



## Saussurea involucrata: A review of the botany, phytochemistry and ethnopharmacology of a rare traditional herbal medicine



Wai-I Chik<sup>a,1</sup>, Lin Zhu<sup>a,1</sup>, Lan-Lan Fan<sup>b,1</sup>, Tao Yi<sup>a,\*</sup>, Guo-Yuan Zhu<sup>c</sup>, Xiao-Jun Gou<sup>d</sup>,  
Yi-Na Tang<sup>a</sup>, Jun Xu<sup>a</sup>, Wing-Ping Yeung<sup>a</sup>, Zhong-Zhen Zhao<sup>a</sup>, Zhi-Ling Yu<sup>a</sup>,  
Hu-Biao Chen<sup>a,\*\*</sup>

<sup>a</sup> School of Chinese Medicine, Hong Kong Baptist University, Hong Kong Special Administrative Region, China

<sup>b</sup> Guangxi Botanical Garden of Medicinal Plant, Nanning, Guangxi 530023, China

<sup>c</sup> The State Key Laboratory of Quality Research in Chinese Medicine, Macau University of Science and Technology, Macau, China

<sup>d</sup> Sichuan Industrial Institute of Antibiotics, Chengdu University, Chengdu 610051, China

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### ABSTRACT

**Ethnopharmacological relevance:** *Saussurea involucrata* Matsum. & Koidz. is an endangered species of the Asteraceae family, growing in the high mountains of central Asia. It has been, and is, widely used in traditional Uyghur, Mongolian and Kazakhstan medicine as well as in Traditional Chinese Medicine as Tianshan Snow Lotus (Chinese: 天山雪蓮). In traditional medical theory, *S. involucrata* can promote blood circulation, thereby alleviating all symptoms associated with poor circulation. It also reputedly eliminates cold and dampness from the body, diminishes inflammation, invigorates, and strengthens *Yin and Yang*. It has long been used to treat rheumatoid arthritis, cough with cold, stomach ache, dysmenorrhea, and altitude sickness in Uyghur and Chinese medicine.

**Aim of the review:** To comprehensively summarize the miscellaneous research that has been done regarding the botany, ethnopharmacology, phytochemistry, biological activity, and toxicology of *S. involucrata*.

**Method:** An extensive review of the literature was carried out. Apart from different electronic databases including SciFinder, Chinese National Knowledge Infrastructure (CNKI), ScienceDirect that were sourced for information, abstracts, full-text articles and books written in English and Chinese, including those traditional records tracing back to the *Qing Dynasty*. Pharmacopoeia of China and other local herbal records in Uighur, Mongolian and Kazakhstan ethnomedicines were investigated and compared for pertinent information.

**Results:** The phytochemistry of *S. involucrata* has been comprehensively investigated. More than 70 compounds have been isolated and identified; they include phenylpropanoids, flavonoids, coumarins, lignans, sesquiterpenes, steroids, ceramides, polysaccharides. Scientific studies on the biological activity of *S. involucrata* are equally numerous. The herb has been shown to have anti-neoplastic, anti-inflammatory, analgesic, anti-oxidative, anti-fatigue, anti-aging, anti-hypoxic, neuroprotective and immunomodulating effects. Many have shown correlations to the traditional clinical applications in Traditional Chinese Medicine and medicines. The possible mechanisms of *S. involucrata* in treating various cancers are revealed in the article, these include inhibition of cancer cells by affecting their growth, adhesion, migration, aggregation and invasion, inhibition of epidermal growth factor receptor signaling in cancer cells, hindrance of cancer cell proliferation, causing cytotoxicity to cancer cells and promoting expression of tumor suppressor genes. Dosage efficacy is found to be generally concentration- and time-dependent. However, studies on the correlation between particular chemical constituents and specific bioactivities are limited.

**Conclusion:** In this review, we have documented the existing traditional uses of *S. involucrata* and summarized recent research into the phytochemistry and pharmacology of *S. involucrata*. Many of the

**Abbreviations:** DSE, dark-septate endophytic; SEM, scanning electron microscope; RA, rheumatoid arthritis; NO, nitric oxide; PGE<sub>2</sub>, prostaglandin E<sub>2</sub>; ROS, reactive oxygen species; DPPH, 2, 2-diphenyl-1-picrylhydrazyl; ABTS, 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid); HIF-1, hypoxia-inducible factor-1; ATP, adenosine triphosphate; LAC, laccase; LD, lactate dehydrogenase; SOD, superoxide dismutase; MDA, malondialdehyde; GPx, glutathione peroxidase; PBMC, peripheral blood mononuclear cell

\* Corresponding author. Fax: +852 3411 5571.

\*\* Corresponding author. Fax: +852 3411 2461.

E-mail addresses: [yitao@hkbu.edu.hk](mailto:yitao@hkbu.edu.hk) (T. Yi), [hbchen@hkbu.edu.hk](mailto:hbchen@hkbu.edu.hk) (H.-B. Chen).

<sup>1</sup> These authors contributed equally to this work.

traditional uses have been validated by phytochemical and modern pharmacological studies but there are still some areas where the current knowledge could be improved. Although studies have confirmed that *S. involucrata* has a broad range of bioactivities, further in-depth studies on the exact bioactive molecules and the mechanism of action are expected. Whether we should use this herb independently or in combination deserves to be clarified. The exact quality control as well as the toxicology studies is necessary to guarantee the stability and safety of the clinic use. The sustainable use of this endangered resource was also addressed. In conclusion, this review was anticipated to highlight the importance of *S. involucrata* and provides some directions for the future development of this plant.

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## Contents

|  |    |
|--|----|
| 1. Introduction  | 45 |
| 2. Ethnopharmacology   | 46 |
| 3. Botany  | 46 |
| 3.1. Nomenclature  | 46 |
| 3.2. Plant occurrence  | 46 |
| 3.3. Botanical description   | 48 |
| 3.4. Conservation  | 48 |
| 4. Quality control   | 49 |
| 4.1. Species authentication  | 49 |
| 4.2. Limits of indicator compounds   | 49 |
| 5. Phytochemistry  | 49 |
| 5.1. Phenylpropanoids  | 49 |
| 5.2. Flavonoids  | 49 |
| 5.3. Coumarins   | 49 |
| 5.4. Lignans   | 50 |
| 5.5. Sesquiterpenes  | 50 |
| 5.6. Steroids  | 50 |
| 5.7. Ceramides   | 50 |
| 5.8. Polysaccharides   | 51 |
| 6. Bioactivity   | 51 |
| 6.1. Anti-neoplastic   | 51 |
| 6.2. Anti-arthritis  | 52 |
| 6.3. Anti-oxidative and anti-aging   | 53 |
| 6.4. Anti-fatigue  | 53 |
| 6.5. Neuro-protective and anti-hypoxic   | 53 |
| 6.6. Immunomodulation  | 57 |
| 6.7. Other pharmacological activities  | 57 |
| 7. Toxicological studies   | 57 |
| 8. Modern clinical application   | 57 |
| 8.1. Anti-arthritis  | 57 |
| 8.2. Counteracting infertility   | 57 |
| 8.3. Others application of <i>S. involucrata</i> -containing compound prescription | 58 |
| 9. Conclusion and prospects  | 58 |
| Acknowledgments  | 58 |
| References   | 58 |

## 1. Introduction

In central Asia, *Saussurea involucrata* Matsum. & Koidz. (Fig. 1.) has long been used under the herbal names “Tianshan Snow Lotus”, “Xinjiang Xuelian”, “Xuelian Hua” and “Xuehe Hua” (Flora of China Editorial Committee, 1999). *S. involucrata* has been an important medicinal herb in various ethnomedical systems which are namely Traditional Chinese Medicine, Uyghur medicine, Mongolian medicine and Kazakhstan medicine, among which similarities in pattern of usage has been manifested. These include treatment of rheumatoid arthritis and regulation of menstrual cycle. It is recorded in Pharmacopoeia of People’s Republic of China since 2005 and earlier in local herbal records of the above mentioned ethnomedicines (Chinese Pharmacopoeia Commission, 2010; National Institutes for Food and Drug Control, 1984).

According to the Guangdong Provincial Traditional Chinese Medicine Hospital, which is the top Traditional Chinese Medicine hospital in China, *S. involucrata* has a broad-spectrum of clinical applications, including anti-inflammatory and analgesic, anti-oxidative, anti-hypoxia, anti-fatigue, anti-aging and hormonal-related gynecological disorders, infertility as well as immunomodulation. These are closely correlated with those traditional uses. In recent years, the effectiveness in anti-cancer therapy has further put *S. involucrata* under the spotlight.

Along with its growing reputation, chemical constituents of *S. involucrata* have been extensively studied. Phenylpropanoids, flavonoids, coumarins, lignans, sesquiterpenes, steroids, ceramides and polysaccharides as main compositions were isolated and identified. Among them, rutin and chlorogenic acid have been proven with pharmacological evidence and active compounds in

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