Investigation of distribution of elements in a Korean ginseng by using a neutron activation method

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1. Introduction

The Distinction of production areas of Korean ginsengs has been tried by using neutron activation techniques such as an instrumental neutron activation analysis (INAA) and a prompt gamma activation analysis (PGAA). This study was done as a part of those efforts. As is well known, the distribution of elements varies according to the part of plant [1] due to the difference of enrichment effect and influence from a soil where the plants have been grown. So a correlation study between plants and soil is an important issue. In this study, the distribution of trace elements within a Korean ginseng was investigated by using an instrumental neutron activation analysis.

2. Experiments

Experiments were carried out for a total of 10 ginseng samples, which were five-year-old Korean ginsengs directly sampled from one site and ten locations of Gwanghwa-gun located within Incheon city. Surface contaminants of ginseng were removed by wiping with brush and by washing in an ultrasonic cleaner with warm distilled water. Each ginseng was divided into five parts including a central body, a rhizome, a lateral root, a fine root and a periderm. The ginsengs were dried in a freeze dry machine and powdered by a pulverizer. Each part of the ginseng was sampled into two groups. One is weighed to be 20 ~ 50 mg for the determination of elements with short half-life nuclide and the other to be 150 ~ 200 mg for long half-life nuclide. The samples were packed into a polyethylene vials for neutron irradiation and irradiated in a vertical irradiation hole of the HANARO research reactor. Samples for short half-life nuclides were irradiated for 60 seconds in a PTS#1 hole, and those for long half-life nuclides were irradiated for long a irradiation time of 2 hours in a PTS#1 or PTS#2. The neutron flux in a PTS#1 is about 4.3×10^{13} n/cm^2 and that in a PTS#2 is about 3.2×10^{13} n/cm^2. The long irradiation samples were counted in two steps according to the decay properties. At first, samples were counted for 5,000 seconds with a cooling time of 7~10 days and then counted again for 10,000 seconds after 15 ~ 20 days. Elemental concentrations in the ginseng were calculated by using a KAERI-NAA software [2] coded in the MATLAB for a fast and convenient analysis.

3. Results & Discussion

The concentration values were averaged for the ten ginsengs and shown in Fig. 1. The most abundant seven elements in ginsengs are potassium, calcium, magnesium, chlorine, sodium, iron and aluminum.

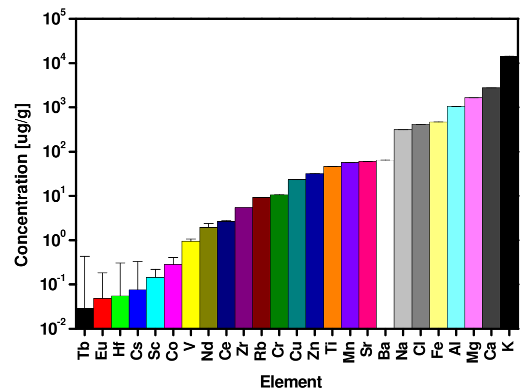

Fig. 1. Elemental concentrations in a ginseng.

Elements with short half-life nuclides for each part of a ginseng were shown in Fig. 2. Most elements seem to be enriched in the four parts much more than in the central body. Especially enrichment for aluminum, titanium and vanadium is bigger than those for others. Rhizome and fine root are the most enriched parts for most elements excluding some exceptions. Rhizome is at the end of the path of the minerals from soil to stem and fine root directly absorbs minerals from soil, which are the reasons that those two parts show larger concentrations than another two parts of lateral root and the periderm of the central body. This trend is almost same with those for elements with medium and long half -life nuclides.

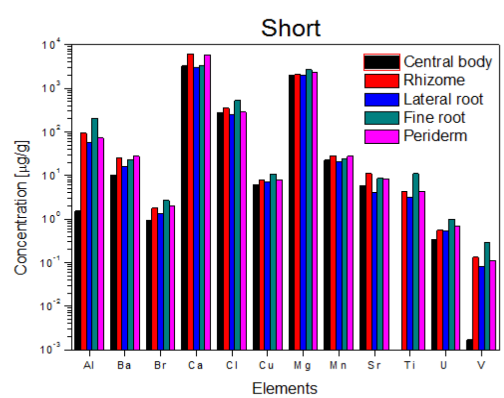

Fig. 2. Concentrations of elements with short half lived nuclides.

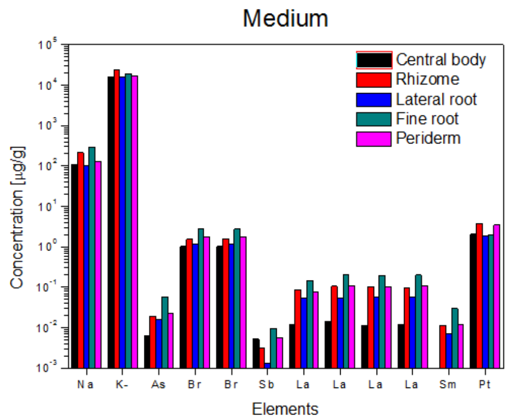

Fig. 3. Concentrations of elements with medium half lived nuclides.

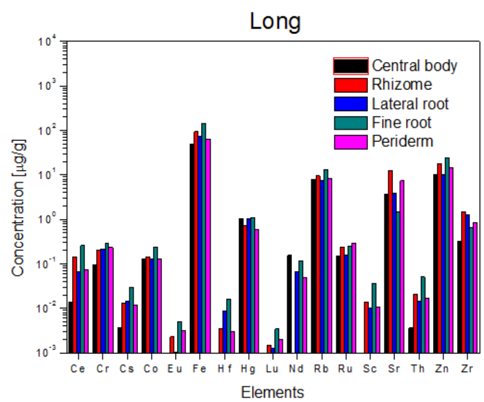

Fig. 4. Concentrations of elements with long half lived nuclides.

4. Conclusions

Elemental distribution was investigated for the ginsengs sampled at the Ganghwa-gun area. The rhizome and fine root are more enriched parts than the lateral root, periderm and central body due to the enrichment effects and the influence from soil. Most elements are enriched in a rhizome because rhizome is a path between soil and stem and also in a fine root because fine root is a part directly absorbing minerals from soil and water.

REFERENCES

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[2] G.M. Sun, Y.N. Lee, J.H. Moon, "Development of Quantification Software using Multi-analytical Methods for an Instrumental Neutron Activation Analysis: KAERI-NAA", *Korean Nuclear Society Autumn Meeting, Gyeongju, Korea, October 29-30, 2009.*