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Effects of Different Selenium Concentrations on Photosynthetic Pigment Content of *Pterocypsela laciniata*

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Abstract: A pot experiment was conducted to study the effects of different selenium concentrations on photosynthetic pigment content of *Pterocypsela laciniata*. Five aspects of chlorophyll *a* content, chlorophyll *b* content, carotenoid content and chlorophyll content, respectively, were used to analyze the changes of photosynthetic pigment content in *P. laciniata* under different selenium concentrations soil treatment. The study showed that when the concentration of selenium was 5 mg/kg, the photosynthetic capacity of *P. laciniata* was promoted. When the concentration of selenium was greater than 10 mg/kg, the content of photosynthetic pigment in *P. laciniata* was lower, which was generally lower than that of the control group.

Introduction

Adversity, also known as coercion, is a general term for all kinds of environmental factors that are harmful to plant growth and survival. Many studies have shown that the first response to plant perception stress is the decline in photosynthesis and the reduction of photosynthetic pigments in the leaves [1]. Selenium is one of the essential nutrients for human and animal, and it is also a useful element for plant growth and development. A large number of studies have shown that appropriate selenium can increase the content of chlorophyll and carotenoid in plant leaves, thus improving plant photosynthesis efficiency. However, excessive selenium is toxic to plants, poisoning symptoms, growth and physiological activities are inhibited [2]. The previous experiments showed that selenium stress had a significant effect on plant photosynthesis. Under low selenium stress (selenium concentration was 50 mg/L), the content of carotenoids and chlorophyll in *Chlorella vulgaris* increased at first and then decreased. However, under the condition of high selenium stress (selenium concentration was 800 mg/L), the content of photosynthetic pigments decreased significantly. [3].

Pterocypsela laciniata is a wild vegetable, and its nutritional value is high, and it has many functions such as anti-tumor, anti-oxidation, anti-cardiovascular and cerebrovascular diseases [4]. It can be used as a vegetable plant, providing nutrient rich stems and leaves for people in the off-season, and can also serve as a good health care product for people [5]. It is an effective way to supplement selenium for human body to obtain selenium enriched agricultural products through agricultural bioaugmentation [6]. Therefore, in this experiment, *P. laciniata* was cultivated in the soil containing different concentrations of selenium. The effect of different selenium concentration on the content of *P. laciniata* photosynthetic pigment was studied in order to find new selenium rich vegetables from wild vegetables and provide reference for the development of wild vegetables.

Materials and Methods

Materials. The seeds of *P. laciniata* were collected near the Chengdu Campus of Sichuan

Agricultural University. After the seedling in the laboratory, at the end of March 2018, the seedlings with better growth and better consistency were transplanted to the pot.

Experimental Design. The soil was taken from the farmland soil near the Chengdu Campus of Sichuan Agricultural University. After the soil was dried, crushed and screened by 5 mm, 3.0 kg soil was put into the plastic basin of 15cm × 18 cm (high × diameter). Selenium is added to the soil in the form of Na_2SeO_3 solution and fully mixed. Keep the soil moist, place 60 days, mix the soil regularly and make the soil mix well. The selenium concentration in soil was 0, 5, 10, 25, 50, 75 and 100 mg/kg respectively. The seedlings were transplanted into the basin after breeding in the laboratory. 4 plants were planted in each pot, and four seedlings were scattered in the basin. Each treatment was planted with 6 pots (6 replicates). The distance between the basins is 10 cm, and it is completely arranged at random. During the whole growth process of *P. laciniata*, water was kept daily to maintain the field capacity of about 80% of the soil in the basin and to remove other weeds and pests in time. After 50 days of cultivation, the newly developed mature leaves of each plant were selected and the content of photosynthetic pigments in *P. laciniata* was determined by acetone ethanol extraction [7].

Statistical Analyses. Statistical analyses were conducted using statistical software of SPSS 17.0. Data were analyzed by one-way ANOVA with least significant difference at 5% confidence level.

Results and Discussion

Chlorophyll *a* content of *P. laciniata*. The chlorophyll *a* content of the control group was the highest, which was 2.808 mg/g (Fig. 1). Under the condition of selenium treatment, the content of chlorophyll *a* decreased. As selenium treatment concentration increased from small to large, the content of chlorophyll *a* in each treatment were 98.43%, 89.64%, 83.90%, 80.70%, 78.03%, 73.29% in turn. When the concentration of selenium was 5 mg/kg, the content of chlorophyll *a* was 2.764 mg/g, which was not significantly different from that of the control group. When the concentration of selenium was greater than or equal to 10 mg/kg, the chlorophyll *a* content of each treatment was significantly different from that of the control group.

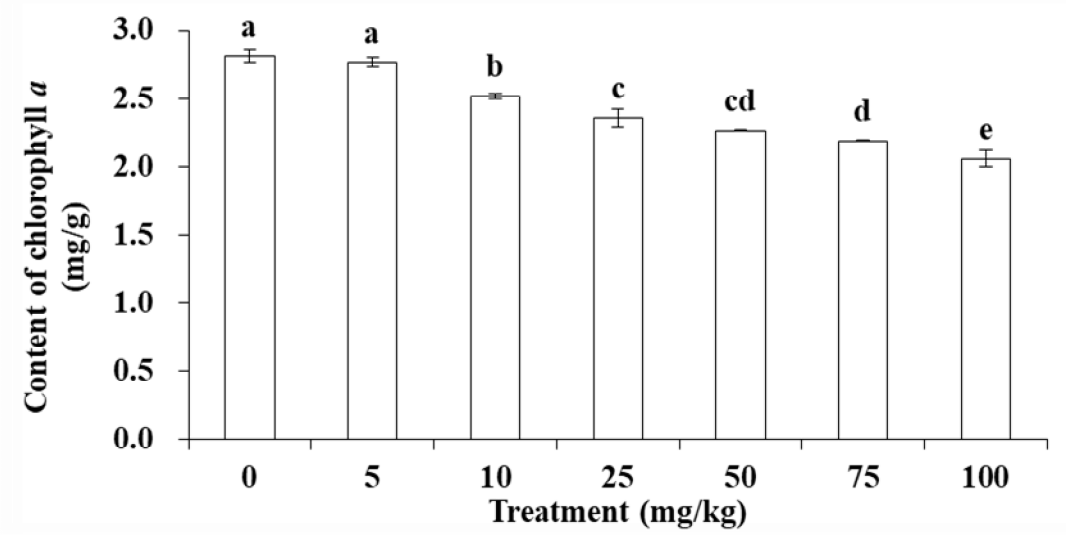

Fig. 1 Chlorophyll *a* content of *P. laciniata*

Chlorophyll *b* content of *P. laciniata*. With the increase of selenium concentration, the content of chlorophyll *b* increased first and then decreased (Fig. 2). When the concentration of selenium was 5 mg/kg, the content of chlorophyll *b* was 1.321 mg/g, which was 27.02% higher than that of the control. When the concentration of selenium was greater than 10 mg/kg, the content of chlorophyll *b* began to decrease, and the difference was significantly different from that of the control group.

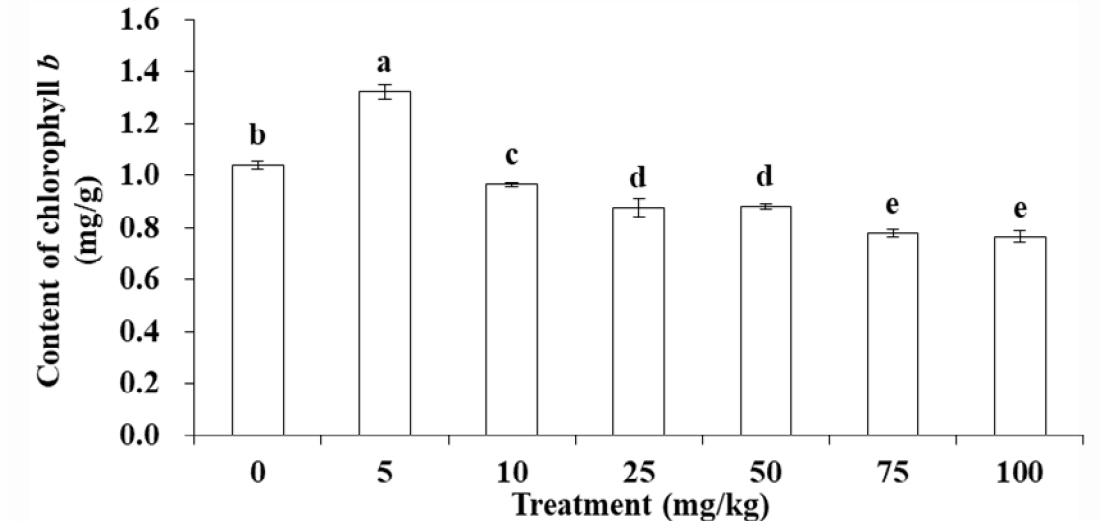

Fig. 2 Chlorophyll *b* content of *P. laciniata*

Carotenoid content of *P. laciniata*. The carotenoid content in the control group was the highest, 0.686 mg/g (Fig. 3). With the increase of selenium concentration, the carotenoid content decreased first and then increased. When the concentration of selenium was 5 mg/kg, the content of carotenoid decreased by 2.77% compared with the control. At this time, the difference was not significant. With the increase of selenium concentration, the carotenoid content gradually decreased and the difference reached a significant level with the control. When the selenium concentration was 100 mg/kg, the content of carotenoid increased to 0.637 mg/g.

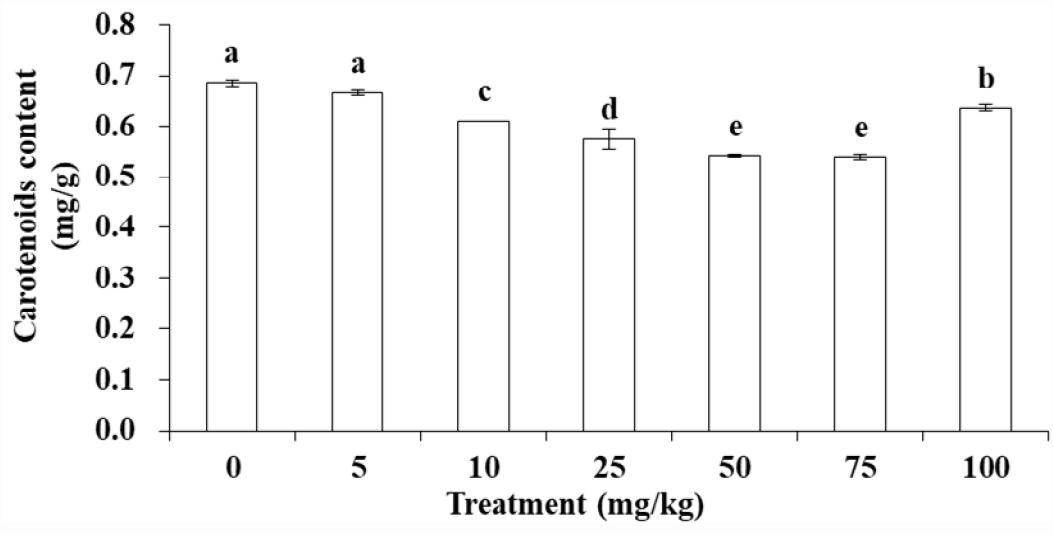

Fig. 3 Carotenoid content of *P. laciniata.*

Total chlorophyll content of *P. laciniata*. With the increase of selenium concentration, the total chlorophyll content first increased and then decreased (Fig. 4). When the concentration of selenium was 5 mg/kg, the total chlorophyll content was the largest, 4.085 mg/g, and was significantly different from the control. When the concentration of selenium was greater than or equal to 10 mg/kg, the total chlorophyll content decreased, and the total chlorophyll content was smaller than that of the control group, which was significantly different from that of the control group.

Conclusions

Chlorophyll and carotenoid are important factors affecting the photosynthetic rate of plant leaves, and the content of photosynthetic pigments is one of the important indexes to reflect the changes of photosynthesis and physiological activity of crops. This study showed that when the concentration

of selenium was 5 mg/kg, the photosynthetic capacity of *P. laciniata* was promoted. When the selenium concentration was more than or equal to 10 mg/kg, the content of the photosynthetic pigment of *P. laciniata* was lower, which was generally lower than that of the control group.

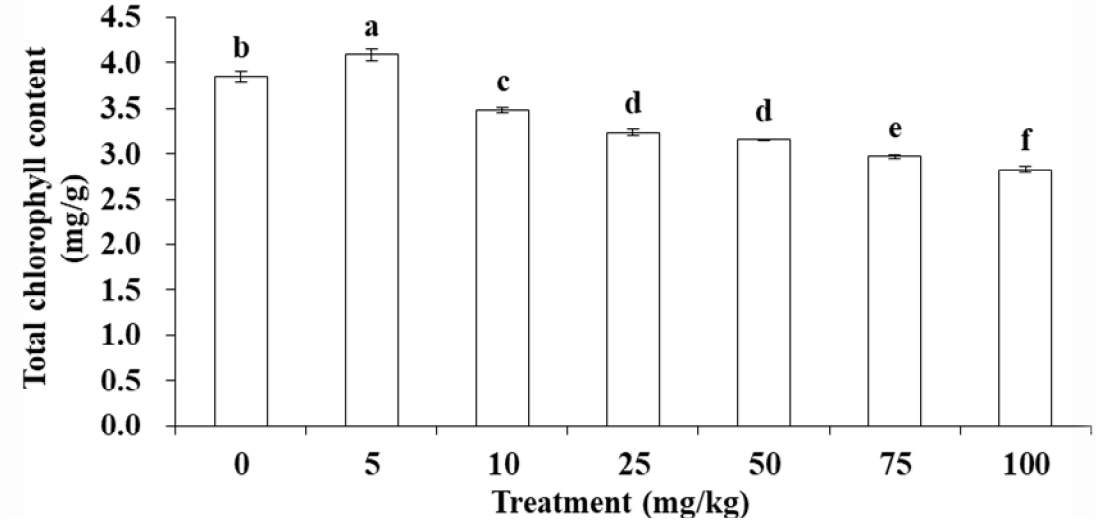

Fig. 4 Total chlorophyll content of *P. laciniata.*

Acknowledgements

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