Total saikosaponin content in some species of \textit{Bupleurum} L.

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Abstract. The aim of this study was to determine the total saikosaponin content in some species of \textit{Bupleurum} L. genus. For the first time, the saikosaponin content was investigated in roots of \textit{B. scorzonerifolium} from Buryatia and Mongolia. The differences in the quantitative content of saikosaponins in the \textit{B. scorzonerifolium} roots can be explained by the possible polymorphism of this plant. Dynamic change of the total saikosaponin content in roots of \textit{B. scorzonerifolium} in different phenophases didn’t undergo significant changes. The total saikosaponin content was at the highest level in the roots of \textit{B. bicaule}.

1. Introduction

In recent times, the genus \textit{Bupleurum} L. plants have been subjected to thorough scientific scrutiny by scientists all over the world related to their high biological activity (including anti-inflammatory, immunoregulatory, antibacterial and antiviral one) due to the content of saikosaponins, polysaccharides, flavonoids, essential oils and fatty acids in them [1]. The fatty acids composition of \textit{B. scorzonerifolium} roots in flora of Mongolia and Buryatia, also \textit{B. chinense} from Xining province of China was investigated by us earlier [2]. Constituents of essential oil and lipid fraction from the aerial part of \textit{B. scorzonerifolium} from different habitats was also investigated by us [3]. The main significant and specific group of biologically active compounds from bupleurum roots are saikosaponins – oleanane type triterpenoid saponins. Specifically, the saikosaponins content is the main quality indicator of the raw material – Radix Bupleuri. In the Chinese and Japanese Pharmacopoeias the total content of saikosaponins A and B is normalized as $\geq 0.3\%$ and $\geq 0.35\%$, respectively [4], [5].

It is known, that the accumulation of biologically active substances is determined by many factors. For instance, Wei Huang et al. showed, that the highest saikosaponin content was found in samples from meadow environment and low saikosaponins contents in samples from understory and brushy environment [6]. Completely different results were shown in other works. Results of [7] showed saikosaponins roots quantities tended to be low in opened areas where direct radiations are high (shrubs and grassland) compared to evergreen and deciduous forest. Another work [8] suggested that low light activates stress-response pathways, leading to increased saikosaponins content.

As a result, the aim of this work was to determine the total saikosaponin content in some species of \textit{Bupleurum} L. genus (\textit{B. bicaule}, \textit{B. chinense}, \textit{B. scorzonerifolium}).
2. Models and Methods

2.1. Plant Materials

Plant materials were collected from 2014 to 2018 in Russia (the Republic of Buryatia), Mongolia (Khartii aimag) and China (Xining province, Table 1). All samples were collected during different periods and air-dried before being ground into fine powder. Voucher specimens were identified by Dr. Oleg A. Anenkhonov from Institute of General and Experimental Biology, Siberian Branch, Russian Academy of Sciences (IGEB SB RAS).

2.2. Determination of total saikosaponin contents

The total saikosaponin content was determined by means of PE-5400 spectrophotometer (Ekokhim) with the optical path length of 1 cm. We followed the methods and measurement conditions of [9]. The detection wavelength was 546 nm. Standard of saikosaponin A was purchased from Shanghai Yuanye Bio-Technology Corporation Ltd., Shanghai. The regression equation between absorbance (Y) and the quantity of saikosaponin-A (X) was: \( Y = 3.8900X - 0.0212; r = 0.9999 \).

3. Results and Discussion

The total saikosaponin content in bupleurum roots were determined using UV-spectrophotometry (Table 1). These results consistent with requirements to of saikosaponin content according to Chinese and Japanese Pharmacopoeias.

### Table 1. Characteristics of samples and their total saikosaponin content.

| Sample No | Year of collection | Location | Total saikosaponin content (%) |
|-----------|--------------------|----------|-------------------------------|
| B. scorzonerifolium | | | |
| 1 | 2014 | Surroundings of the Sotnikovo village, Ivolginsky district, Buryatia, Russia | 0.96±0.04 |
| 2 | 2015 | Surroundings of the Sotnikovo village, Ivolginsky district, Buryatia, Russia | 0.69±0.02 |
| 3 | 2015 | Surroundings of the Georgievka village, Khorinsky district, Buryatia, Russia | 0.58±0.01 |
| 4 | 2015 | Surroundings of the Zagnustaya arbor, Selenginsky district, Buryatia, Russia | 0.77±0.01 |
| 5 | 2015 | Surroundings of the Berkh territory, Khentii aimag, Mongolia | 1.95±0.04 |
| 6 | 2015 | Surroudnings of the Bayan Ulaan Uul mountain, Khentii aimag, Mongolia | 0.87±0.04 |
| 7 | 2016 | In 10 km to Khorinsky village, Khorinsky district, Buryatia, Russia | 0.61±0.03 |
| 8 | 2016 | Surroundings of the Sosnovoozersk village, Eravninsky district, Buryatia, Russia | 0.63±0.02 |
| 9 | 2017 | Surroundings of the Shiringa village, Eravninsky district, Buryatia, Russia | 0.80±0.02 |
| 10 | 2018 | Surroundings of the Yuzhnyi village, Ulan-Ude city, Buryatia, Russia, Pre-vegetation period | 1.27±0.04 |
| 11 | 2018 | Surroundings of the Yuzhnyi village, Ulan-Ude city, Buryatia, Russia, Vegetation period | 1.12±0.04 |
| 12 | 2018 | Surroundings of the Yuzhnyi village, Ulan-Ude city, Buryatia, Russia, Blossom period | 1.28±0.03 |
| 13 | 2018 | Surroundings of the Yuzhnyi village, Ulan-Ude city, Buryatia, Russia, Fruit period | 1.20±0.05 |
| 14 | 2018 | Zheleznodorozhnyi district, Ulan-Ude city, Buryatia, Russia | 0.97±0.02 |
| B. bicaule | | | |
| 15 | 2016 | Surroundings of the Sosnovoozersk village, Eravninsky district, Buryatia, Russia | 2.77±0.02 |
| 16 | 2018 | Surroundings of the Kasaty village, Mukhorshibirsy district, Buryatia, Russia | 2.86±0.02 |
| B. chinense | | | |
| 17 | 2015 | In 49 km to northeast from Xining, Xining province, PRC | 1.36±0.04 |
| 18 | 2016 | Xining, Xining province, PRC (chaihu) | 1.50±0.05 |
The highest total saikosaponin content was found in *B. bicaule* roots (2.77% and 2.86%). The content of the amount of saikosaponins in the *B. scorzonerifolium* roots ranges from 0.58% to 1.95%. The highest total content was found in the sample from Mongolia (No 5 – 1.95%).

The differences in the quantitative content of saikosaponins in the *B. scorzonerifolium* roots can be explained by the possible polymorphism of this plant. So, for *B. falcatum* from Japan this pattern is shown. Repeatedly cultivated in the same conditions the seeds of wild-growing *B. falcatum* from seven different habitats in Japan showed a different content of saikosaponins in roots [10]. Dynamic change of the total saikosaponin content in roots of *B. scorzonerifolium* in different phenophases didn’t undergo significant changes. So, these results didn’t consistent with the findings of Tan L et al. [9]. They showed that the content of total saikosaponin in roots of *B. chinense* was high in both pre-blossoms of spring, and the fruit-mature period of autumn [9]. Chinese samples, wild *B. chinense* and *chaihu* (pharmacy raw material) contain 1.36% and 1.50%, respectively.

4. Conclusion

Thus, the total saikosaponin content in the roots of *B. scorzonerifolium* and *B. bicaule* from Buryatia and Mongolia investigated for the first time. It was shown that the studied samples meet the requirements of the Eastern countries’ pharmacopoeias in the terms of quantitative content of saikosaponins. The highest content was found in the roots of *B. bicaule*, which makes this species promising for further complete phytochemical analysis.

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