



## NOTE

### Simultaneously Determining the Wholesome and Harmful Elements in Wild *Amaranthus mangostanus* L. by ICP-MS

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In this study, the contents of many trace elements were simultaneously determined in wild *Amaranthus mangostanus* L. by ICP-MS. The results showed that *Amaranthus mangostanus* L. contained many kinds of wholesome elements, especially K, Ca and Mg were all more than 2000 µg/g FW. The concentration of Fe in *Amaranthus mangostanus* L. was 53.36 µg/g FW, which should be the reason why *Amaranthus mangostanus* L. have therapeutic efficacy for iron deficiency anemia. The descending order of the other wholesome is Na > Zn > Sr > Mn > Cu > Mo > Li > Se. As, Cr and Cd in *Amaranthus mangostanus* L. did not exceeded the national standard, but the concentration of lead was higher than the national standard, so wild *Amaranthus mangostanus* L. should be detected before eating.

**Key Words:** *Amaranthus mangostanus* L., Wholesome elements, Harmful elements, ICP-MS.

Amaranth (*Amaranthus mangostanus* L.) is annual herb, which belongs to Amaranthaceae, whose edible organs are tender leaves and stems. Amaranth were distributed around the world. In recent years, with the quest for a return to nature, wild amaranth becomes essential vegetables of people on the table and upscale hotels. Amaranth contains a wealth of essential nutrients, such as carotene, vitamin B<sub>1</sub>, vitamin B<sub>2</sub>, vitamin C and trace elements Ca and Fe. All parts of amaranth plant can be used as medicine, which have therapeutic efficacy for enteritis, constipation, goiter, iron deficiency anemia, jaundice and cancer. But the mechanism for the above-mentioned efficacy of amaranth is less reported, especially the main active ingredients in amaranth is not comprehensively reported and content of harmful elements has not been reported. It is of great significance to find these functions of amaranth to study the contents of more trace elements<sup>1</sup>.

Trace elements, as the body of vital nutrients, are essential for human health. Several trace elements (Ca and Fe) has been studied in amaranth, which is not enough to study nutrition and the mechanism of therapeutic efficacy of amaranth. With the development of instrumental analysis techniques, determination of trace elements becomes more and more simple and more and more accurate. Inductively coupled plasma mass spectrometry (ICP-MS) is good technology developed in

recent years for determination of trace elements<sup>2</sup>. In addition to the accuracy and efficiency, ICP-MS can also determine many elements simultaneously.

All trace elements in *Amaranthus mangostanus* L. were determined by inductively coupled plasma mass spectrometry (ICP-MS, Model Thermo-X7, Thermo Electron Corporation, USA).

The wild *Amaranthus mangostanus* L. (Fig. 1) were collected from Mount Tianmu, Hangzhou District of Zhejiang province, China. Samples were taken back to the laboratory in the incubator in order to avoid water loss.

Weighing 0.5 g *Amaranthus mangostanus* L. in a mortar to grind into the homogenate and add 6 mL of concentrated nitric acid soaking for 12 h, then add 2 mL 30 % H<sub>2</sub>O<sub>2</sub> solution soaking for 4 h; digesting and heating to boiling of the sample until remaining 1 mL, transferring to a 15 mL centrifuge tube. Constant volume to 10 mL. Experiment was repeated 5 times.

**Parameters of ICP:** Power, 1200 W; flow of cooling gas (Ar), 12.0 L/min; flow of supplemental gas (Ar), 1.80 L/min; flow of carried gas (Ar), 0.90 L/min. Parameters of MS: vacuum of analysis room, 5.86×10<sup>-6</sup> Torr; impulse voltage, 1150 V.

**Wholesome elements in *Amaranthus mangostanus* L.:** The results showed that *Amaranthus mangostanus* L. contains



Fig. 1. The wild *Amaranthus mangostanus* L.

many kinds of wholesome elements, especially K, Ca and Mg, whose concentrations were all higher than 2000  $\mu\text{g/g}$  FW. The concentration of Fe in *Amaranthus mangostanus* L. was 53.36  $\mu\text{g/g}$  FW, which should be the reason why *Amaranthus mangostanus* L. have therapeutic efficacy for iron deficiency anemia. The descending order of the other wholesome is  $\text{Na} > \text{Zn} > \text{Sr} > \text{Mn} > \text{Cu} > \text{Mo} > \text{Li} > \text{Se}$  (Table-1).

TABLE-1  
CONTENTS OF WHOLESOME ELEMENTS  
IN WILD *Amaranthus mangostanus* L.

| Elements | Content                    |
|----------|----------------------------|
| Li       | 61.56 ng/g FW              |
| Fe       | 53.36 $\mu\text{g/g}$ FW   |
| K        | 8359.20 $\mu\text{g/g}$ FW |
| Mg       | 2277.69 $\mu\text{g/g}$ FW |
| Na       | 19.26 $\mu\text{g/g}$ FW   |
| Zn       | 15.14 $\mu\text{g/g}$ FW   |
| Se       | 15.87 ng/g FW              |
| Mo       | 401.53 ng/g FW             |
| Sr       | 11.71 $\mu\text{g/g}$ FW   |
| Cu       | 2.27 $\mu\text{g/g}$ FW    |
| Mn       | 8.13 $\mu\text{g/g}$ FW    |

#### Harmful elements in *Amaranthus mangostanus* L.:

Harmful metals mainly refers to heavy metals, including As, Cr, Cd and Pb, which is important to evaluate the food safety. The data showed that As, Cr, Cd and Pb in *Amaranthus mangostanus* L. were 27.95, 81.24, 19.60 and 235.12 ng/g FW respectively (Table-2). As, Cr and Cd in *Amaranthus mangostanus* L. did not exceeded the national standard<sup>3-5</sup>, but the concentration of Pb was higher than the national standard<sup>6</sup>, which should be relative to the soil and groundwater. So wild *Amaranthus mangostanus* L. should be detected before eating.

TABLE-2  
CONTENTS OF HARMFUL ELEMENTS IN  
WILD *Amaranthus mangostanus* L. (ng/g FW)

| Elements | Content |
|----------|---------|
| As       | 27.95   |
| Cd       | 19.60   |
| Pb       | 235.12  |
| Cr       | 81.24   |

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