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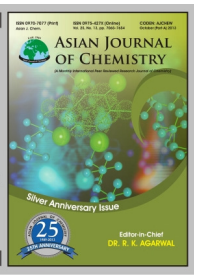

# Mineral Contents in the Roots of Blue and White Flowered *Platycodon grandiflorum* (Jacq.) A. D.C. from China and Korea

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In this paper, we described the mineral contents of 11 different accessions of balloon flower (*Platycodon grandiflorum*) collected from China and Korea. The roots of balloon flower plants with blue flowers had greater concentrations of five important minerals-Ca, Fe, Mg, Mn and Zn than did the roots of plants with white flowers. In most cases, the concentration of minerals in the roots of plants with blue flowers was nearly twice that of plants with white flowers. Concentrations of Ca and Mg were much higher than concentrations of the other minerals assayed in the roots of all plants, regardless of flower colour. Accession CB02 had blue flowers and its roots contained the highest levels of Ca, Mn and Zn. Accessions CB01 and CB05, which also had blue flowers, had roots with the highest amounts of Mg and Fe, respectively. Among the accessions, CB02, might suitable to use commercially as its mineral content was much higher than that of any other tested accession.

**Key Words: Blue and white flower colour, Minerals, Balloon flower.**

## INTRODUCTION

*Platycodon grandiflorum* is a perennial plant of the Campanulaceae family that contains triterpenoid saponin, carbohydrates and fibers. Platycodi Radix, the roots of *Platycodon grandiflorum*, is used in traditional oriental medicine as an expectorant and antitussive to treat coughs, colds, upper respiratory tract infections, sore throats, tonsillitis and chest congestion[1]. It is also eaten as a vegetable in northern China and Korea. *P. grandiflorum* improves insulin resistance and lipid profiles in rats with diet-induced obesity[2]. The saponin contained in *P. grandiflorum* is reported to reduced serum cholesterol concentration by inhibiting the reuptake of bile acids in the intestine and increasing fecal excretion[3]. Dietary intake of *P. grandiflorum* may therefore be useful for prevention and improvement of metabolic disorders such as NIDDM, syndrome X, coronary artery disease, hypercholesterolemia and hyperlipidemia[4,5].

According to the World Health Organization (WHO)[6] mineral deficiencies are widespread in developing countries. The deficiency of calcium is associated with weak bones and teeth, cardiovascular diseases, diabetes, hypertensive disorders of pregnancy, obesity and cancer of the colon. Iron deficiency may cause anemia, which can reduce work capacity and resistance to fatigue. Magnesium deficiency is related to anxiety, asthma, hypotension, insomnia, irritability, menstrual migraines, muscle pains, restlessness and vertigo[7]. Manganese influences the intestinal tract lining, biliary lining, laryngeal passages and excretory duct of the liver, ovaries and the linings of the generative organs. Zinc deficiency causes growth retardation or failure in fetuses, infants and adolescents. The deficiency of zinc can also cause delayed sexual maturation, behavioural changes, diarrhea, skin lesions and eye lesions[8].

Most balloon flower research has focused on the medicinal value of the plant, particularly the different types of saponin

present in thse species. There has been little research regarding the mineral content. We determined the minerals content of different accessions of balloon flower that were collected from different sources in Asia. The objectives of this study were to find out the best accessions assessing the minerals *i.e.*, calcium, iron, magnesium, manganese and zinc contents of different accessions of balloon flower in different sources.

## EXPERIMENTAL

Balloon flower (*P. grandiflorum*) seeds were collected from different areas of China and Korea and stored at 4 ºC. Balloon flower seeds were germinated in a greenhouse and the seedlings were transferred to an experimental farm at the Agricultural College of Yanbian University (Longjing, China). After 7 months, the roots of the balloon flower plants were harvested and dried at 60 ºC for 48 h.

**Determination of mineral contents:** Dried plant roots (1 g) were transferred to 250 mL glass volumetric flasks. Samples were dissolved in 20 mL nitric acid diluted by water (5:1, v/v). Samples were then incinerated in a microwave oven at 210 ºC. Distilled deionized water and ultrahigh-purity commercial acid were used to prepare all reagents, standards and samples. After the digestion treatment, samples were filtered through Whatman No. 42 filter paper. The filtrates were collected in 50 mL flasks and analyzed using an Inductively Ciupled Plasma Atomic Emission Specto meter (ICP-AES, Perkin-Elmer- Instrument, USA). The mineral contents of the samples were quantified using standard solution (Quality Control Standard, Perkin-Elmer- Instrument, USA). Mineral nutrients were checked against certified values in reference plant samplesreceived from the National Institute of Standards and Technology (NIST; Gaithersburg, MD, USA).

## RESULTS AND DISCUSSION

Among the 11 accessions tested, six had blue flowers and five had white flowers. Among the six accessions with blue flowers, five originated from China and only one originated from Korea (South). Among the five accessions with white flowers, three were collected from China and of the remaining two were from Korea (North). The accessions, their assigned accession number and flower colour are presented in Table-1. Fig. 1 shows both white and blue balloon flowers.

TABLE-1
ACCESSION NUMBER, ORIGIN AND FLOWER COLOUR OF *Platycodon grandiflorum* COLLECTED IN CHINA AND KOREA [Ref. 16]

| Accession number | Accession | Flower colour |
|---|---|---|
| CB01 | Longjing, Jilin, China | Blue |
| CB02 | Changchun, Jilin, China | Blue |
| CB03 | Ningan, Heilongjiang, China | Blue |
| CB04 | Chifeng, Neimeng, China | Blue |
| CB05 | Linyi, Shandong, China | Blue |
| KB01 | Chunchon, Kangwon, Korea (South) | Blue |
| CW01 | Longjing, Jilin, China | White |
| CW02 | Yanji, Jilin, China | White |
| CW03 | Meihekou, Jilin, China | White |
| KW01 | Sinuiju, Pyonganbuk, Korea (Norh) | White |
| KW02 | Najin, Hamgyongbuk, Korea (North) | White |

Fig. 1. A sample of both white and blue flower colour balloon flower [Ref. 16]

**Mineral contents of balloon flower roots:** Balloon flowers from both from China and Korea are potential sources of minerals that are important for human nutrition (Table-2). Five important minerals, Ca, Fe, Mg, Mn and Zn are present in significant concentrations in the roots of balloon flowers.The Ca content of accessions with blue flowers was more varied than that of accessions with white flowers. The blue-flowered CB02 contained 29 and 20 % more Ca than KB01 and CB04, respectively. KB01 and CB04 were the blue-flowered accessions with the lowest concentrations of calcium. The white-flowered accessions CW01 and KW01 contained similar amount of Ca. These accessions contained 24 % more than CW03, which had the lowest concentration of Ca among white-flowered accessions.

The blue-flowered CB05 contained 47, 28, 15, 13 and 11 % more Fe than KB01, CB01, CB04, CB03 and CB02, respectively. Among white-flowered accessions, KW01 contained the highest amount of Fe. The Fe concentration in KW01 was 41, 27, 26 and 14 % greater than that in CW03, KW02, CW02 and CW01, respectively. The blue-flowered CB01 contained 28, 25, 10.5, 10 and 8 % more Mg than KB01, CB04, CB02, CB03 and CB05, respectively. There was more variation in Mg content among blue-flowered accessions than among white-flowered accessions. The white-flowered KW01 contained more Mg than any other white-flowered accession with 25, 15, 6 and 4 % more Mg than CW03, KW02, CW02 and CW01, respectively. There was a similar in the Fe and Mg content of white-flowered accessions.

TABLE-2
MINERALS CONTENT OF THE ROOTS OF BOTH BLUE- AND WHITE-FLOWERED BALLOON FLOWER (*Platycodon grandiflorum*)

| Accession number | Mineral (μg/g) | | | | |
|---|---|---|---|---|---|
| | Ca | Fe | Mg | Mn | Zn |
| CB01 | 1976.2 ± 38.2 | 221.1 ± 5.6 | 1171.1 ± 31.4 | 6.5 ± 0.2 | 30.2 ± 0.9 |
| CB02 | 2102.9 ± 46.4 | 270.8 ± 6.4 | 1052.0 ± 22.6 | 10.4 ± 0.3 | 72.2 ± 2.7 |
| CB03 | 1949.4 ± 53.7 | 264.9 ± 5.7 | 1055.2 ± 42.6 | 7.4 ± 0.3 | 52.5 ± 2.1 |
| CB04 | 1687.7 ± 27.2 | 258.5 ± 6.2 | 877.6 ± 18.9 | 4.5 ± 0.2 | 34.1 ± 1.3 |
| CB05 | 1961.9 ± 41.7 | 305.4 ± 4.6 | 1075.0 ± 32.7 | 7.0 ± 0.3 | 37.9 ± 1.6 |
| KB01 | 1493.8 ± 27.3 | 163.4 ± 3.8 | 839.7 ± 21.6 | 1.2 ± 0.1 | 25.2 ± 0.7 |
| CW01 | 1831.9 ± 47.4 | 237.4 ± 6.5 | 1090.0 ± 29.3 | 3.6 ± 0.1 | 32.3 ± 1.1 |
| CW02 | 1730.1 ± 39.5 | 203.9 ± 4.7 | 1066.9 ± 33.6 | 8.7 ± 0.2 | 30.5 ± 1.4 |
| CW03 | 1399.9 ± 28.4 | 163.2 ± 4.1 | 855.7 ± 19.4 | 2.9 ± 0.1 | 22.7 ± 0.9 |
| KW01 | 1830.9 ± 61.8 | 275.2 ± 5.9 | 1130.7 ± 28.4 | 8.5 ± 0.3 | 28.1 ± 1.2 |
| KW02 | 1642.9 ± 47.3 | 200.8 ± 5.5 | 959.6 ± 22.8 | 4.1 ± 0.1 | 19.8 ± 0.7 |

The blue-flowered CB02 contained 57, 38, 33 and 29 % more Mn than the other blue-flowered accessions CB04, CB01, CB05 and CB03, respectively. The white-flowered CW02 contained 67, 59, 53 and 2 % more Mn than the other white-coloured accessions CW03, CW01, KW02 and KW01, respectively. The Zn content of the blue-flowered accessions was almost double that of the white-flowered accessions. CB02 contained 65, 58, 53, 48 and 27 % more Zn than the other blue-flowered accessions KB01, CB01, CB04, CB05 and CB03, respectively.

Minerals content varies with species, cultivar, geographical place of harvest, season, environmental factors, the method of mineralization and physiological factors[9-12]. In particular, the Ca and Fe content of vegetables are reported to vary with species and cultivar[13-15].

## Conclusion

The results of this study may contribute toward the identification of high-mineral content accessions of balloon flower that might be commercially produced for medicinal purposes.

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