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Selenium Enrichment Ability of *Capsella bursa-pastoris*

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Abstract. Pot experiment was conducted to investigate the dry weight, selenium extraction and accumulation of roots, stems, leaves and shoots of *Capsella bursa-pastoris* under the conditions of 0, 5, 10, 25, 50, 75 and 100 mg/kg. The results showed that selenium at the concentrations of 5, 10 and 25 mg/kg could promote the growth of *C. bursa-pastoris*, and the selenium content of each part of *C. bursa-pastoris* increased with the increase of selenium concentration. The transfer factor increased at first and then decreased, the maximum was 0.474. The accumulation of selenium increased at first and then decreased with the concentration increasing, and reached the maximum at 25 mg/kg.

1.Introduction

Selenium is a necessary trace element for human body. It has certain health care function and cannot be synthesized by human body and can only be absorbed from outside [1]. According to the investigation, the selenium intake of Chinese residents is far lower than the recommended intake of nutrition society, and their health is threatened [2]. Oral sodium selenite tablets are a way to supplement selenium, but the absorption rate of inorganic agents in human body is very low, and it has certain toxic and side effects [3]. The use of plants to convert inorganic selenium into organic selenium to increase the content of selenium in food is a fundamental measure to increase the selenium intake of residents [4]. *Capsella bursa-pastoris* is an annual or biennial herb of *Capsella* of *Cruciferae*, which is distributed in temperate regions of the world. It is common wild and also cultivated artificially [5]. The selenium content of four kinds of garlic [6], *Brassica campestris* [7-8] treated plants was higher than that of the control. Using *C. bursa-pastoris* and sodium selenite as raw materials, the changes of dry weight, selenium content and selenium accumulation of *C. bursa-pastoris* in different selenium concentration soil were studied in this experiment.

2.Materials and methods

2.1 Materials collection

C. bursa-pastoris seeds were collected in farmland near Chengdu campus of Sichuan Agricultural University. Sodium selenite is a common laboratory reagent and is purchased from Chengdu Kelong chemical reagent factory. The soil is fluvo-aquic soil from farmland near Chengdu campus of Sichuan Agricultural University (selenium is not detected), which is spread out for drying for one week and then passed through a 5 mm sieve.



2.2 Experimental design

The experiment was carried out in Chengdu campus of Sichuan Agricultural University. 3 kg of soil was weighed and put into a 21 cm × 20 cm (height × diameter) basin. 0, 5, 10, 25, 50, 75 and 100 mg/kg of sodium selenite solution were added respectively to fully mix with the soil, keep the soil moist, mix again after natural standing and balancing for 4 weeks, and mix the soil thoroughly and evenly from time to time. Selecting *C. bursa-pastoris* seeds with full grains, sterilizing in 10% hydrogen peroxide solution for 10 min, then washing with ultrapure water, uniformly placing in a culture dish with filter paper, maintaining sufficient water, and accelerating germination in a 20 degc artificial incubator. Sowing in a 32-hole tray after exposure to white light to raise seedlings, when growing to 3-5 real leaves, selecting *C. bursa-pastoris* seedlings with the same growth rate to transplant into prepared pots with different selenium concentration treated soil, 4 plants in each pot, repeating each treatment 5 times. After *C. bursa-pastoris* grows in soil with different selenium concentrations for 30 d, various indexes are harvested and determined. The dry weights of roots, stems and leaves were determined by conventional methods. The contents of selenium in different parts of *C. bursa-pastoris* were determined by atomic fluorescence spectrometry [9].

2.3 Statistical analyses

Use software of EXCEL 2010 to sort out the test data and use SPSS 18.0 for statistical analysis. The obtained data were analyzed by univariate analysis of variance (ANOVA) with $P < 0.05$ as the standard and Duncan method was used to test the significance of the difference.

3. Results and discussion

3.1 Effects of selenium on the dry weight of *Capsella bursa-pastoris*

It can be seen from Table 1 that with the increase of selenium concentration in soil, the dry weight of roots, stems, leaves and shoots parts of *C. bursa-pastoris* increased first and then decreased. It reached the maximum at 10 mg/kg, which was 32.64%, 10.79%, 11.09% and 11.05% higher than that of the control, respectively. This indicated that the low concentration of selenium promoted the growth of *C. bursa-pastoris*, while the high concentration inhibited it. From the point of view of the effect. roots > leaves > shoots > stems, this may be due to the direct contact between roots and soil selenium, the shoots of selenium need to transport.

Table 1. Effects of selenium on the dry weight of *Capsella bursa-pastoris*.

Treatments (mg/kg)	Roots (g/plant)	Stems (g/plant)	Leaves (g/plant)	Shoots (g/plant)
0	0.144 ± 0.003a	0.454 ± 0.001a	0.451 ± 0.041a	0.905 ± 0.023c
5	0.180 ± 0.001a	0.500 ± 0.006a	0.500 ± 0.001a	1.000 ± 0.005a
10	0.191 ± 0.011ab	0.503 ± 0.001a	0.501 ± 0.003a	1.005 ± 0.002a
25	0.148 ± 0.019ab	0.476 ± 0.033a	0.480 ± 0.023a	0.957 ± 0.009b
50	0.129 ± 0.010ab	0.254 ± 0.002b	0.227 ± 0.015b	0.481 ± 0.037d
75	0.107 ± 0.002b	0.181 ± 0.013c	0.167 ± 0.009c	0.348 ± 0.013e
100	0.099 ± 0.007b	0.152 ± 0.001c	0.136 ± 0.008c	0.288 ± 0.001f

Values are means ± standard errors. Means with the same letter within each column are not significantly different at $P < 0.05$.

3.2 Effects of selenium on the selenium content of *Capsella bursa-pastoris*

It can be seen from Table 2 that the selenium content in the roots, stems, leaves and shoots of *C. bursa-pastoris* increases with the increase of selenium concentration in the soil, and reaches the maximum at 100 mg/kg, reaching 74.980, 37.736, 20.847 and 28.799 µg/g, respectively. According to the increasing degree of selenium content, It is roots > stems > shoots > leaves; transfer factor increased first and then decreased, reaching the maximum of 0.474 in 25 mg/kg. It can be seen that the

application of selenium in the soil can improve the ability of the roots of *C. bursa-pastoris* to transport to the shoots.

Table 2. Effects of selenium on the selenium content of *Capsella bursa-pastoris*.

Treatments (mg/kg)	Roots (µg/g)	Stems (µg/g)	Leaves (µg/g)	Shoots (µg/g)	Transfer Factor
0	0	0	0	0	0
5	10.438±0.248e	3.339±0.067e	2.290±0.056 b	2.816±0.710 cd	0.271
10	12.206±1.072e	5.815±0.496e	4.427±0.379 b	5.122±0.440 c	0.451
25	34.314±1.331d	17.996±0.569d	14.505±0.59 8a	16.256±0.09 4b	0.474
50	59.399±3.379c	32.346±1.602c	15.622±0.68 9a	24.442±0.36 6a	0.414
75	69.900±0.506b	35.218±0.559b	18.847±0.70 4a	27.180±0.73 5a	0.389
100	74.980±0.827a	37.736±1.913a	20.847±1.88 4a	28.799±0.39 8a	0.384

Values are means ± standard errors. Means with the same letter within each column are not significantly different at $P < 0.05$.

3.3 Effects of selenium on the selenium extraction of *Capsella bursa-pastoris*

It can be seen from Table 3 that with the increase of selenium concentration in soil, the selenium accumulation in stems, leaves and shoots increased at first and then decreased, and reached the maximum at 25 mg/kg. It was 8.567, 6.976 and 15.543 g/plant, respectively. The accumulation of selenium in root was increased at low concentration, and kept around 7.500 g/plant at high concentration. This may due to the special physiological structure of *C. bursa-pastoris* root.

Table 3. Effects of selenium on the selenium accumulation of *Capsella bursa-pastoris*.

Treatments (mg/kg)	Roots (µg/plant)	Stems (µg/plant)	Leaves (µg/plant)	Shoots (µg/plant)
0	0	0	0	0
5	1.879±0.028b	1.668±0.026d	1.146±0.030d	2.841±0.196e
10	2.440±0.091b	2.926±0.256c	2.219±0.177c	5.145±0.432d
25	5.108±0.084a	8.567±0.086a	6.976±0.132a	15.543±0.243a
50	7.600±0.076a	8.214±0.331a	3.484±0.210b	11.698±0.561b
75	7.445±0.238a	6.352±0.315b	3.077±0.111bc	9.428±0.854c
100	7.416±0.190a	5.737±0.489b	2.548±0.068c	8.286±0.131c

Values are means ± standard errors. Means with the same letter within each column are not significantly different at $P < 0.05$.

4. Conclusions

The application of selenium at the concentration of 5, 10 and 25 mg/kg could promote the growth of roots, stems, leaves and shoots of *C. bursa-pastoris*, and the treatment of 10 mg/kg had the best effect. The higher the concentration of selenium in the soil, the higher the content of selenium in the all parts of *C. bursa-pastoris*, and which reached the maximum at 100 mg/kg. The transfer factor increased first and then decreased, and reached the maximum at 25 mg/kg. The accumulation of selenium in each

part of *C. bursa-pastoris* increased first and then decreased, and reached the maximum at 25 mg/kg. It can be seen that the application of selenium in soil can promote the growth and improve the ability of selenium accumulation. The effect of applying 25 mg/kg concentration is the best.

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