Identification of medicinal plants used as Tibetan Traditional Medicine Jie-Ji

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A R T I C L E   I N F O

Article history:
Received 5 April 2010
Received in revised form 24 June 2010
Accepted 17 July 2010
Available online 6 August 2010

Keywords:
Tibetan Traditional Medicine
Jie-Ji
Ethnobotanical survey
Gentiana

A B S T R A C T

Aim of the study: Based on the authors' collection of specimens used as Jie-Ji in local Tibetan areas, China, and taxonomic determination, this paper aims to give a list of medicinal plants as Jie-Ji, formally identify the ones recognized as Jie-Ji Ga-Bao or Jie-Ji Na-Bao and to offer basic data for further studies on these Tibetan herbs.

Materials and methods: Local herbalists were visited in Tibetan areas, China to observe which plants were being used as Jie-Ji. Samples of the indigenous plants were collected at the same time. Also, the medicinal plants as Jie-Ji were taxonomically identified.

Results: A list of medicinal plants including 10 species of Jie-Ji in local Tibetan areas is given, including their morphological pictures used for identification.

Conclusions: The origin of Jie-Ji is from 10 species of the Section Cruciata, Genus Gentiana (Gentianaceae). Five species with dark blue flowers are used as Jie-Ji Na-Bao, the other five with white flowers are used as Jie-Ji Ga-Bao. Also, Gentiana macrophylla Pall. with dark blue flowers in the Section Cruciata, Genus Gentiana is not the original plant of Jie-Ji Na-Bao. The species endemic to the province are used as the original plants of Jie-Ji only in local Tibetan area of the province. Finally, the drug use of Jie-Ji in Traditional Tibetan Medicine is reasonable and it is efficacious.

1. Introduction

Living mainly on the Qinghai–Tibet plateau, Tibetans have accumulated abundant medical knowledge during the prolonged course of fighting diseases and have developed a distinctive Tibetan medical system. They have been recorded in many classic works. ‘The Four Medical Tantras’ (Sibu Yidian, AD 773–783) is one of these famous Tibetan classics. There are rich in contents such as: general knowledge of physiology, pathology, anatomy of the human body, diagnosis and treatment for clinical diseases, and the properties of various medicines, etc. in the treatise (Yutok Yonten Gonpo, 1987).

Jie-Ji (jie-ji, Tibetan name), a common Tibetan herb, was cited in ‘The Four Medical Tantras’ and is traditionally used for the treatment of Chi-Ba disease. The symptoms of this condition are: abdominal swelling, yellowness of eyes, yellowness of skin, and darkness of urine (Yutok Yonten Gonpo, 1987). Also, Jie-Ji was divided into two kinds, i.e. Jie-Ji Ga-Bao (jie-ji ga-bao, with white flowers) and Jie-Ji Na-Bao (jie-ji na-bao, with dark blue flowers) in another Tibetan medical classic Jing Zhu Ben Cao (Dimaer Danzeng Pengcuo, 1986). According to Tibetan Medicine, the origin of Jie-Ji is from the plants of the Section Cruciata, Genus Gentiana (Gentianaceae). However the actual situation is more complex. Not only might there be different species used as the origin of Jie-Ji in different areas (Yang, 1991), but some species were misidentified as well (Qinghai Institute for Drug Control and Qinghai Institute of Tibetan Medicine, 1996).

Due to the fact that the first stage in assuring the quality, safety and efficacy of herbal medicines is identification of the plant species (WHO, 2000), our research group has been concentrating on the ethnobotanical survey and identification of Tibetan herbs since 1992. A survey of Jie-Ji has been carried out after our studies on two Tibetan herbs Chuan-Bu (Zhaoh and Zhao, 1992) and Ta-Ri-Qing (Zhao, 1993). Based on our collection of specimens used as Jie-Ji in Tibet Autonomous Region (Zhao et al., 2010), Yunnan Province, Sichuan Province and Gansu Province, China, and taxonomic determination, this paper aims to give a list of medicinal plants as Jie-Ji in local Tibetan areas, formally identify the ones recognized as Jie-Ji Ga-Bao or Jie-Ji Na-Bao and to offer basic data for further studies on these Tibetan herbs.

2. Methodology

Local herbalists were visited in Tibet Autonomous Region and other Tibetan areas of Yunnan Province, Sichuan Province and Gansu Province, China to observe which plants were being used as
Jie-Ji. Samples of the indigenous plants were collected at the same time.

Also, a specimen collection of the Section Cruciata, Genus *Gentiana* was carried out in Tibet Autonomous Region and other Tibetan areas of Yunnan Province, Sichuan Province and Gansu Province for 7 years (Fig. 1). At least three samples of the plant with flowers and (or) fruits were collected in each population. The voucher specimens were deposited at the Herbarium of the College of Traditional Chinese Medicine, Shanghai University of Traditional Chinese Medicine, China (Tables 1 and 2).

We also consulted the herbarium collections of the Section Cruciata, Genus *Gentiana* in the Herbarium of Northwest Institute of Plateau Biology, Chinese Academy of Sciences, the Herbarium of Tibetan Traditional Medical College in Tibet Autonomous Region, the Herbarium of Gannan Institute for Drug Control of Tibetan Autonomous Prefecture of Gannan in Gansu Province, the Herbarium of School of Life Science, Lanzhou University and the Herbarium of School of Pharmacy, Lanzhou University.

Subsequently, based on the dissection of reproductive parts and morphological observation of the specimens, their systematic position has been determined, respectively.

### 3. Results

The origin of Jie-Ji in Tibetan areas, a total of 10 species of the Section Cruciata, Genus *Gentiana* were determined. Five species with dark blue flowers are used as Jie-Ji Na-Bao, i.e. *Gentiana dahurica* Fisch., *Gentiana crassicaulis* Duthie ex Burk., *Gentiana siphonantha* Maxim. ex Kusnez., *Gentiana waltonii* Burk. and *Gentiana lhassica* Burk., the other five with white flowers are used as Jie-Ji Ga-Bao, i.e. *Gentiana straminea* Maxim., *Gentiana robusta* King ex Hook. f., *Gentiana dendrologi* Marq., *Gentiana tibetica* King ex Hook. f. and *Gentiana officinalis* H. Smith (Fig. 2) (Table 1, 2).

According to the morphological characters of flowers or inflorescences, a key for the identification of 10 species is compiled as follows:

2. Flowers dense and head-like.
3. Inflorescence with broad bract-like leaves ......... *Gentiana crassicaulis*
4. Inflorescence without broad bract-like leaves ......... *Gentiana siphonantha*
5. Flowers rare in cyme.
6. Calyx tube split on 1 side; ovary on a gynophore ......... *Gentiana waltonii*
7. Calyx tube not split; ovary sessile.
8. Calyx lobes unequal ......... *Gentiana dahurica*
9. Calyx lobes subequal ......... *Gentiana lhassica*
10. Corolla white or light yellow (population: Jie-Ji Ga-Bao).
11. Flowers rare in cyme ......... *Gentiana straminea*
12. Flowers dense and head-like.
13. Inflorescence with broad bract-like leaves ......... *Gentiana tibetica*
15. Calyx tube with truncate apex ......... *Gentiana officinalis*
16. Calyx tube with obtuse apex.
17. Corolla 3-3.5 cm, inside with brown-green striae ......... *Gentiana robusta*
18. Corolla 2.5–3 cm, inside without brown-green striae ......... *Gentiana dendrologi*

Also, based on our survey and Ho’s work (Ho, 1988), the species distribution is shown in Table 3. Some species are endemic to the province, i.e. *Gentiana robusta* King ex Hook. f., *Gentiana tibetica* King ex Hook. f. and *Gentiana waltonii* Burk. to Tibet, *Gentiana dendrologi* Marq. to Sichuan.

#### Table 1

<table>
<thead>
<tr>
<th>Species</th>
<th>Collection date</th>
<th>Collector name</th>
<th>Native distribution</th>
<th>Morph. part used</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Gentiana dahurica</em> Fisch.</td>
<td>18/8/2003</td>
<td>Z.L. Zhao 2003022</td>
<td>Flower, root</td>
<td></td>
</tr>
<tr>
<td><em>Gentiana crassicaulis</em> Duthie ex Burk.</td>
<td>7/8/2007</td>
<td>Z.L. Zhao 2007501</td>
<td>Cultivated</td>
<td>Flower, root</td>
</tr>
<tr>
<td><em>Gentiana siphonantha</em> Maxim. ex Kusnez.</td>
<td>28/8/2004</td>
<td>Z.L. Zhao 2004301</td>
<td>Flower, root</td>
<td></td>
</tr>
<tr>
<td><em>Gentiana waltonii</em> Burk.</td>
<td>19/8/2007</td>
<td>Z.L. Zhao 2007701</td>
<td>Flower, root</td>
<td></td>
</tr>
<tr>
<td><em>Gentiana lhassica</em> Burk.</td>
<td>1/9/2008</td>
<td>Z.L. Zhao 2009Z021</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>12/9/2009</td>
<td>Z.L. Zhao 2009Z001</td>
<td>Flower, root</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 1.** Map indicating collection locality.
4. Discussion

As well as the five species identified as Jie-Ji Na-Bao, *Gentiana macrophylla* Pall. with dark blue flowers in the Section Cruciata, Genus Gentiana was believed to be the other original plant (*Qinghai Institute for Drug Control and Qinghai Institute of Tibetan Medicine, 1996*). However according to our ethnobotanical studies, we disagree with this classification. No specimen of *Gentiana macrophylla* Pall. was collected in the area of the Qinghai–Tibet plateau during our field investigation. We found it only on the Loess plateau (*Qingshui, Gansu Province, voucher: Z.L. Zhao 2003024*). Also, it is not distributed in Tibet Autonomous Region, and on the contrary, Gansu, Hebei, Nei Mongol, Ningxia, Shanxi and Shaanxi are the main distribution areas of this species (*Ho, 1988*). We therefore believe that the origin of Tibetan Traditional Medicine in some other papers may also have been misidentified (*Sun et al., 2006*).

*Gentiana macrophylla* Pall. and *Gentiana officinalis* H. Smith closely resemble each other, so the two species can be easily misidentified. However it differs from the latter in leaf shape, distribution area and from the color of the corolla. *Gentiana macrophylla* Pall. has ovato-elliptic or narrowly elliptic, 2.5–6 cm late basal leaves and a dark blue corolla. The latter has lanceolate or elliptic-lanceolate, 1.5–3.5 cm late basal leaves and a white to light yellow corolla. We noticed that in some specimens of *Gentiana officinalis* H. Smith, the margin of corolla lobes is red-purplish or dark purplish and it is probably the main reason for misidentifying the species as *Gentiana macrophylla* Pall.

We noticed that, according to the morphological description of Jie-Ji in Tibetan classic works and the knowledge of the plant identification passed down by oral tradition, local herbalists have been using the plants around them as the origin of the herb. It is obvious that every species has its own distribution and some species are endemic to the province, so that there are different uses of original plants in the different provinces. The 6 species are used as Jie-Ji, i.e. *Gentiana straminea* Maxim., *Gentiana crassicaulis* Duthie ex Burk., *Gentiana lwassica* Burk., *Gentiana robusta* King ex Hook. f., *Gentiana tibetica* King ex Hook. f. and *Gentiana waltonii* Burk. in Tibet, and the latter 3 species endemic to Tibet are used only in the province. *Gentiana crassicaulis* Duthie ex Burk. is the most common original plant in Yunnan. There are 6 species as the original plants in Sichuan, and the endemic species *Gentiana dendrologi* Marq. is used only in the province. Also, the 5 species are used as Jie-Ji, i.e. *Gentiana straminea* Maxim., *Gentiana crassicaulis* Duthie ex Burk., *Gentiana lwassica* Burk., *Gentiana robusta* King ex Hook. f., *Gentiana tibetica* King ex Hook. f. and *Gentiana waltonii* Burk. in Tibet, and the latter 3 species endemic to Tibet are used only in the province. *Gentiana crassicaulis* Duthie ex Burk. in Tibet is a rare plant in the province according to our survey, and the former 4 species are used as the main original plants in Gansu.

*Gentiana* plants with about 400 species are distributed in Europe, Asia, America, Africa, and Australia (*Ho, 1988*). Since the 1960s, almost 200 secondary metabolites have been isolated from the genus, most being iridoids, secoiridoids, flavonoids or triterpenoids, some of them with promising bioactivities such as central nervous system effects, smooth muscle relaxing, antidepressant, antiinflammation, immunostimulant activity, cytoxicity and so on (*Yang et al., 2010*). With significant liver-protection and promoting bile secretion effects and other bioactivities, gentiopicric acid (a secoiridoid glycoside) is distributed widely within Gentiana species (*Liu et al., 2002; Yang et al., 2010*). Also, gentiopicric acid exists in the original plants of Jie-Ji (*Tan and Kong, 1997; Chinese Pharmacopoeia Commission, 2005; Duan et al., 2007; Liu et al., 2008*). Jie-Ji is traditionally used for the treatment of the diseases related to hepatobiliary system disorders. Therefore the drug use of “Jie-Ji in Traditional Tibetan Medicine is reasonable and it is efficacious.

In general, the medicinal part of *Gentiana spp.* is the root in TCM. However the flower is also an important medicinal part of Jie-Ji. According to our primary chemical analyses, the contents of

Table 2

<table>
<thead>
<tr>
<th>Species</th>
<th>Collection locality</th>
<th>Collection date</th>
<th>Collector and number</th>
<th>Native distribution</th>
<th>Morph. Part used</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>Tianshu, Gansu</td>
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<td>Z.L. Zhao 2004302</td>
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</tr>
<tr>
<td></td>
<td>Luqiu, Gansu</td>
<td>19/8/2005</td>
<td>Z.L. Zhao 2005301</td>
<td>Flower, root</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mozhugongka, Tibet</td>
<td>22/8/2008</td>
<td>Z.L. Zhao 2008X2003</td>
<td>Flower, root</td>
<td></td>
</tr>
<tr>
<td>Gentiana tibetica King ex Hook. f.</td>
<td>Linzhu, Tibet</td>
<td>19/8/2007</td>
<td>Z.L. Zhao 2007703</td>
<td>Flower, root</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Linzhu, Tibet</td>
<td>24/7/2008</td>
<td>Gaaw Dorje no number</td>
<td>Flower, root</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lanzhou, Gansu</td>
<td>10/9/2003</td>
<td>Z.L. Zhao 2003056</td>
<td>Flower, root</td>
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<tr>
<td></td>
<td>Lanzhou, Gansu</td>
<td>10/9/2003</td>
<td>Z.L. Zhao 2003058</td>
<td>Flower, root</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Luqiu, Gansu</td>
<td>19/8/2005</td>
<td>Z.L. Zhao 2005302</td>
<td>Flower, root</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lanzhou, Gansu</td>
<td>27/8/2005</td>
<td>Z.L. Zhao 2005308</td>
<td>Flower, root</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lanzhou, Gansu</td>
<td>25/8/2006</td>
<td>Z.L. Zhao 2006413</td>
<td>Cultivated</td>
<td></td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Species</th>
<th>Province</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gentiana straminea Maxim.</td>
<td>Tibet, Sichuan, Gansu, Yunnan</td>
</tr>
<tr>
<td>Gentiana robusta King ex Hook.f.</td>
<td>Tibet, Sichuan, Gansu, Yunnan</td>
</tr>
<tr>
<td>Gentiana dendrologi Marq.</td>
<td>Tibet, Sichuan, Gansu, Yunnan</td>
</tr>
<tr>
<td>Gentiana tibetica King ex Hook. f.</td>
<td>Tibet, Sichuan, Gansu, Yunnan</td>
</tr>
<tr>
<td>Gentiana officinalis H. Smith</td>
<td>Tibet, Sichuan, Gansu, Yunnan</td>
</tr>
<tr>
<td>Gentiana lwassica Fisch.</td>
<td>Tibet, Sichuan, Gansu, Yunnan</td>
</tr>
<tr>
<td>Gentiana crassicaulis Duthie ex Burk.</td>
<td>Tibet, Sichuan, Gansu, Yunnan</td>
</tr>
<tr>
<td>Gentiana siphonantha Maxim. ex Kusnez.</td>
<td>Tibet, Sichuan, Gansu, Yunnan</td>
</tr>
<tr>
<td>Gentiana waltonii Burk.</td>
<td>Tibet, Sichuan, Gansu, Yunnan</td>
</tr>
<tr>
<td>Gentiana lwassica Burk.</td>
<td>Tibet, Sichuan, Gansu, Yunnan</td>
</tr>
</tbody>
</table>

Note: +: found in the province.
gentiopicroside in the stem, leaf or flower of *G. lhassica* and *G. waltonii* were higher than in the root. It suggests that the quality of the aerial parts may be superior than the subterranean parts.

Based on our ethnobotanical survey, species identification and preliminary research (Zhao et al., 2006; Qin et al., 2009; Wang et al., 2009; Wu et al., 2010), further pharmacological studies should be carried out.

5. Conclusions

The origin of Jie-Ji is from 10 species of the Section Cruciata, Genus *Gentiana* (Gentianaceae). Five species with dark blue flowers are used as Jie-Ji Na-Bao, the other five with white flowers are used as Jie-Ji Ga-Bao. Also, *G. macrophylla* Pall. with dark blue flowers in the Section Cruciata, Genus *Gentiana* is not the original plant of Jie-Ji Na-Bao. There are different uses of the Tibetan herb in the different provinces, and the species endemic to the province are used as the original plants of Jie-Ji only in local Tibetan area of the province. Finally, the drug use of Jie-Ji in Traditional Tibetan Medicine is reasonable and it is efficacious.

Acknowledgements

Research of the authors was supported by the Innovation Program of Shanghai Municipal Education Commission (09ZZ131). The authors are grateful to Dr. Don Green from London Metropolitan University for his assistance in English writing; also to ethnobotanists in the Tibetan Traditional Medical College in Tibet Autonomous Region, Gannan Institute for Drug Control of Tibetan
Autonomous Prefecture of Gannan in Gansu Province, Garze Institute for Drug Control of Tibetan Autonomous Prefecture of Garze in Sichuan Province, Chongqing Academy of Chinese Materia Medica in Chongqing and Alpine Economic Plant Institute of Yunnan Academy of Agricultural Science in Yunnan Province, for the kind assistance in the survey.

References