EPITHERMAL NEUTRON ACTIVATION ANALYSIS OF THE ASIAN HERBAL PLANTS

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Asian medicinal herbs Chrysanthemum (*Spiraea aquilegifolia* Pall.) and Red Sandalwood *(Pterocarpus Santalinus*) are widely used in folk and Ayurvedic medicine for healing and preventing some diseases. The modern medical science has proved that the Chrysanthemum (*Spiraea aquilegifolia* Pall.) possesses the following functions: reducing blood press, dispelling cancer cell, coronary artery's expanding and bacteriostating and Red Sandalwood *(Pterocarpus Santalinus*) is recommended against headache, toothache, skin diseases, vomiting and sometimes it is taken for treatment of diabetes. Species of Chrysanthemums were collected in the north-eastern and central Mongolia, and the Red Sandalwood powder was imported from India. Samples of Chrysanthemums (branches, flowers and leaves) (0.5 g) and red sandalwood powder (0.5 g) were subjected to the multi-element instrumental neutron activation analysis using epithermal neutrons (ENAA) at the IBR-2 reactor, Frank Laboratory of Neutron Physics (FLNP) JINR, Dubna. A total of 41 elements (Na, Mg, Al, Cl, K, Ca, Sc, V, Cr, Mn, Fe, Co, Ni, Zn, As, Se, Br, Rb, Sr, Zr, Mo, Cd, Cs, Ba, La, Hf, Ta, W, Sb, Au, Hg, Ce, Nd, Sm, Eu, Tb, Dy, Yb, Th, U, Lu) were determined. For the first time such a large group of elements was determined in the herbal plants used in Mongolia. The quality control of the analytical results was provided by using certified reference material Bowen Cabbage. The results obtained are compared to the "Reference plant» data (B. Markert, 1992) and interpreted in terms of excess of such elements as Se, Cr, Ca, Fe, Ni, Mo, and rare earth elements.

The authors acknowledge the RFBR-Mongolia grant 08-05-90214-Mong_a.

INTRODUCTION

Herbal medicines are the staple of medical treatment in many civilizations including those of Africa, China, Egypt, India, Latin America and others [1]. According to the World Health Organization (WHO) estimates, 70% of the world population use herbal medicines and herbal products for primary health care [2]. Thousands of plants are used for curing various diseases in Mongolia. The larger part of treatment in Mongolian Traditional Medicine is medication. Our country has over 600 types of medical plants so far discovered. In addition Mongolia imports more than 100 components of traditional medicine from China and the Russian Federation [3]. To Medicinal herbs have

been used for healing as an alternative medicine, by all cultures, for thousands of years. About 80% of the world's population does not have access to conventional drugs and, therefore, rely on traditional medicine. According to the World Health Organization, the use of medicinal herbs becomes widely used even in the industrial countries as a complementary way to cure and prevent diseases.

Usually herbal medicines are not regulated as medicines. Problems might arise due to the lack of adequate regulations, the pharmacological complexity of herbal products, and the lack of information on the pharmacology and toxicity of the compounds [4]. Herbal plants have a unique and special use in pharmacology, but other components or trace elements which present in the herbs may cause side effect [5].

A direct correlation between elemental content of medicinal plants and their curative ability is not yet understood in terms of modern pharmacological concept. So, the quantitative estimation of various trace element concentrations is important for determining the effectiveness of the medicinal plants in treating various diseases and also to understand their pharmacological action. Moreover, trace elemental analysis of medicinal plants can be used to decide the dosage of the herbal drugs prepared from these plant materials.

Neutron activation analysis is a very convenient method for analyzing trace elements in all types of samples, including herbal medicine. Examples of recent work on the use of the technique are 28 elements in medicinal herbs [6] 12 elements in Chinese medicinal herbs [7], Ayurvedic Indian medicinal herbs [8].

The present study was undertaken to investigate the elemental contents in 2 types of medicinal herbs commonly used in controlling and healing of different diseases.

EXPERIMENTAL

Sample collection and preparation

Species of Chrysanthemums were collected in the north-eastern and central Mongolia, and the Red Sandalwood powder was imported from India. In the laboratory the sample of Chrysanthemums was cleaned from extraneous plant materials and dried to constant weight at 30^0-40^0 for 48 hours. The samples were not washed and not homogenized.

Analysis

The concentration of elements in the herbal plant samples was determined by a multi-element instrumental neutron activation analysis using epithermal neutrons (ENAA) at the IBR-2 reactor, FLNP JINR, Dubna. To carry out ENAA investigations, plant samples of 0.5 g were heat-seated in polyethylene foil bags and packed in aluminum cups for short and long irradiation, respectively.

The analytical procedures and the basic characteristics of the employed pneumatic system are described in detail elsewhere [9]. Two types of analysis were done. One of is a short irradiation of 3-5 min to analyze for short-lived isotopes (Al, Ca, Cl, I, Mg, Mn, and V). After a decay-period of 5 to 7 min the irradiation samples were measured twice, first for 3-5 and then for 10-15 min. A long-irradiation of 4-5 days was used to analyze for long-lived radionuclides. After irradiation the samples were re-packed and measured twice, first in 4-5 days for 40-50 min to determine As, Br, K, La, Na, Mo, Sm, U, and W and in 20 days for 2.5-3 hours to determine Ba, Ce, Co, Cr, Cs, Fe, Hf, Ni, Rb, Sb, Sc, Sr, Ta, Tb, Th, Yb, and Zn. The gamma spectra of the samples were measured with a Ge-Li detector with a resolution of 2.5-3 keV for the ^{60}Co 1332 keV line. A HPGe with a resolution of 1.9 keV for the ^{60}Co 1332 keV line was also used.

The processing of the data and determination of the concentrations of elements were performed using certified reference materials and flux comparators with the help of the software developed in FLNP, JINR [10].

RESULTS AND DISCUSSION

The concentrations of 41 elements were determined in 2 medicinal herbs samples using INAA. Table 1 shows the elemental concentrations determined in the medicinal herbal samples and certified reference material Bowen Cabbage.

The data on major, minor and trace elements content in plants are of vital importance to understand the poharmacological action of the herbs. The data will be useful also in deciding the dosage of the herbs used in the final formulation. As trace elements play a very important role on the formation of biologically active compounds in the plants, more studies are needed to understand the exact mechanisms of action and formation of active constituents for each medicinal plant.

For the first time such a large group of elements was determined in the herbal plants used in Mongolia. The quality control of the analytical results was provided by using certified reference material Bowen Cabbage. The results obtained are compared to the "Reference plant" [11] data and interpreted in terms of excess of such elements as Se, Cr, Ca, Fe, Ni, Mo, and rare earth elements.

CONCLUSION

The data obtained in the present work are important for synthesis of new herbal drugs which can be used for the control and cure of various diseases. In order to develop a stronger basis for appreciating the curative effects of medicinal plants, there is a need to investigate their elemental content. It has been demonstrated that INAA with its multi-elemental characterization over a wide range of concentrations, blank free-nature and minimum sample preparation is the ideal analytical technique for such studies.

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Table 1. Elemental concentrations in medicinal herbs samples (in ppm dry weight)

№	**Elements**	**Bowen Cabbage CRM**	**“Reference plant”**	**Chrysan themum**	**Sandal tree**
1	Na,	563	**150**	697	48,3
2	Mg	2160	**0,2%**	3000	244
3	Al	142	**80**	1460	28,4
4	Cl	5760		2410	210
5	K	32500	**1,9%**	22300	1120
6	Ca	18800	**1%**	6760	8160
7	Sc	0,03	**0,02**	0,30 (14)	0,01
8	V	-	**0,5**	1,80	0,09
9	Cr	2,94	**1,5**	3,48	2,56
10	Mn	22,1	**200**	31,6	19,3
11	Fe	179	**150**	1070	616
12	Co	0,12	**0,2**	0,36	0,09
13	Ni	2,87	**1,5**	6,43	9,17
14	Zn	41,9	**50**	27,7	10,3
15	As	0,15	**0,1**	0,76	0,29
16	Se	0,10	**0,02**	0,45	0,04
17	Br	7,96	**4**	22,4	0,97
18	Rb	7,00	**50**	21,6	1,00
19	Sr	49,6	**50**	23,0	21,8
20	Zr	6,67	**0,1**	42,6	3,31
21	Mo	10,0	**0,5**	3,56	3,43
22	Cd	0,3	**0,05**	1,01	0,10
23	Cs	0,03	**0,2**	0,19	0,001
24	Ba	11,6	**40**	25,9	9,61
25	La	0,16	**0,2**	1,35	0,10
26	Hf	0,03	**0,05**	0,29	0,001
27	Ta	0,01	**0,001**	0,03	0,01
28	W	0,12	**0,2**	0,32	0,57
29	Sb	0,05	**0,1**	0,10	0,03
30	Au	0,001	**0,001**	0,001	0,002
31	Hg	0,35	**0,1**	0,34	0,13
32	Ce	0,39	**0,5**	2,01	0,09
33	Nd	0,98	**0,2**	1,34	0,43
34	Sm	0,02	**0,04**	0,17	0,01
35	Eu	0,001	**0,008**	0,02	0,01
36	Tb	0,001	**0,008**	0,02	0,001
37	Dy	-	**0,03**	0,14	0,02
38	Yb	0,03	**0,02**	0,05	0,01
39	Th	0,03	**0,005**	0,32	0,01
40	U	0,02	**0,01**	0,12	0,001
41	Lu	0,001	**0,003**	0,02	0,001