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Radioactive activities in plant in the area the rare earth mine Muong Hum, Lao Cai

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Abstract: Nowadays, the determination of the total content of radioactive substances contained in plants is a great concern of public health care and in radiation safety control. However, the radioactivity in this type of sample is often very low, making their determination very difficult. This paper presents a method to determine the total alpha and beta radioactivity in plants by the HPGe gamma spectrometer and the LB4200 total alpha and beta measurement system at the laboratory of the Institute of Nuclear Science and Technology, the Institute of Energy. Vietnamese atom. Analytical results of 10 plant samples (04 samples of vegetables, 03 samples of water spinach, 02 samples of beans, 02 samples of potatoes) collected from households growing in the area of rare earth mine Muong Hum, Bat Xat district, Lao Cai province showed a clear distinction between plant samples, total alpha activity in tubers and fruit samples was higher than in green vegetable samples; The total beta activity in the samples was very low, almost negligible.

Keywords: alpha activity, beta activity, plants, Lao Cai

1. Introduction

Currently, the study of using plants as indicators in environmental monitoring, evaluation and treatment has been widely applied in the world. Because indicator plants are closely related to the living environment, they are also an important link in the transport of radionuclides from the source of pollution to humans and can be used as a method. environmental treatment techniques [1-3]. Therefore, in recent years, the method of using plants to treat radioactive pollution has been interested in research and investment because of its low investment cost, safety and environmental friendliness [4-6].

In the process of growth and development, plants absorb natural or artificial radioisotopes in the surrounding environment, especially in areas containing high levels of radionuclides. Therefore, in plants, there is a certain amount of radionuclides, and depending on the high or low radioactive content, the long or short use time of the plant will directly affect human health. Therefore, the determination of total alpha and beta activities in plant samples has been studied recently by domestic and foreign scientists [6-10].

The article presents the results of determining alpha and beta radioactivity in plant samples taken in the area of Muong Hum commune, Bat Xat district, Lao Cai province. This is an area of rare earth mines containing natural radionuclides with high concentration.

2. Research Methods

2.1. Research subjects

In this study, the author selected to conduct with 04 types of samples as follows: 03 samples of morning glory; 04 samples of cruciferous vegetables; 02 samples of beans and 02 samples of potatoes. These are samples grown and used by people in the area every day.

+) Water spinach: Water spinach contains many substances that are very important for the living organism such as: protit, glucose, cellulose. On the other hand, water spinach has good ability to absorb heavy metals, radiation, toxic substances... in water and soil.

+) Vegetables contain many substances such as protein, glucose, fiber, vitamins, minerals such as calcium, potassium, sodium, phosphorus ... Vegetables also have the ability to absorb toxic substances, heavy metals, radioactive substances. uranium, radium…

+) Cowpea contains protein, vitamins A and C, many vitamins of group B and many important trace elements for the body's development such as calcium, iron, potassium, phosphorus, magnesium, zinc...

+) Potatoes: Potatoes contain a lot of starch, many B vitamins and minerals necessary for humans such as zinc, calcium, magnesium, iron, phosphorus ...

Samples of morning glory, vegetables, cowpeas, potatoes were collected in the vegetable growing area of households in Muong Hum commune, these are the foods commonly consumed by people in the area.

2.2. Research Methods

In this work, the author has selected the method of processing and processing samples according to the ashing method. The advantage of this method is that it avoids chromogenic reactions that increase the "Quenching" effect in the detector and has high sample recovery. The disadvantage of the method is that it requires specialized skills and equipment. The treatment of samples by the ashing method is depicted [6-10].

3. Sample treatment

3.1. Sample cleaning

- Samples of green vegetables were removed from the root, withered leaves, then washed with water, rinsed with distilled water twice, and left to dry at room temperature.
- Potato samples were washed, peeled and allowed to dry at room temperature.

Table 1. Quantification of samples by ashing method

Sample	Symbol	Mass (g)	Note
Water spinach	M.01	175,0	Fresh samples
	M.02	174,6	Fresh samples
	M.03	176,1	Fresh samples
Cabbage	C.01	163,2	Fresh samples
	C.02	160,0	Fresh samples
	C.03	157,6	Fresh samples
	C.04	162,4	Fresh samples
Pea	Đ.01	158,0	Fresh samples
	Đ.02	159,3	Fresh samples
Potato	T.01	167,0	Fresh samples
	T.02	165,6	Fresh samples

3.2. Sample drying

The above samples were chopped and dried at 85°C for 72 hours. After the checkweighing, the loss in mass is shown in Table 2.

Table 2. Sample weight loss after drying

Sample	Amount of fresh samples (g)	Amount of sample after drying (g)	Attenuation (%)	Note
M.01	175,0	17,7	89,4	Water spinach
M.02	174,6	16,8	88,9	Water spinach
M.03	176,1	18,2	90,1	Water spinach
C.01	163,2	11,8	93,5	Cabbage
C.02	160,0	10,7	92,3	Cabbage
C.03	157,6	10,2	92,7	Cabbage

C.04	162,4	11,3	93,8	Cabbage
Đ.01	158,0	16,5	88,4	Pea
Đ.02	159,3	16,7	88,7	Pea
T.01	167,0	38,3	78,6	Potato
T.02	165,6	37,4	76,9	Potato

3.3. Sample heating

After drying, the samples are ashed in a specialized furnace. In order to ensure that the sample is completely ashed, after a number of tests, we have selected the firing temperature to be 700oC and the firing time to be 4 hours. The mass of ash obtained and the reduction in mass reduction are given in Table 3.

Table 3. Mass of calcined sample and amount of ash received

Sample	Amount of dry sample (g)	Amount of ash obtained (mg)	Attenuation (%)	Note
M.01	10	512	88,2	water spinach
M.02	10	517	88,7	water spinach
M.03	10	509	88,5	water spinach
C.01	10	623	90,4	Cabbage
C.02	10	621	90,2	Cabbage
C.03	10	627	90,5	Cabbage
C.04	10	624	90,6	Cabbage
Đ.01	6	202	92,8	Pea
Đ.02	6	204	92,7	Pea
T.01	10	301	94,5	Potato
T.02	10	305	94,6	Potato

4. Results and Discussion

In HPGe gamma spectrometer and alpha total counting system, beta LB4200 is used to analyze vegetable and tuber samples, by pulse discriminant technique, the signal of alpha radiation and signal of beta will be separated. on two separate channels.

Data analysis on the alpha channel and mass correction according to the instrument's standard data on the standard sample, determined the specific activity value of alpha radiation in the analyzed samples. The results are given in Table 4.

Table 4. Alpha activity in samples

Sample	The count has subtracted the font (CPM)	Alpha activity (Bq.kg-1)	Note
M.01	35,65 ± 0,74	41,33 ± 0,87	Water spinach
M.02	36,42 ± 0,72	42,18 ± 0,81	Water spinach
M.03	35,31 ± 0,72	42,25 ± 0,83	Water spinach
C.01	67,87 ± 0,92	45,24± 0,62	Cabbage
C.02	66,75 ± 0,91	46,04± 0,63	Cabbage
C.03	66,57 ± 0,91	45,32± 0,61	Cabbage
C.04	67,87 ± 0,92	45,87± 0,61	Cabbage
Đ.01	41,55 ± 0,78	48,12 ± 0,95	Pea
Đ.02	42,12 ± 0,77	48,79 ± 0,96	Pea
T.01	63,53 ± 0,91	82,34 ± 1,23	Potato
T.02	65,24 ± 0,93	83,75 ± 1,25	Potato

Results obtained in Table 4 show that there is a clear distinction in total alpha radioactivity in the samples. Radioactivity was highest in fruit and tuber samples (48.12 ÷ 83.75 Bq/kg), lower than in green vegetables (41.33÷46.04 Bq/kg).

The measurement results of beta radiation in the above samples, the beta channel of the instrumentation system shows that there is very little signal, almost insignificant. This proves that the amount of beta radiation in the plant samples is mainly from the element carbon (14C isotope). During the ashing process, this element was released in the form of carbonnic gas (CO2) out of the ash. This shows that, to determine the total beta radioactivity in plant samples, we can completely apply the method of measuring radiocarbon activity according to the radiocarbon age measurement process [12,13].

5. Conclusion

Using ashing technique, gamma spectrometer and alpha and beta total activity counter system are effective methods to determine the total alpha radioactivity in plant samples. Analytical results from 10 samples showed that there was a clear distinction between samples, total alpha activity in tubers and fruits was higher than in green vegetables.

With this ashing method, in the measurement results, the amount of beta radiation from the ash sample was not recorded, indicating that the beta radiation is mainly from the radioactive isotope of carbon. This element has been heated to CO2 and so to determine the total beta activity in plant samples we can completely use the radiocarbon age measurement procedure.

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