Trace-Element Analysis by Use of PIXE Technique on Agricultural Products

A. Takagi, R. Yokoyama, K. Makisaka
K. Kisamori, Y.Kuwada, D. Nishimura, R.Matsumiya, Y.Fujita, M.Mihara, K. Matsuta and M. Fukuda

▪ Purpose

Our group has worked on developing a way to determine production area of foods by analyzing its trace elements with PIXE. We tried to verify that trace elements of soy beans come from the soil of production area.

▪ Experiment

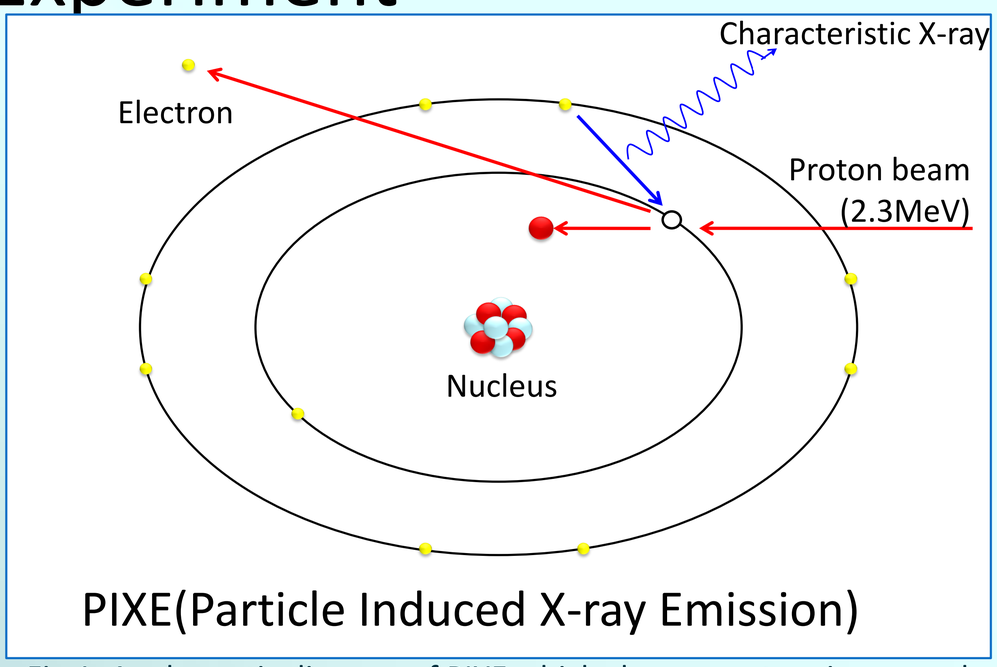
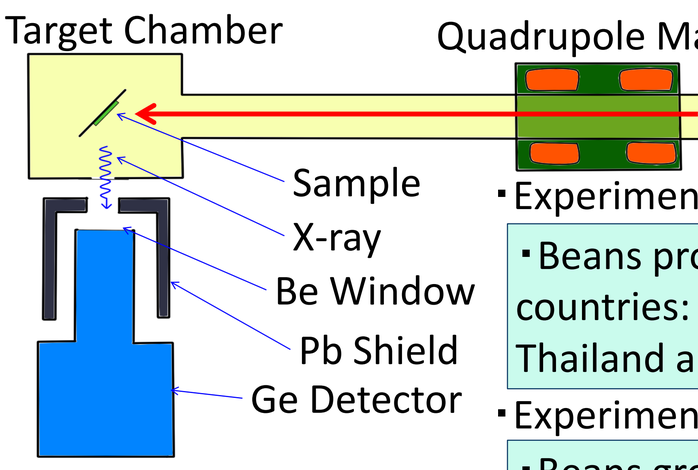


Fig.1: A schematic diagram of PIXE which shows an atom in a sample.

▪ Experimental set up and samples



2.3MeV Proton Beam
(Produced by Van de Graaff Accelerator at Osaka University)

▪ Experiment 1

- Beans produced in 4 different countries: China, Taiwan, Thailand and Japan.

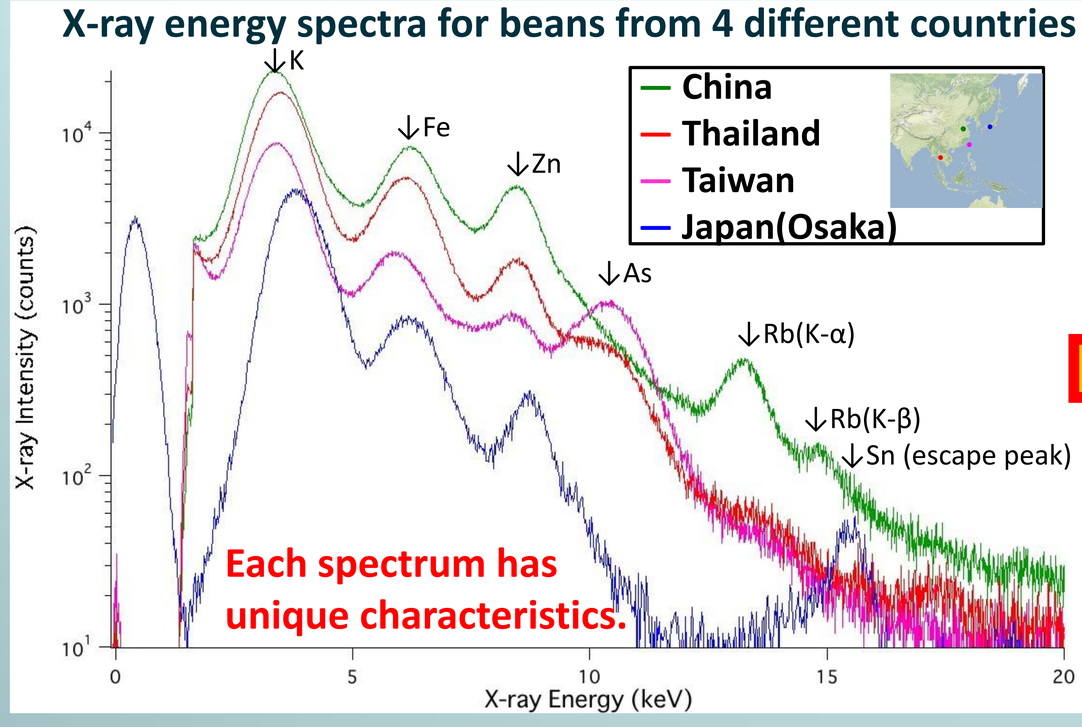
▪ Experiment 2

- Beans grown up in normal soil and Rubidium-added soil.

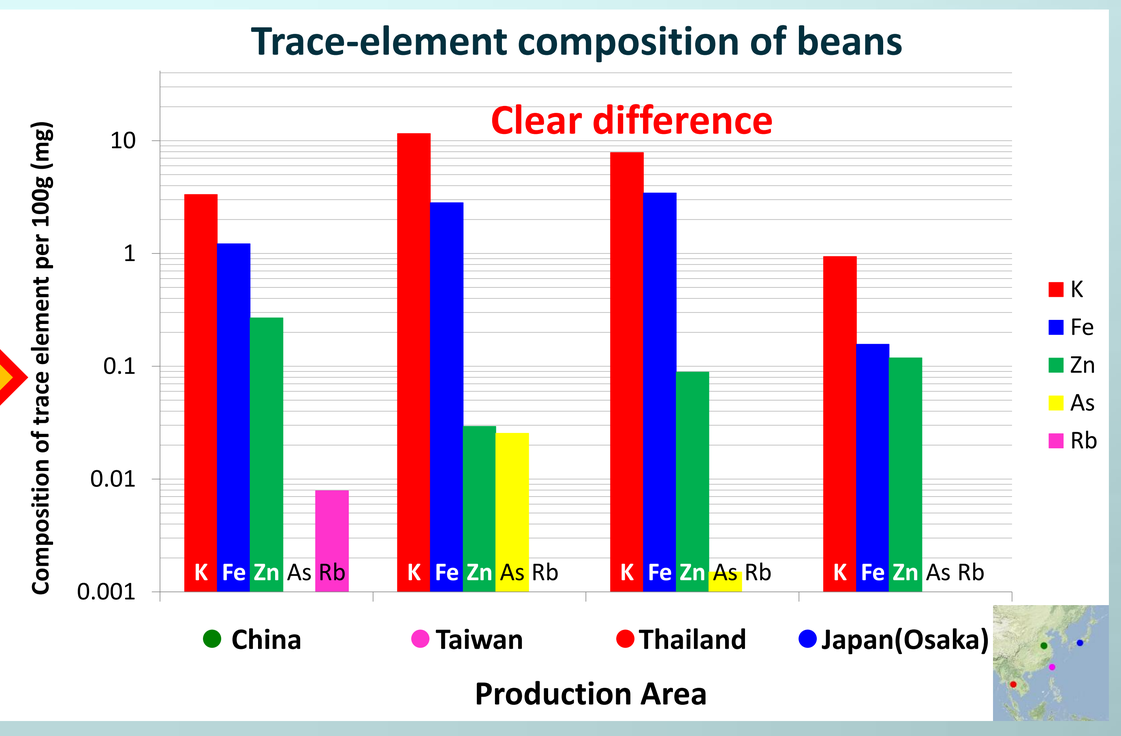
We put Sn to the sample as the standard of concentration.

▪ Result

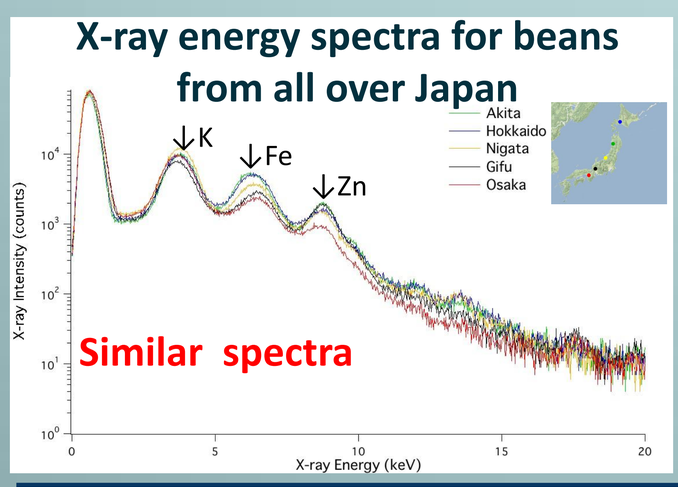
X-ray energy spectra for beans from 4 different countries



Trace-element composition of beans



X-ray energy spectra for beans from all over Japan



▪ Experiment 1

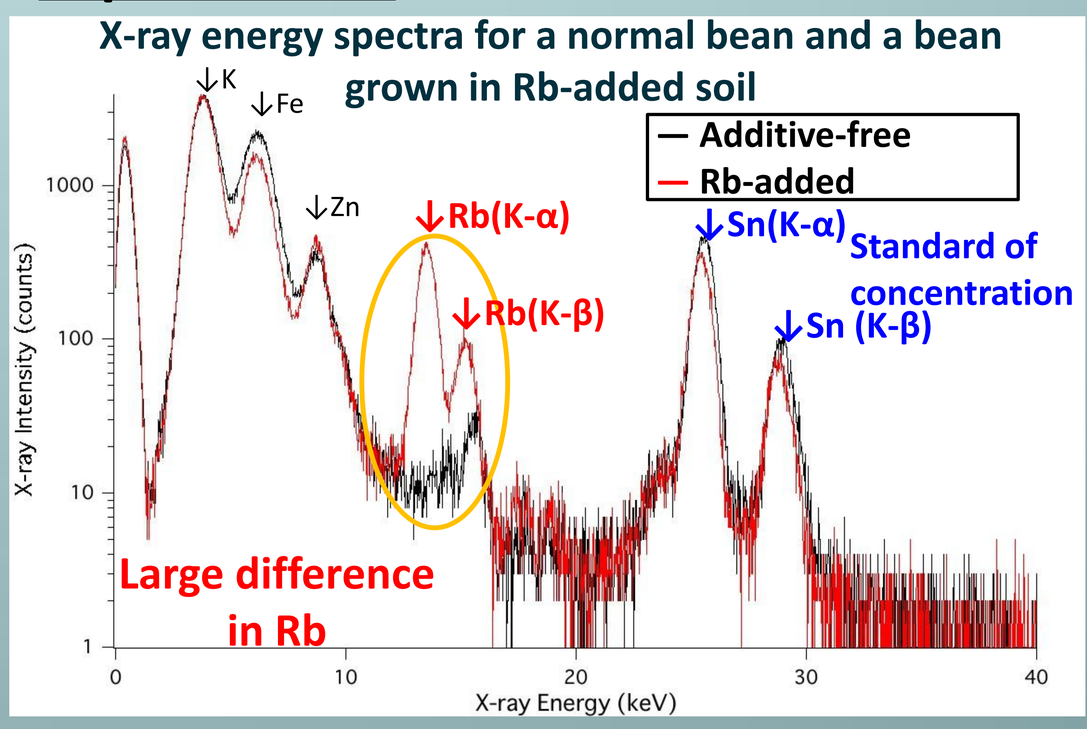
Difference of trace elements in beans from different area.

▪ Analysis

We fit each peak with two Gaussian (K-α and K-β) and linear background to count the number of X-rays.
We obtained the concentration of elements by comparing the peaks with that of Sn.
Rb of the amount from 0.2mg to 5mg per 100g of beans was detected from the beans grew in Rb-added soil whereas Rb was not detected from beans in normal soil.

▪ Experiment 2

X-ray energy spectra for a normal bean and a bean grown in Rb-added soil



We investigated whether the difference of trace elements is due to the soil.

We grew up beans in normal and Rb-added soil.

▪ Conclusion

We found that differences in concentration of trace elements depend on the production area. The difference is affected by the soil at least concerning with Rb.
The PIXE study could be used to distinguish the production area of agricultural products.

This study is carried out as a part of Osaka University Science Honors Program Commissioned by Ministry of Education, Culture, Sports, Science and Technology (Development Programs for Gifted Students in Universities).