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## THE BIODIVERSITY AND ORNAMENTAL VALUES OF ERICACEAE JUSS. IN CHINA

Luo Binsheng<sup>1</sup>, Long Chunlin<sup>1,2,\*</sup>

<sup>1</sup>College of Life and Environmental Science, Minzu University of China, Beijing 100081, China  
E-mail: 15116994953@163.com

<sup>2</sup>Kunming Institute of Botany, Chinese Academy of Science, Kunming 650201, China  
E-mail: long@mail.kib.ac.cn

Ericaceae is a big family and an important resource in China. It has high biodiversity and great potential for ornamental in China especially the genus *Rhododendron*. However, there are very few literatures have covered the whole Ericaceae family. By literatures review combining with our filed trips for years, we conclude the status of Chinese Ericaceae as ornamentals and evaluate the ornamental value of Chinese Ericaceae to lay a comprehensive reference for future researches.

**Key words:** *Ericaceae*; *biodiversity*; *ornamental application*; *China*.

### Introduction

Ericaceae, a big family contains around 22 genera and 826 species, has widely spread in the sub-frigid zone in the Northern Hemisphere and temperate zone [1].

Ericaceae plants are also widely distributed in China, especially in mountain areas of Southwest China with high-level biodiversity and cultural diversity [2]. High richness of Ericaceae plant species is shown in Sichuan, Yunnan and Tibet, which is also considered as the diversity center of *Rhododendron* and *Agapetes* [2].

It is a very long history for Chinese to study and use Ericaceae plants. In early AC 492, Tao Hongjing recorded the sheep died after taking *Rhododendron molle* leaves in his medicinal book [3]. Later in Chinese Ming Dynasty (AC1368—AC1644), a famous Chinese medicinal book called *Compendium of Materia Medica* described the details of morphological and medicinal information about *Rhododendron simsii* [3]. As an important valuable plant family, Ericaceae plants have various uses in many fields including food, beverage, medicine, gardening, timber, even biopesticides [4].

As it is known, Ericaceae is a family with great potential ornamentals. Although there still have several wild species have possibilities to be introduced and cultivated into excellent ornamental species in China, there are very few literatures have covered the whole family. Only some genera have been mentioned, in which *Rhododendron* plants are the most popular ones. In order to fill this gap and provide a valuable and convenient reference for future development of Ericaceae ornamentals, this paper tries to represent the biodiversity of Chinese Ericaceae and evaluate the current status with potential of Ericaceae in ornamental fields.

### The Biodiversity of Ericaceae in China

According to a statistical study, Ericaceae (22 genera, 826 species) is the 9<sup>th</sup> on the list of top ten most diverse Chinese plant families and *Rhododendron* is the biggest genus with 588 species [1–5].

Field studies on the application of Acoraceae were carried out from 2013 to 2017 in Guizhou, Chongqing, Sichuan, Yunnan and other parts of southern China. Ethnobotanical data were collected through different interview methods (participatory rural appraisal (PRA), direct observation, semi-structured interviews, key informant interviews, individual discussions and focal group discussions) [6–9] is the 9<sup>th</sup> on the list of top ten most diverse Chinese plant families and *Rhododendron* is the biggest genus with 588 species [1–5].

Ericaceae plants have a diversity of habitats and altitudes. A good example is the

Gaoligong Mountains where the Ericaceae plants are distributed everywhere no matter in the north, south, eastern slopes or western slopes of the region [2]. In the Gaoligong Mountains, the distribution range of Ericaceae plants are from 900 to 4800 meters high ;The most diversity zones are between 2500 and 4000 meters above sea level [2]. Another case study from Jiangxi Province showed a high biodiversity of local Ericaceae: flower types and colors of Ericaceae plants are multivariate; the main living forms include deciduous, semi-evergreen, evergreen shrub and small tree; the habitats contain middle elevation warm habitat, the lowland forests and low altitude arid lands [6].

In addition, the frequent endemism of Ericaceae species also displayed the high biodiversity of Ericaceae in China. Although no endemic genus occurs in China, 409 species in Ericaceae are endemic [7].

#### ***The ornamental value of Ericaceae in China***

Ericaceae is famous for its ornamental value. The most popular genus is *Rhododendron* [8]. There are several other genera which are used as ornamentals in China but with different ornamental parts and ornamental purposes, like *Gaultheria*, *Vaccinium*, *Enkianthus*, *Agapetes*, *Pyrola* and others [8].

#### ***Rhododendron***

*Rhododendron*, which has roughly 1000 species mostly distributed in Asia, Europe, and North America, is the biggest genus in Ericaceae [1]. There are 571 species with 409 endemic to China [1]. *Rhododendron* species are important resources for ornamental, food, medicine, and timber in China [4]. As the important ornamental genus, *Rhododendron* has been popular in ancient times because of their beautiful flowers, leaves, architectures and fragrance, so that a great deal of tales and legends and ancient Chinese poetries described and admired the beauty of *Rhododendron* [3].

Although the history of cultivating *Rhododendron* plants in China is earlier than western countries for more than 1000 years, the cultivation technologies are still falling behind [9]. Since 1980s, Hangzhou Botanical Garden, Lushan Botanical Garden, West China Subalpine Botanical Garden, Kunming Botanical Garden, Guizhou Botanical Garden, Shanghai Botanical Garden, Jinggangshan Botanical Garden and others have introduced, domesticated and cultivated abundant wild *Rhododendron* species and have achieved big progresses [10]. Lushan Botanical Garden has introduced and cultivated more than 280 *Rhododendron* species [11], and Hangzhou Botanical Garden has collected and conserved more than 200 *Rhododendron* species and varieties [10]. By the efforts of horticulturalists, numerous hybrid varieties and cultivars have sprung up and the registered *Rhododendron* varieties were up to 20,000 by the end of 2001 [12]. Many evergreen *Rhododendron* hybrid varieties were also introduced from other countries [12].

In southern China, *Rhododendron dronpulchrum* is commonly cultivated in parks and gardens [3]. *R. simsii* has been grown in the whole country. However, the fewer cultivars or varieties of *Rhododendron* have been marketed and promoted in China's urban landscaping [4], in terms of its rich species diversity.

Beyond the traditional methods, many new modern biological technologies are applied for cultivating and reproducing *Rhododendron* plants in China. For example, the technique of tissue culture and rapid propagation made a lot of progresses on *Rhododendron cephalanthum*, *Rhododendron molle* and *Rhododendron fortune* [10]. The genetic engineering technology is also used for the studies on *Rhododendron* plants [12].

#### ***Vaccinium***

The genus *Vaccinium* contains roughly 450 specie throughout the northern hemisphere and some other places in the world, in which 92 species (51 endemic) occur in China [1]. It is known for possessing one of the strongest antioxidant activity of any edible fruit such as famous blueberry [13]. *Vaccinium* species have great potential value for medicinal use

because of their strong biological activity, along with some unique chemical constituents [13]. There are many *vaccinium* species which can be introduced and developed into ornamental plants, only few are being grown for ornamentals nowadays according to our investigation.

*Vaccinium bracteatum* is a very important species in southern China. People use its leaves to dye the rice and use its fruits to make jelly, beverages and other products [14]. The extracts from the leaves and fruits of *Vaccinium bracteatum* contain high nutritive value and good bioactivities [14]. It is also a good ornamental plant species. The new leaves of *Vaccinium bracteatum* are bright red and they gradually change into green over time [15]. Furthermore, because its elegant shape, it was used as potted ornamentals [15]. Although *Vaccinium bracteatum* has good garden application, the related studies on cultivating and seedling are relatively weak.

Another research was carried out in 2015, 12 sections of *vaccinium* species were synthetically compared, analyzed and evaluated [16]. There are many *vaccinium* species that can be used as ornamentals including *Vaccinium vacciniaceum*, *Vaccinium conchophyllum*, *Vaccinium saxicola* and some other species from Sect. Monanthos, Sect. Cyanophthalmos, Sect. Vaccinium and Sect. Oxycoccus [16]. Some can be used as potted ornamentals and there are some with strong soil adaptability and beautiful appearance for landscaping [16].

### ***Gaultheria***

*Gaultheria* is a genus and contains about 135 species of evergreen shrubs in the family Ericaceae [1]. *Gaultheria* possesses various values. More and more research results have been published due to the use of *Gaultheria* in different areas, including clinics, industry, agriculture, foodstuff, and horticulture [17].

In western countries, *Gaultheria* has a long cultivation history for ornamentals, like *Gaultheria pyroloides*, *G. depressa*, *G. mucronata*, *G. procumbens* and *G. shallon*. The plantations became one of the stem industries in Pacific coast of the Northwest United States [17]. Not only as an ornamental, the fruits of *Gaultheria* plants are also bright and beautiful. Together with its evergreen and graceful shape as well as its long flowering phase and fruiting period, some *Gaultheria* species have great potential for potted ornamental and landscaping after domestication [17]. In China, near 30 species of *Gaultheria* can be used as ornamentals like *Gaultheria purpurea* and *G. jingdongensis*. But most of them have not been grown in large scale or industrialization [17]. In addition, some species can even help to improve the ecological system. For example, *Gaultheria borneensis* and *G. shallon* are good species for soil and water conservation [17, 18]. *G. nummularioides* is an indicative plant for iron and nickel (<http://db.kib.ac.cn/CNFlora/SearchResult.aspx?id=28214>).

In general, China has rich sources of *Gaultheria* species with great exploration potential and development value. It still remains a lot of work to be done on wild species domestication, new variety-breeding and commercialization of *Gaultheria*.

### ***Enkianthus***

*Enkianthus* is a small genus with 12 species distributed from the East Himalayas through China to Japan, extending south to Indochina [1]. There are 7 species with 4 endemic species in China [2].

Some *Enkianthus* species are also well known as ornamental plants like *Enkianthus campanulatus*, which is one of the commonest gardening plants. *E. campanulatus* is an ornamental for both flower and foliage. In summer, the flowers are full of branches like small bells while in winter the color of green leaves turn into red or orange [19].

Although most species in this genus are distributed in China, they still have not been widely applied in gardening. There was only one species, *Enkianthus quinqueflorus*, sold in the market during the spring festival in Guangdong, Hong Kong and Macau [20]. People believe that luxuriant flowers can bring good fortune to the new year's business [20]. However, all of the plants of this species are collected from the wild, excessive collection

caused the damage to this species and the local ecological system. The Hong Kong government enacted the law to prohibit the collection and sale of *Enkianthus quinqueflorus* in 1920 [19]. According to our investigation, more and more people grow this species with new techniques to sell in mainland China and transport it to Hong Kong nowadays.

### *Agapetes*

*Agapetes* is a genus with 80 species worldwide mostly distributed in Asia [1]. There are 53 species (17 endemic) in China [1]. Because of the center of diversity of *Agapetes* is in Southwest China, China has great resources of this genus [21].

Most *Agapetes* plants are evergreen shrubs, epiphytic, usually with a swollen rootstock as well as beautiful and elegant flowers and fruits. In addition, their trunk can grow into bizarre forms which attract people's interests. Therefore, *Agapetes* plants were thought with great potential for potted ornamentals. Almost every part of the plant can be used ornamentally. *Agapetes burmanica*, *A. brandisian*, *A. buxifolia*, *A. hosseana*, *A. lacei*, *A. incurvate*, and *A. scortechinii* are their representatives [22]. Moreover, the swollen rootstock of *Agapetes mannii* is a traditional Chinese medicine for analgesia, diuresis, detumescence, hepatitis, stomachache and rheumatism according to our investigations.

However, very few species like *Agapetes burmanica* and *A. brandisian* are used as potted ornamental plants. They are used by the people in Dali, Yunnan Province, in which a few of them are cultivated in small scale [22]. More studies on breeding for new varieties, domestication and cultivation need to be done to exploit more wild species in this genus. Due to this, *Agapetes* has a great prospect to be used in gardening applications, more work should be done to develop it.

### *Pyrola*

There are around 30 *Pyrola* species mostly distributed in northern temperate regions and 26 species (15 endemic) are located in China [1]. It is also an important genus for Chinese medicine. For example, *Pyrola calliantha* and *P. decorata* were recorded into *Chinese Pharmacopoeia* for effectively treating rheumatism, strengthening tendons and bones and stopping bleeding [23]. Some species in other countries are also used to produce cosmetics, essential oil, flavoring agent and beverages [24].

This genus also has great potential for ornamentals. *Pyrola* species are short, evergreen and shade tolerant, with racemes flowers and blooming in summer [25]. Some species have green and red flowers or striped leaves [25]. These features make *Pyrola* plants a great resource for shade-tolerant ground cover, indoor ornamental plants or potted ornamental plants. Nevertheless, very few related researches on the introduction and domestication of *Pyrola* have been carried out. Only few studies have focused on some preliminary investigation on the introduction and domestication of *Pyrola incarnata* and *P. calliantha* [26].

### Conclusion

Ericaceae is an important plant family within different usages especially on gardening in China since ancient times. According to the taxonomic situation, morphological diversity, life forms diversity, habitat diversity and rich endemism, we can conclude that Ericaceae has high biodiversity in China. As for the ornamental application, genus *Rhododendron* has been developed very well. Some other genera including *Gaultheria*, *Vaccinium*, *Enkianthus*, *Agapetes*, and *Pyrola* have also been made some progresses in China. In summary, Ericaceae has great potential for ornamentals. More studies need to be done and new modern techniques should be introduced in to make the studies more efficiently completed. More beautiful wild species and new varieties can be dedicated.

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**Луо Биншенг, Лонг Чунлин Биоразнообразие и декоративная ценность *Ericaceae* juss. в Китае** // *Works of the State Nikit. Botan. Gard.* – 2017. – V. –145 – P. 119-124.

*Ericaceae* – это большое семейство и важный ресурс в Китае. Растение имеет большое биоразнообразие и высокий декоративный потенциал в Китае, особенно род *Rhododendron*. Однако, в литературе имеется недостаточно источников обо всем семействе *Ericaceae*. По имеющимся литературным источникам в сочетании с нашими многолетними полевыми исследованиями мы считаем, что *Chinese Ericacea* имеет статус ценной декоративной культуры и является предметом пристального изучения для последующих поколений исследователей.

**Ключевые слова:** *Ericaceae*; биоразнообразие; использование в качестве декоративного растения; Китай.