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·Review·

Phytochemistry and pharmacology of Allii Macrostemonis Bulbus, a traditional Chinese medicine

YAO Zhi-Hong [1*], QIN Zi-Fei [1Δ], DAI Yi [1], YAO Xin-Sheng [1, 2*]

[1] *College of Pharmacy, Jinan University, Guangzhou 510632, China;*

[2] *State Key Laboratory of Quality Research in Chinese Medicine, Macau University of Science and Technology, Avenida Wai Long, Taipa, Macau, China*

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[ABSTRACT] Allii Macrostemonis Bulbus (Xiebai in Chinese), as a famous traditional Chinese medicine, has great medicinal and dietary values since ancient times. In China, the dry bulbs of *Allium macrostemon* and *Allium chinense* are both used as its original plants. Pharmacological studies have revealed that both of them could increase plasminogen activator activity and prolong the effect of coagulation to achieve antiplatelet aggregation which validates their traditional uses for the treatment of thoracic obstruction and cardialgia in clinics. Besides, several other significant activities, including lipid-lowering, anti-atherosclerosis, antitumor, antispasmodic, antibacterial, antioxidant, and insecticidal activities, have already been reported. The volatile oils, nitrogenous compounds, and steroidal saponins are the major beneficial compounds. Among them, steroidal saponins are considered as the characteristic constituents. In this review, the current information concerning the phytochemistry and pharmacology of Allii Macrostemonis Bulbus is summarized comprehensively. In addition, several research future perspectives are presented, especially the mechanism of bioactive components and fraction from the bulbs of *Allium macrostemon* and *Allium chinense*.

[KEY WORDS] Allii Macrostemonis Bulbus; *Allium macrostemon*; *Allium chinense*; Phytochemistry; Pharmacology; Future perspectives

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Introduction

Allii Macrostemonis Bulbus, first recorded in the famous classic of Chinese herbal *Shen-Nong-Ben-Cao-Jing*, is considered as a "top grade" herb for the treatment of thoracic obstruction and cardiodynia (similar to coronary heart disease) [1]. In China, the dry bulbs of *Allium macrostemon* and *Allium chinense* are both used as *Allii Macrostemonis Bulbus* [2]. *Allium macrostemon* is a species of *Allium* family, which is widely distributed in East Asia, including China, Japan, Korea, Mongolia, and the Russian Far East [3-4], while *Allium chinense* is native to China and also naturalized in other parts of Asia as well as North America [5-6].

The morphologies of the two dry bulbs are obviously different. Dry bulbs of *Allium macrostemon* are irregularly ovoid (0.5–1.5 cm high and 0.5–1.8 cm in diameter) and externally yellowish-white or pale yellowish-brown, crumpled, translucent (Fig. 1-A) [2-3], while the dry bulbs of *Allium chinense* are lightly compressed long-ovate (1–3 cm high and 0.3–1.2 cm in diameter) and externally pale yellowish-brown or brown, marked with shallowly longitudinal wrinkles (Fig. 1-B) [2, 5].

In addition, *Allii Macrostemonis Bulbus* is listed as a food in the Food Safety Law of the People's Republic of China due to its high nutritional value [7]. According to the reported analysis, *Allium macrostemon* is rich in numerous nutrient substances and trace elements, such as saccharides, protein, fat, calcium, phosphate, iron, carotene, VB_1, VB_2, VC, and nicotinic acid [8-10]. Moreover, *Allium chinense* is also called as *Ganoderma lucidum* in vegetables due to its potential medical benefit in tonics to help the intestines, and as a stomachic [11].

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[*Corresponding author] Tel: +86 20 85221767, Fax: +86 20 85221559, E-mail: yaozhihong.jnu@gmail.com, tyaozh@jnu.edu.cn (YAO Zhi-Hong); tyaoxs@jnu.edu.cn (YAO Xin-Sheng)

[Δ]Co-first author

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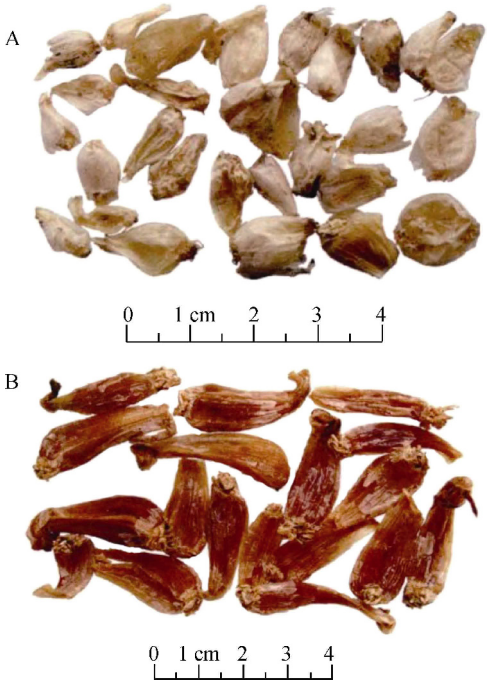

Fig. 1 Bulbs of *Allium macrostemon* Bunge and *Allium chinense* G. Don
(A) Bulbs of *Allium macrostemon* Bunge
(B) Bulbs of *Allium chinense* G. Don

The purpose of this review was to better understand the medical and nutritional effects of *Allii Macrostemonis Bulbus*, providing comprehensive information on its phytochemistry and pharmacological properties.

Phytochemistry

Typically, the chemical components of *Allium macrostemon* and *Allium chinense* are both categorized as volatile oils, nitrogenous compounds, steroidal saponins, and others. Among them, volatile oils and steroidal saponins are the most important for their biological properties [12-13, 23-24]. To date, a total of 136 compounds (Table 1) have been isolated and identified from the bulbs of *Allium macrostemon* and *Allium chinense*, including 55 volatile oils (**1**–**55**), nine nitrogenous compounds (**56**–**64**), 61 steroidal saponins (**65**–**125**), and 11 other compounds (**126**–**136**) [12-16, 18-64].

Volatile Oil

Among the 55 essential oils (Fig. 2), there are 49 (**1**–**46**, **52**, **53,** and **55**) sulfur-containing compounds [12-16]. Most of them are similar to garlic oil, which have been developed into a product to lower cholesterol and blood lipids [17]. Dimethyl disulfide (**8**), methyl propyl disulfide (**10**), methyl allyl disulfide (**11**), propyl isopropyl disulfide (**19**), propyl ally disulfide (**20**), isopropyl ally disulfide (**22**), 1, 3-dithiane (**26**), dimethyl trisulfide (**28**), methyl propyl trisulfide (**31**), methyl allyl trisulfide (**32**), and dimethyl tetrasulfide (**40**) are the

Table 1 Compounds identified from the bulbs of *Allium macrostemon* and *Allium chinense*

No.	Compounds	Species	Reference
1	ethyl *cis*-1-propenyl sulfide	*A. chinense*	[16]
2	diallyl sulfide	*A. chinense*	[16]
3	3-[(1-methylethy)thio]-1-propene	*A. macrostemon*	[12]
4	methyl allyl sulfide	*A. macrostemon*	[14-15]
5	1-hydroxyl-2-sulfhydryl-ethane	*A. macrostemon*	[14-15]
6	2, 4-dimethylthiophene	*A. macrostemon*	[12]
7	1, 3-dimethylthiophene	*A. macrostemon*	[14]
8	dimethyl disulfide	*A. macrostemon* *A. chinense*	[12-14, 16]
9	methyl ethyl disulfide	*A. macrostemon* *A. chinense*	[14, 16]
10	methyl propyl disulfide	*A. macrostemon* *A. chinense*	[12-14, 16]
11	methyl allyl disulfide	*A. macrostemon* *A. chinense*	[12-13, 16]
12	methyl *cis*-1-propenyl disulfide	*A. macrostemon* *A. chinense*	[14, 16]
13	methyl isopropyl disulfide	*A. macrostemon*	[14]
14	methyl butyl disulfide	*A. chinense*	[16]
15	ethyl propyl disulfide	*A. chinense*	[16]
16	ethyl *cis*-1-propenyl disulfide	*A. chinense*	[16]
17	ethyl *trans*-1-propenyl disulfide	*A. chinense*	[16]
18	propyl propenyl disulfide	*A. macrostemon*	[14-15]
19	propyl isopropyl disulfide	*A. macrostemon*	[12]
20	propyl allyl disulfide	*A. macrostemon* *A. chinense*	[12-13]