patients, healthy person, and infants with their mothers. The CR-39 detector attained a very good sensitivity in measuring variation of Uc among participators of each group of study, where the range of Uc excreted in all subjects have been found to be 0.79247-3.5058 µg/L with an overall average of 1.79004 µg/L for bladder cancer patients, 0.79734-1.00707 µg/L with an overall average of 0.89308 µg/L for healthy group, and 0.45975-0.89442µg/L with an overall average of 0.70914 µg/L for infants with their mothers group. Comparison of these results with results 2.00038, 0.9464, 0.7742 µg/L which obtained by using kinetic phosphorimetry analyzer for the same groups respectively, showed a good agreement (where the average percentage error Er % of Uc measurement using CR-39 detector is 10.897%, 5.681% and 8.424% respectively), whereof confirm efficiency of CR-39 detector in Uc calculation in bio assay samples, and appointment of optimum etching condition could be increase this efficiency, Where the results of Uc estimation after re-etching CR-39 at (10 hours) showed excellent agreement with results of kinetic phosphorimetry analyzer where the average Er % is 1.743.
Keyword: CR-39 detector, bio assay sample, Depleted Uranium, etching condition.

Corresponding author

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INTRODUCTION

Radionuclide spread throw environment by action of the nature and human activity. Depleted uranium considered a new source of radioactivity that introduced into environment after using it in I and II Gulf war, it pass through the environment and reaching the human body by ingestion or inhalation, or through the skin such as other material [1]. Determination of internal hazard of radionuclides inters the humans body it's not direct because some of these nuclides can be excreted through urine and/or feces before it has had the chance to decay [2]. In addition to the tendency for a particular element to be taken up by a particular organ or tissue, the deposited amount of radioactive material, the type and the energy of the radiation emitted from it [3], and the sensitivity of the exposed tissue affect on the total annual radiation effective dose. The main organs of uranium deposition in the body are kidneys, liver, bones and it deposited in various other tissues generally at lower concentrations especially in soft tissues [4].

The continued action of the emitted alpha particles can cause significant injury, because they deposit their energy over a period of years in a limited region [2]. It affected directly or indirectly in the cells, therefore, a finally resulting in manifestation of morphological and functional changes caused cancer, with acute or stochastic effects on the same irradiated person and or his offspring [5, 6].

The majority of uranium that enters the body through the gastrointestinal tract without being absorbed is excreted through the feces, and hence fecal uranium excretion basically indicates merely the current level of uranium in the food, but fails to detect any incorporation through inhalation, in contrast with uranium excretion in urine is proportional to the uranium level in the body due to all path way. So that renal uranium excretion is used in this study to measure uranium concentration (Uc) [7]. Measurements of uranium excretion in urine, in contrast to feces, provide a reliable basis for detection uranium. The overall elimination half-life of uranium under conditions of normal daily intake has been estimated to be between 180 and 360 days in humans [8].

The Variation of uranium execration in urine sample due to same amount of uranium consuming in same individual is affected by intake pathway, solubility type of uranium, the time fallowing exposure, and illness and age of individual. Also this variation is depending on dissimilarity in uranium Background levels from one individual to another because of their different habits and environments [14]. However, Urinary uranium excretion ranged from 0.04 to 0.4 µg/L [9] and 0.0 4 to 0.57 µg/L [10], and it's obvious that this is in decimal fraction of µg/L unit (or in part per million), and hence it required to use a technique with a high detection sensitivity to measure Uc in urine samples.

However, the Minimum Detectable Activity (MDA), the cost of detection, and the goodness of the detection system represent the main items in any routinely measurements of radionuclides such as U_C in urine. Therefore, the solid state nuclear track detectors (SSNTDs) can achieve these requirements among other techniques such as Neutron Activation Analysis, Kinetic Phosphorimetry Analyzer, Coupled Plasma Mass Spectroscopy, and etc..SSNTDs can register very small flux of any heavy charged particles such as alpha particles even one particle.

Heavily ionizing radiation passed through solid state nuclear track detector (SSNTDs) can create narrow paths (30-100 A^o) of intense damage along their tracks [11]. The Advantage of SSNTD is combining the track recording properties of photographic emulsions and the single particle counting abilities. Beside, SSNTDs have some useful features; extremely simple to use, obtained in any size, inexpensive, quite robust, unaffected by high doses of background radiations of energy below the given thresholds [12], do not involve any electronic accessories, used in remote experimental locations, and amenable to different geometrical arrangements. The integrating nature of the detectors allows events to be accumulated over long periods of time, so that SSNTDs have found various applications in different fields of science and micro-analysis technology [13] like determination of actinide elements at trace concentration level in pure solutions as well as solutions of complex [14].

CR-39 is the well known detector or film of the SSNTDs. It composes of Polyallyldiglycol Carbonate detector with chemical composition $C_{12}H_{18}O_7$ [15]. It is organic detector with sensitivity larger than that inorganic because the bonds C-C and C-H are easy broken after exposing to the radiation, also the organic type have a higher analytic power than inorganic one [16]. The outline of idea of track formation is a dense region of ionization produced by the charge particle and number of ions exceeds a certain threshold value [17]. It's based on radiochemical damage mechanism in polymers.

EXPERIMENTAL BRANCH

Sample Collection:

Urine samples were collected from sixty bladder cancer patients (they were visitor to Al-Amal National Hospital for Cancer Management,Al-Imamein Al khadimein city hospital / Al Jwad center for tumor treatment and Medical City / Oncology teaching hospital), thirty healthy person resident in different position and ten infants with their mothers. The healthy person and infants with their mothers' urine samples were chosen to be as controls and references samples. All participators of study lived in all districts of Baghdad governorate, and the ages of healthy group participators are in the range of that for patient group with both genders.

Sample was taken from the adult person with urine cup contain 60 ml, but in the case of the infant, the sample gathering by urine bag. All samples were accumulated to be 500-1000 ml in about 24 hour [18]. Total 24 hour urine samples were collected in polyethylene bottles, and immediately acidized by the addition of 1ml concentrated HCl to avoid precipitate formation. Each sample, after shaking, divided for some parts in urine cups; first for Uc measurement by KPA technique, second for Uc estimation by SSNTD technique using CR-39 detector, and the rest of each sample is kept for other measurements.

Measurement of Uranium Concentration:

There are many parameters and special conditions that required in using the felicitous detector and sample preparation to get the best results in quantifying the number of tracks registered on SSNTDs. Selection the felicitous detector is overlapped with the characteristics of the detector; firstly the detection threshold; where it's the lowest for CR-39, which is 0.05 $MeV/mg.cm^2$. Secondly the highest sensitivity of CR-39 [11], and thirdly the registration efficiency, whereas special precautions necessary for proper utilization of the SSNTD technique and various aspects of track registration especially from solution media, which depending on the registration geometry, non-uniformity of the source material[19],position of the detector in the capsule containing the solution[12], change in concentration during sealing, seepage of solution inside the detector and also the environmental effects[20].

Sample preparation:

CR=39 detector of 1cm ×1cm area was cut manually using electrical cutter, from commercially available sheets of CR-39 plastic of dimensions 30cm × 20cm with 500 µm thick, which was made by Pershore Moulding LTD Company UK., and sealed in triple laminated pouches with 1 mm thick polyethylene radiator of same dimension in front of it for enhanced sensitivity.

As shown in Fig. 1, each piece of CR-39 was immersed in the urine sample in a hermetically sealed cylindrical plastic container (Test tube filled of 10 ml urine) of diameter 1cm and length 12cm [12], placed vertically in rack to insure fixing the detector strip at the desired position in the tube, and hence get good registration efficiency as mentioned before. The irradiation process was carried at room temperature, and 3 drops of HCl added to sample to prevent polymerization of urine sample [21]. During the irradiation time, which is 69 day for CR-39, α- particles emitted from uranium and their corresponding daughters were bombarded CR-39 film.

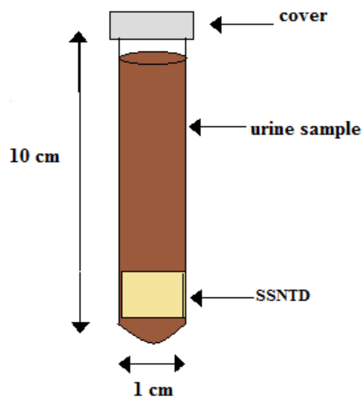

Fig1: Arrangement of the urine sample withCR-39 film in a well-closed plastic container.

After the irradiation, the exposed film washed with distilled water and they etched in NaOH solution with 6.25N at 70 C° for 9hr using water bath. Then detector films were taken out of NaOH solution and washed with distilled water for many times. After cleaning and drying the films at room temperature, the track number became ready to read later, using the optical microscope with 400X magnification and CCD camera.

Achievement calibration curve of SSNTD:

Uranium standard solution was prepared for calibration curve of SSNTD. Amount 117.9 mg of uranium octoxide U_3O_8 dissolved in 100ml of 0.82M nitric acid HNO_3 in volumetric flask to prepare a stock standard solution of 10 mg/l (10ppm). This solution diluted in 0.82M nitric acid HNO_3using dilution Eq.(1) to obtained standards solution with desired Uc (1, 2, 3, 4, 5 and 7 ppb). This series of standards was used to construct the calibration curves for the low ranges of Uc.

$$1^{st} \text{ volume} \times 1^{st} \text{ concentration} = 2^{nd} \text{ volume} \times 2^{nd} \text{ concentration} \ldots (1)$$

CR-39 detectors immersed in uranium standard solution using the same arrangement of urine samples in a well-closed plastic container as shown in Fig. (1). after washing the detectors with distilled water, the etching operation had been done using 6.25N of NaOH at 70 C° for 9hr. Once more the detectors washed with distilled water after etching, and dried at room temperature. Number of track recorded using the optical microscope corroborated with CCD camera.

The tracks density of uranium from stander solution calculated according to Eq. (2) [22];

$$\rho = \frac{N}{(A \times T)} \quad \ldots \ldots \ldots (2)$$

Where ρ is the track density (tracks /cm^2.h), N is the average number of tracks, A is the area of the field view (cm^2), and T is the irradiance Time (h). Finally, the calibration curve was obtained and shown in Fig. 2. From this curve, a fitting Eq. (3), was deduced, which can directly estimate U_C from the track density.

$$Uc = \frac{(\rho + 12.5)}{18.6} \quad \ldots \ldots \ldots (3)$$

Estimation the Optimum Etching Time:

The best means of observing the tracks is by etching the SSNTDs material with a chemical solution, and enlarges the original track to a size, which is visible in the optical microscope [23]. The etching conditions, which are time and temperature of etching presses and etching solution concentration or normality, were optimized empirically for each detector material, whereas they obtained by getting maximum track density registered on these detector [24]. Etchings time can vary from few seconds to many hours, it varies according to the exact etching conditions; the temperature and the concentration of the etchant, in addition different parameters can affect track formation such as total energy lose rate, primary ionization, restricted energy loss, type and energy of ionized charge particle and also the depending on the chemical structure of detector material [17].

In the case of CR-39 detector, the general etching conditions are NaOH with 6N, 70 C^{o}, and 1-4h, whereas the lightest detectable particle is H atom with energy 1 MeV [24]. Consequently, to estimate the optimum etching time, which increase revelation maximum track density of α-particle emitted from uranium accumulated in acidic aqueous media such as our urine samples, re-etching with increasing time was done as fallow:

Selected irradiated CR-39 detectors had been etched five times with increasing the etching time one hour at each step with the same etching conditions (temperature of etching process=70 C^{o}, etching solution normality=6.25N). After that the same track registration procedure was followed.

RESULTS

Results of Uc measurement in urine sample:

The measured Mean Uc from urine samples, for all participant groups using CR-39 detectors, was revealed that the CR-39 detector attained a very good sensitivity in measuring the variation of Uc among participators group of study. Where Table 1 showed that range of patients Uc is 0.79247- 3.5058 µg/L with an average all 1.79004 µg/L, Range of healthy group is 0.79734- 1.00707 µg/L with an average all 0.89308 µg/L and range of infants with their mothers group is 0.45975- 0.89442 µg/L with an average all 0.70914 µg/L.

Table 1: The range of Uc and their mean in all participant groups.

The group	No of cases	Range of Uc using CR-39 (µg/L)	Mean ± SE of Uc using CR-39(µg/L)
Patients	60	0.79247- 3.5058	1.79004
healthy	30	0.79734-1.00707	0.89308
Infants with their mothers	10	0.45975- 0.89442	0.70914

To emphases the ability of using the CR-39 in estimation Uc in bio assay samples, Uc in the same urine samples of all participators was measured using Kinetic Phosphorimetry Analyzer (KPA-11) technique, where the urine samples prepared and Uc measured in (µg/L)unit in Radiation Protection Center - Iraqi Environmental Ministry[25]. KPA-11 is extremely sensitive technique and evaluates Uc with highly precise, accurate measurements and detection limit (10 ng/L) [26], but it's very expensive and requires a particular procedure for preparing the samples in comparison with SSNTD.

Uc values of each bladder cancer patient measured using KPA was sketched as function of its facing value using CR-39 detector as shown in Fig. (3-a), and the relation between each of technique is linear. Also Fig. (3-b) shows percentage error (Er %) between the two techniques as a function of each Uc value. Where the calculated average all percentage error is 10.897%. Fig. (4-a) and (5-a) show the relation between each of technique approach linear in measurement Uc of healthy and infant with their mothers' participator samples respectively, and their percentages error of using CR-39 technique are shown in Fig. (4-b) and (5-b). The average all Er % of healthy group was 5.681%, and for infant with their mothers group was 8.424%. Comparison of Uc results using KPA-11 with that of using CR-39 detector showed a good agreement, whereof confirm efficiency of CR-39 detector in Uc calculation in bio assay samples.

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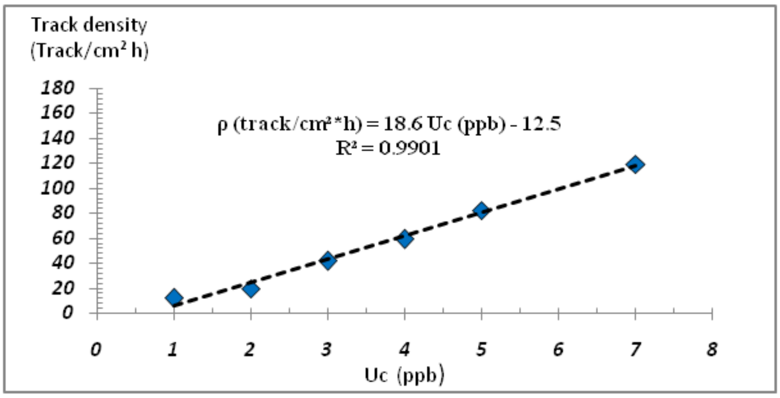

Fig 2: Calibration curve for standard uranium (ppb)

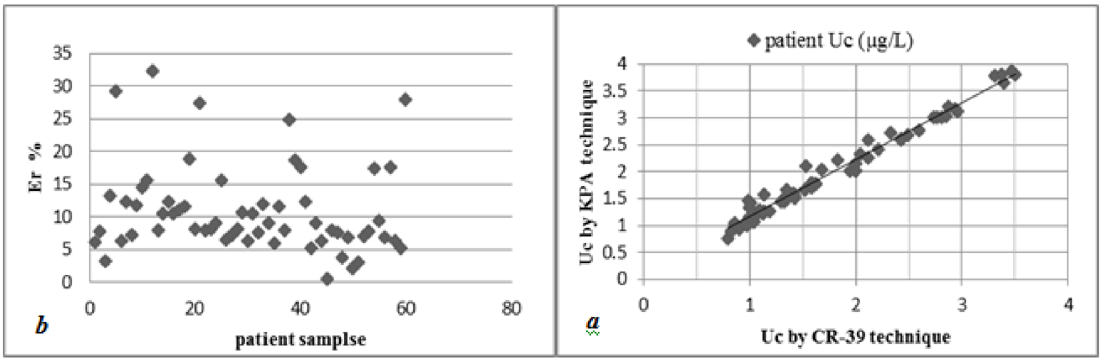

Fig 3: (a) patient Uc using KPA and CR-39 technique, (b) percentage error between each technique.

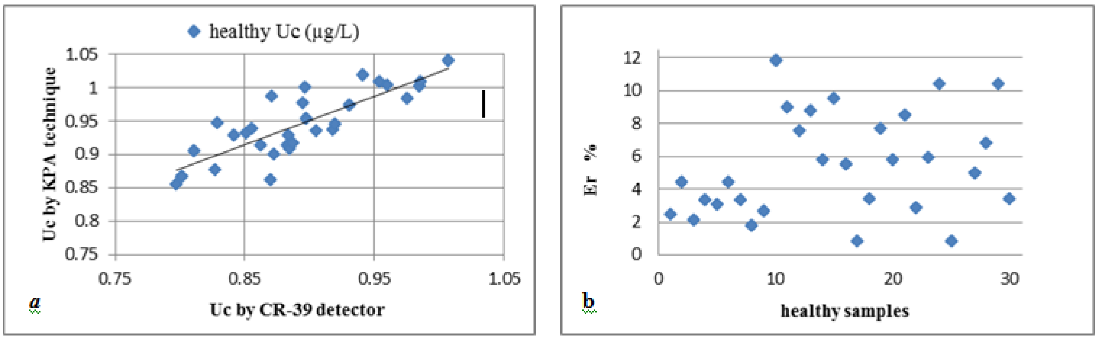

Fig 4: (a) Healthy Uc using KPA and CR-39 technique, (b) percentage error between each technique.

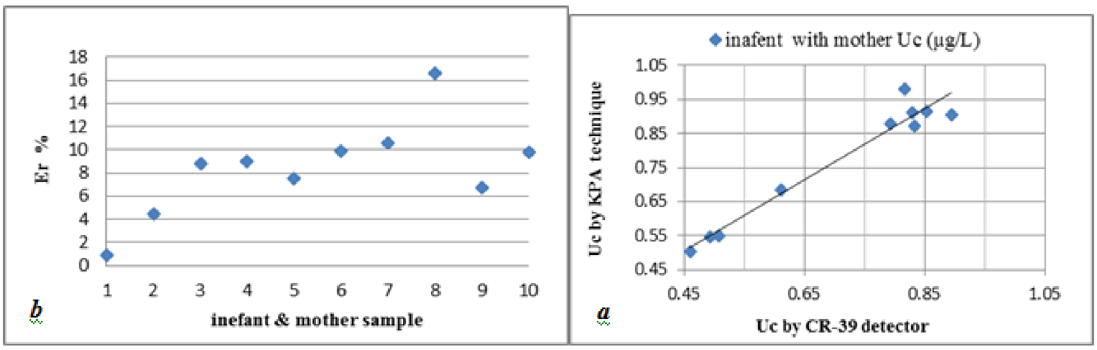

Fig 5: (a) Infant with their mothers Uc using KPA and CR-39 technique, (b) percentage error between each technique.

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Results of estimating the optimum etching time:

The comparison of averaged counted track belong to each detector at different time of etching was shown in Fig.(6-a), and the results refer to increase track registration with increasing time of etching, reaching the maximum at 10h for almost detectors, after that, decreasing rapidly with larger etching time. It must be mentioned that wasn't all the detectors etched for 10h because of fearing from losing the track with referring that there wasn't previous stander reference for optimum etching condition of CR-39 used in bio assay. And as mentioned before they are optimized empirically.

To insure that the results of Uc measurements by using CR-39will be better after re-etching for 10h, a comparison among Uc estimated by CR-39 detectors which etched at 9h and 10h and results of KPA measuring was made in Fig.(6-b). The results showed that appointment of optimum etching condition could be increase the efficiency of CR-39 detector, where the results of uranium concentration estimation after re-etching of CR-39 (10 hours) show excellent agreement with results of KPA.

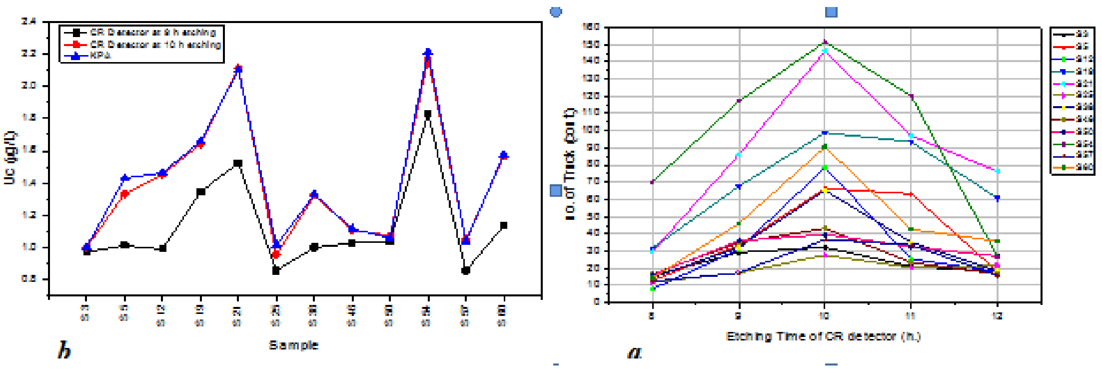

Fig 6: (a) comparison of averaged counted track belongs to each detector at different time of etching, (b) comparison among Uc estimated by CR-39 detectors etched at 9h and 10h with Uc measured by KPA (sample belong to the number of patient).

Coefficient of determination R^2 which quantify the strength of a linear relationship between two variables, giving some information about the goodness of fit of a model and with larger numbers indicating better fits, was used for confirmation the efficiency increasing of CR-39 detector in Uc estimation after re-etching of CR-39 (10 hours). That is deductive results from the comparison between R^2 values 0.850 and 0.993 which illustrated in Fig.s (7-a) and (7-b) respectively.

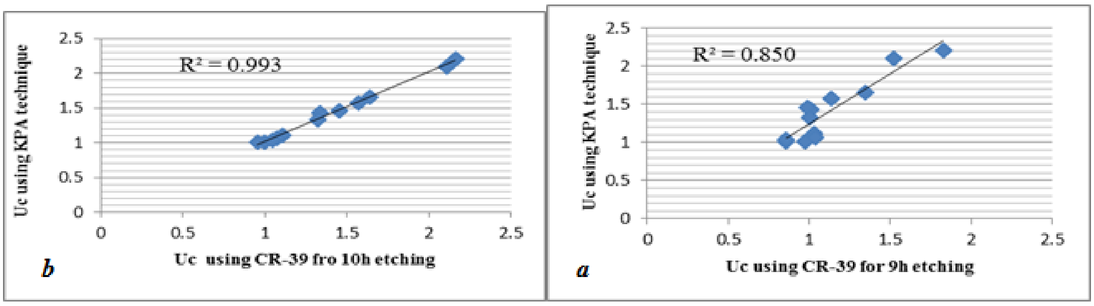

Fig 7: Uranium concentration measurement using KPA and CR-39 detector with etching: (a) 9 hour, (b) 10 hour.

Results of bladder cancer:

In order to stand about the effected parameters on the bladder cancer incidence probability, biological parameters measurements of urine have been gathered and studied with Uc measurements using KPA technique. Fig. (8) shows increasing Uc and Amorphous urate as much as pH decreases. The verification, of bladder cancer patient characters consideration as effected parameters on the bladder cancer incidence probability, demand gathering Uc results using KPA technique with the questionnaire data related to each participators of the study and studied against each other. Chi-square test was used to significant comparison between percentages of distribution of sample which related to bladder cancer patient character according to Questionnaire, also the relationship among these characters of the participators that effected in their Mean of Uc ± SE were shown as follow: The results in table 2 showed that the bladder cancer patients had higher percentage in male than in female but there is no effect to gender factor on Mean of Uc measurement in urine sample. The large majority of cancer kinds have a higher incidence rate in males relative to females, with one of the few and clear exceptions to the rule being breast cancer [27]. The reasons why males appear to be so much more prone to developing cancer than females are complex and still only partially understood [28]. There may be a biological component, with women's sex-hormones and immune system being involved in some of the differences seen, though these have not been fully explored [29]. There may also be factors related to ethnicity and family history of cancer, which increase capability to certain cancers [30].

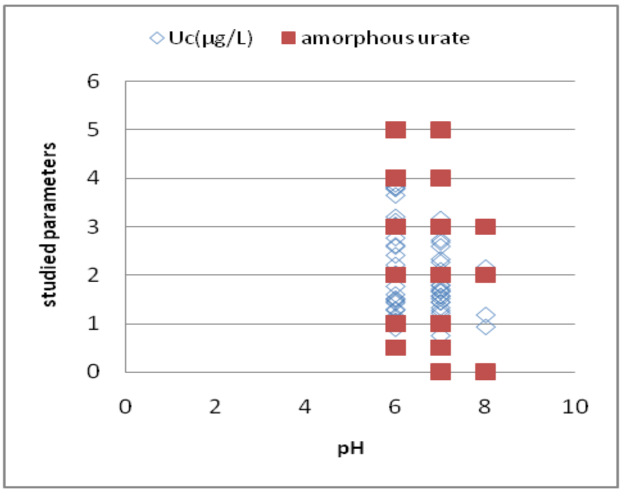

Fig 8: Uranium concentration and amorphous urate as a function of pH of the urine patient's samples.

Table 2: Distribution of bladder cancer patients classified according to Gender and their Mean of Uc (μg/L)

Gender	No.of cases	Percentage (%)	Mean ± SE of Uc (μg/L).
Male	50	83.33	1.99 ± 0.08
Female	10	16.67	2.05 ± 0.06
Chi-Square	---	13.409 **	P-value: 0.148 NS

The distribution of patient, according to their Degree of Study, registered very high percentage about 80% included (uneducated and primary level) from the all cases as shown in table 3, and this refer to that the acculturative awareness is may be could reduce the risk of get cancer. But the measured Mean of Uc is not affected with this factor. Type of the work is one of the effected factors in Distribution of bladder cancer patients as shown in table 4, where the farmer registered high percentage with high Mean of Uc and that explained by their handle with phosphate fertilizers applied to soil in farming. Also high Mean of Uc in other type of work such as seller and ironsmith. While when the officer registered the highest percentage in the distribution, that indicate the type of the work is not the only factor affected in getting the cancer.

Table 3: Distribution of bladder cancer patients classified according to Degree of Study and their Mean of Uc (μg/L)

Degree of Study	No.of cases	Percentage (%)	Mean ± SE of Uc (μg/L).
Not read and write	8	13.33	1.81 ± 0.11
Read and write	12	20.00	1.76 ± 0.14
Primary	18	30.00	1.61 ± 0.09
Preliminary	10	16.67	1.72 ± 0.10

Diploma	6	10.00	1.85 ± 0.14
Bachelor	6	10.00	1.78 ± 0.12
Higher degree	0	0.00	1.74 ± 0.09
Chi-Square	---	9.143 **	P-value: 0.08722 NS

Table 4: Distribution of bladder cancer patients classified according to Type of Work and their Mean of Uc (µg/L)

Type of Work	No.of cases	Percentage (%)	Mean ± SE of Uc (µg/L).
Farmer	11	18.33	1.81 ± 0.12
Seller	8	13.33	1.85 ± 0.09
Housewife	6	10.00	1.69 ± 0.11
Ironsmith	3	5.00	1.82 ± 0.11
Officer	13	21.67	1.64 ± 0.08
Gainer	12	20.00	1.70 ± 0.11
Craftsman	7	11.67	1.70 ± 0.07
Chi-Square	---	5.073**	P-value: 0.091 NS

Married bladder cancer patient registered the highest percentage Distribution classified according to Marry state as shown in table 5 but their Mean of Uc is lower than singled patient. Table 6 shows that may be the Mean of Uc of bladder cancer patients effected in their fertility, where as much as the Mean of Uc increase then No. of child decrease. The non smoking bladder cancer patients registered about 36.67% of the Distribution as shown in table 7, and their Mean of Uc have high significant difference on Mean of Uc of the smoker patients, which referred to fact that the smoking is not only the source f intake of radioactivity.

Table 5: Distribution of bladder cancer patients classified according to Marry state and their Mean of Uc (µg/L)

Marry state	No.of cases	Percentage (%)	Mean ± SE of Uc (µg/L).
Yes	58	96.67	1.99 ± 0.12
No	2	3.33	2.24 ± 0.08
Chi-Square	---	14.594 **	P-value: 0.1093 NS

Table 6: Distribution of bladder cancer patients classified according to No. of child and their Mean of Uc (µg/L)

No. of child	No.of cases	Percentage (%)	Mean ± SE of Uc (µg/L).
0-3	11	18.33	2.29 ± 0.14
4-7	31	51.67	1.95 ± 0.09
>7	18	30.00	1.90 ± 0.11
Chi-Square	---	9.025 **	P-value: 0.1186 NS

Table 7: Distribution of bladder cancer patients classified according to Smoking and their Mean of Uc (µg/L)

Smoker	No.of cases.	Percentage (%)	Mean ± SE of Uc (µg/L).
Yes	38	63.33	1.80 ± 0.12
No	22	36.67	2.34 ± 0.07
Chi-Square	---	9.017 **	P-value: 0.041 * * (P<0.05), ** (P<0.01).

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There is no difference in the percentage distribution of bladder cancer patients classified according to type of drinking as shown in table 8, while the Mean of Uc related to participators drinking pipe water is just slightly higher than that related to participators drinking filter water. That may be explained by the results of Uc measurements in water samples of Baghdad governorate (different districts residential), where Uc of taps water Range 1.088±0.012 to 2.5±0.003 µg/L with an average all 1.794±0.0075 µg/L, and Uc of Local bottled waters Range 1.152±0.017 to 2.46±0.014 µg/L with an average all 1.806±0.015 µg/L [31], consequently both type of drinking have the same effect in getting cancer. The average values of Uc in both type water samples are comparable to the recommended value of ICRP 1.9 µg/L .

Table 8: Distribution of bladder cancer patients classified according to Type of drinking water and their Mean of Uc (µg/L)

Type of drinking water	No.of cases	Percentage (%)	Mean ± SE of Uc (µg/L).
Pipe (tap)	29	48.33	2.06 ± 0.13
Filter	31	51.677	1.94 ± 0.08
Chi-Square	---	1.082 NS	P-value:0.2704 NS

Estimating possible links between drinking water and cancer means distinguishing those chemicals that appear in enough water supplies at enough concentrations to pose a fundamental attributable cancer risk. Finally, the compounds including in the pipes, joints, and fixtures of the water distribution system may pollute process water on its way to the consumer. Likeness in the construction of drinking water distribution systems mean that any carcinogen entering through this pathway may be widespread and can discompose fundamental attributable hazards of cancer [32].

Distribution of bladder cancer patients classified according to period of illness is shown in table 9. The percentage of bladder cancer cases is the highest at period of illness 1year, and the percentage is decrease as much as period of illness increase. Also the Mean of Uc is the highest for group of patient with period of illness 1 year. Results of distribution of bladder cancer patients, classified according to family history in table 10, indicate on absence the effect of genetic factor in causing cancer, where 70% of the cases don't have morbid history with cancer, In addition to that Mean Uc of the bladder cancer patient haven't morbid history is higher than the other patient. When we look at cancer history or (family history), we look at the number of relative who have had cancer, and their ages when they developed it. Cancer happening at older ages is less likely to be inherited. Many cancer kinds, such as lung cancer and cervical cancer are usually due to environmental than genetic influence [33].

Table 9: Distribution of bladder cancer patients classified according to Period of illness (year) and their Mean of Uc (µg/L)

Period of illness (year)	No.of cases	Percentage (%)	Mean ± SE of Uc (µg/L).
1	26	43.33	2.11 ± 0.08
2	21	35.00	1.97 ± 0.13
3	5	8.33	1.98 ± 0.11
4	5	8.33	1.86 ± 0.09
5	3	5.00	1.40 ± 0.11
Chi-Square	---	10.671 **	P-value: 0.081 NS

Table 10: Distribution of bladder cancer patients classified according to Family history and their Mean of Uc (µg/L)

Family history	No.of cases	Percentage (%)	Mean ± SE of Uc (µg/L).
Yes	18	30.00	1.74 ± 0.12
No	42	70.00	2.11 ± 0.14
Chi-Square	---	10.750 **	P-value: 0.108 NS

Color of urine is depending on type of eating, but nevertheless it is considered noteworthy and remarkable, where the highest percentage of bladder cancer patient, as shown in table 11, is 45% for orange urine color, and their Mean of Uc is the highest.

Table 11: Distribution of bladder cancer patients cassified according to Color urine and their Mean of Uc (μg/L)

Color f urine	No.of cases	Percentage (%)	Mean ± SE of Uc (μg/L).
1: Clear yellow	0	0.00	
2: Yellow	23	38.33	1.72 ± 0.06
3: Orange	27	45.00	2.27 ± 0.11
4: Brown	8	13.33	2.18 ± 0.07
5: Bloody	2	3.33	1.87 ± 0.10
Chi-Square	---	9.291 **	P-value: 0.084 NS.

CONCLUSION

There is a world of difference in Uc among groups of participators. The results showed that the CR-39 detector attained a very good sensitivity in measuring Uc variation among participators of study. The CR-39 detector is efficient in Uc calculation in bio assay samples even with low concentration, Sample preparation conditions and appointment of optimum etching condition are effective parameters to get the best results in quantifying number of track registered on SSNTD and increase registration efficiency to maximum, Where the results of Uc estimation after re-etching CR-39 at 10 hours showed excellent agreement with results of kinetic phosphorimetry analyzer. The decreasing pH of urine patient sample caused increasing amorphous urate and Uc.

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