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RESEARCH ARTICLE

Radon Concentration Measurement in Feed Grains by using SSNTD Type CR-39

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Abstract

Solid State Nuclear Track Detector (SSNTD) type CR-39 has been used to determine the radon concentration in samples of feed grains which are available in the local market in Samawah city, Iraq. Sixteen different samples of feed grains have been collected; some of them from Iraq and others were imported. These samples well have been ground using a ceramic mortar and then dried by electric oven to get the best data (that works to increase the surface area and reduce the moisture content). Optical microscope (CM001 CYANScope) has been used to calculate the number of tracks on the detector. The radon concentrations have been obtained by using the distribution technique within sealed-cup. The results indicate that the highest rate of radon found in the Nigella sativa (34.7Bq/m^3) and the lowest rate of radon concentration was in the Vigna radiata and Medicago sativa (1Bq/m^3).So, all feed grains that we tasted contain concentrations of radon, however it is within the allowable limits as recommended by the International Commission of Radiological Protection ICRP and The World Health Organization.

Introduction:-

Radon is a radioactive noble gas emitted by the decay of radium (^{226}Ra unstable element decay into ^{222}Rn and alpha particles). The half-life time of radon-222 is (3.823day). It is difficult to detect radon because it's a colorless, tasteless and odorless gas, whose density is 7.5 times higher than that of air. The boiling point of radon is (-61.8 ^{o}C), freezing point (-71.0 ^{o}C) and density (9.73 Kg.m^{-3}) [1, 2].

Radon gas can diffuse easily out of the soil surface to air or into building. Radon can be trapped in poorly ventilated dwellings and so its concentration can build up to higher levels. Although soil is considered to be the main source of indoor radon concentration, building materials (especially cement) can make a significant contribution to the level of natural radioactivity in closed spaces such as stores and badly-ventilated dwellings [3].

As radon decays they emit alpha particles with 5.486 MeV of energy, to produce polonium isotopes (Po- 218 and Po-214) into a series of other radioactive elements, as they contribute the majority of radiation dose when inhaled. The Radon and its decay products are reported as major causes of lung cancer [4, 5].

Indoor radon variations occur diurnally, and seasonally, and are depended on numerous factors like pressure differentials, soil characteristic, weather conditions (e.g. rainfall, wind speed) and behavior of inhabitant [6].

The aim of the present work is to determine the radon gas concentration in different types of feed grains using alpha-emitters registrations which are emitted form radon gas in CR-39 track nuclear detector.

Preparation of samples and the method:-

Samples have been collected (sixteen samples) from the local markets in Samawah city. Some samples were Iraqi origin and the others were imported from other countries because of absence of the local products at that time. Samples well ground using ceramic mortar, then they are placed in the electric oven (BINDER) for 48 hours at temperature (45 ^{0}C) for completely drying. After drying, twenty grams of each sample placed in transparent plastic flask. The powder of sample had been distributed on the base of flask. Sheet of detector CR-39 was cut into pieces of dimensions (1.5 cm x 1.5cm) and pasted a piece in the bottom of the plastic cover per flask. The cap tightly closed to make sure there are no outlets for alpha particles. One empty flask leaves to calculate the background radiation.

The flasks have been left for 45 days to get a clear view of the effects. Then the detectors take out from the flasks and etched by NaOH solution of concentration 6.25 N, where detectors placed with the solution in a water bath for 5 hours at temperature 70 ^{0}C , then washed by water and dried *. The numbers of tracks were observed by using an optical microscope [7].

The radon gas concentration C_{Rn} in feed grain samples was obtained by using the distribution technique within sealed-cup using the following relation [8, 9]:

$$C_{Rn} = \rho / T K . \quad (1)$$

The density of the tracks (ρ) in the samples calculated according to the following relation:

$$\rho = \text{Track/Area}, \quad (2)$$

where T is the exposure time and K is the distribution system factor, given by [10]:

$$K = \frac{1}{4} \times r \left[2\cos(\theta_c) - \frac{r}{R_\alpha} \right]. \quad (3)$$

*Temperature and irradiation time dependents on the type of solid state detector, which they are found in different thickness, according to manufacturing companies.

Results and Discussions:-

From the present work we have demonstrated, all kinds feed grains have been studied contents rate of radon concentration as present in table (1). Concentrations obtained by using detector CR-39 according distribution technique within sealed-cup.

Table (1) Radon Concentrations for sixteen Samples of Feed Grain

No.	Scientific name of feed Grains	Origin	$\rho[\text{Tr.cm}^{-2}]$	$C_{Rn}[Bq.m^{-3}]$
1	Nigella sativa	India	61.78	34.7
2	Phaseolus vulgaris	Egypt	18.67	10.5
3	Lens culinaris	Syria	3.11	1.7
4	Cicer	India	30.22	17.0
5	Hordeum vulgare	Iraq	55.11	31.0
6	Vigna radiata	Iraq	1.78	1.0
7	Vigna	Turkey	25.78	14.5
8	Avena sativa	Iraq	60.44	34.0
9	Sesamum indicum	Iraq	7.11	4.0
10	Yellow Zea mays	Iraq	30.22	17.0
11	Red Zea mays	Argentina	12.44	7.0
12	Zea mays	Turkey	20.00	11.2
13	Medicago sativa	Iraq	1.78	1.0
14	Pisumsativum	Canada	12.89	7.2
15	Eleusinecoracana	Iraq	20.44	11.5
16	Oryza sativa	India	12.89	7.2

The following figure explains relationship of radon concentrations among different kinds of feed grains.

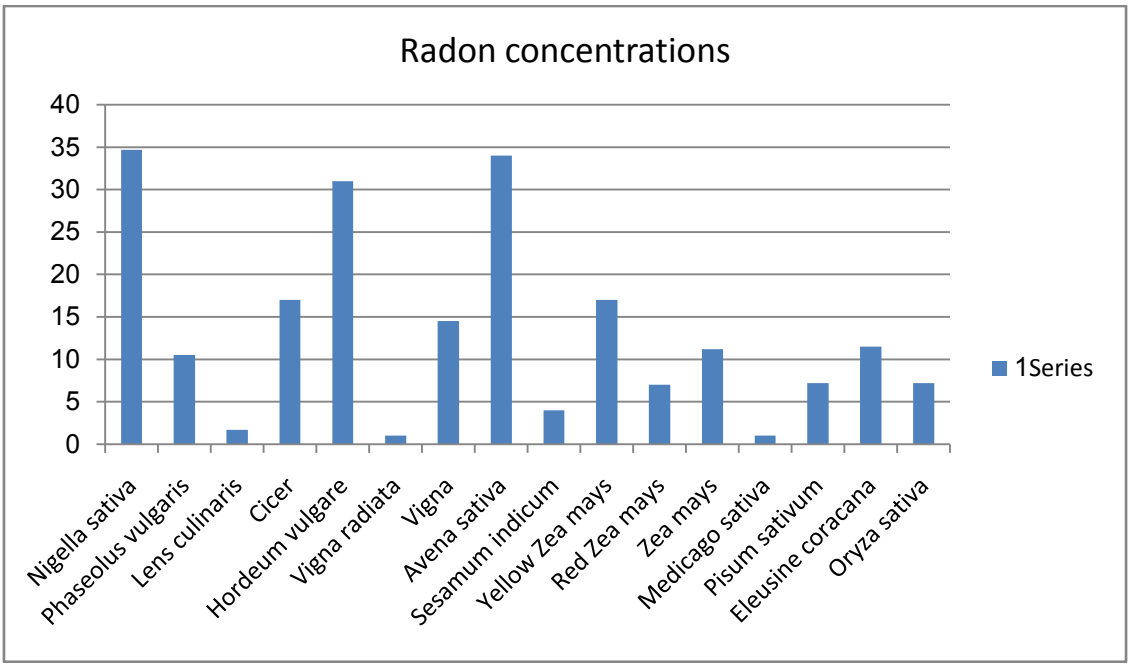

Figure (1) Radon concentrations of sixteen samples feed grains

From the Radon concentrations measurement for the sixteen samples, it has been observed that Nigella sativa which imported from India recorded higher value (34.7 Bq/m^3), while Vigna radiata and Medicago sativa Iraqi origin reveals lowest value with concentration (1 Bq/m^3). Hazardousness radon gas because it is gauge to detect alpha particles (Radon decays to polonium and alpha particle). Alpha particles become dangerous when enter into body, but there are no dangerous if collides with food particles, because it is may be lose their energy while dining. They are hazard when interacts with indoor tissues of body.

Conclusions:-

From the results obtained the following:

1- The highest rate of radon concentrations was (34.7 Bq/m^3) found in Nigella sativa from India, then Avena sativa Iraqi origin.

2- The lowest value of radon concentrations was (1 Bq/m^3) found in Vigna radiata and Medicago sativa Iraqi origin.

3- All values recorded within allowable limits as recommended by the International Commission of Radiological Protection ICRP and The World Health Organization.

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