Research article

Application of morphoanatomy and microscopy in authentication of three species of traditional Chinese herbs of Moghania

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A B S T R A C T

Background: Moghania philippinensis (Merr. et Rolfe) Li, M. macrophylla (Willd.) O. Kuntze and M. ferruginea (Wall. ex Benth.) Li. (Leguminosae) has not the national standards now, and they are just only recorded in appendix of "Pharmacopoeia of the People's Republic of China" (2010 and 2005 edition). But their roots are the crude herbs recourses of the primary ingredient in the famous prescription of "Female Moghania Tablet" for curing colpitis in China. Moreover M. philippinensis was also recorded by the appendix "Pharmacopoeia of the People's Republic of China" (1977 edition). M. strobilifera (Linn.) Ait, M. glutiosa (Prain) Y.T.Wei, and M. Latifolia Benth are still medical used in some local region of Guangxi and Yunnan Province of China. So their crude herbs recourses are confused in Chinese Crude Herbs Market.

Objective: To distinguish three species of Moghania and ensure their safety and efficacy.

Materials and methods: Three species of M. macrophylla (Willd.) O.Kuntze, M. Latifolia Benth and M. glutiosa (Prain) Y.T.Wei from Guangxi, Yunnan and Sichuan Province of China (SWUN) (Table 1). Fresh materials were fixed in FAA. Samples were passed through the traditional ethanol and dimatehylbenzene series, embedded in parafin, and then sliced with a microtome and stained with safranine-fast green and finally mounted. The leaf lower epidermal cells are obtained by the practical peeling technique and clearing method with nail polish blot. The materials were dissociated by nitric acid chromate method. The samples of herbs were powdered.

The average number of palisade cell under the epidermal cells is called Palisade Ratio (PR). Since palisade ratio is consistent and different from plant to plant, this parameter can be used in authentication. Stomatal Index (SI) is a basilic parameter in authentication, which can be obtained from the following formula: Stomatal Index = (number of stomata/every millimeter-square) × 100/(number of stomata/every millimeter-square + number of epidermal cell/every millimeter-square). Mesophyll tissue is divided up by slendest vein, which is called vein islet. The numbers of vein islet in every epidermal cell is called Vein Islet Numbers (VIN), which also can be used as a reliable parameter in authentication since it is consistent in a species of plant. The results were studied using light microscope according to the usual microscopic techniques.

Results: The three species of Moghania were studied to compare the distinguishing morphoanatomic details of root, stem, leaf and petiole, dissociation and powders. The microscopic features were systematically described and illustrated. And detailed key authentication parameters based on these anatomic characteristics were presented. A key was constructed to the three species for convenient classification. Microscopy can be unambiguously used to authenticate and distinguish three species of Moghania.

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1. Introduction

Premenstrual symptoms, colpitis and hyperplasia of mammary glands are three of the common female gynecologic diseases. Among them, the colpitis is the multiple and difficult gynecologic diseases, bringing chronic pains of women.
Table 1
Source of materials of the three species of M.

<table>
<thead>
<tr>
<th>S. Taxon</th>
<th>Batches</th>
<th>Locality</th>
<th>Elevation (m)</th>
<th>Date of collection</th>
<th>Voucher</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 M. macrophylla (Willd.) O. Kuntze</td>
<td>No.1</td>
<td>Sichuan, China</td>
<td>500</td>
<td>April, 2007</td>
<td>Y. Liu 07041001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(SWUN)</td>
</tr>
<tr>
<td></td>
<td>No.2</td>
<td>Sichuan, China</td>
<td>500</td>
<td>April, 2007</td>
<td>Y. Liu 07041002</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(SWUN)</td>
</tr>
<tr>
<td></td>
<td>No.3</td>
<td>Yunnan, China</td>
<td>551</td>
<td>May, 2007</td>
<td>CZ. Peng 07051003</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(SWUN)</td>
</tr>
<tr>
<td>2 M. latifolia Benth</td>
<td>No.1</td>
<td>Yunnan, China</td>
<td>551</td>
<td>April, 2008</td>
<td>CZ. Peng 08041001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(SWUN)</td>
</tr>
<tr>
<td></td>
<td>No.2</td>
<td>Yunnan, China</td>
<td>551</td>
<td>April, 2008</td>
<td>CZ. Peng 08041002</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>(SWUN)</td>
</tr>
<tr>
<td></td>
<td>No.3</td>
<td>Yunnan, China</td>
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<td>CZ. Peng 08041003</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(SWUN)</td>
</tr>
<tr>
<td>3 M. glutiosa (Prain) Y.T.Wei</td>
<td>No.1</td>
<td>Guangxi, China</td>
<td>570</td>
<td>April, 2008</td>
<td>B. Dai 08041001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(SWUN)</td>
</tr>
<tr>
<td></td>
<td>No.2</td>
<td>Guangxi, China</td>
<td>570</td>
<td>April, 2008</td>
<td>B. Dai 08041002</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(SWUN)</td>
</tr>
<tr>
<td></td>
<td>No.3</td>
<td>Guangxi, China</td>
<td>570</td>
<td>April, 2008</td>
<td>B. Dai 08041003</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(SWUN)</td>
</tr>
</tbody>
</table>

Nowadays “Female Moghania Tablet” has the good clinic effect for curing colpitis, and it is the good promoted sales volume in the traditional Chinese medicinal market. Moreover, it was the first choice for women to curing colpitis. The dried roots of Moghania is the primary ingredients in the prescription of “Female Moghania Tablet”, which belongs to Leguminosae of Moghania philippinensis (Merr. et Rolfe) Li, M. macrophylla (Willd.) O. Kuntze and M. ferruginea (Wall. ex Benth.) Li. They were recorded in appendix of “Pharmacopoeia of the People’s Republic of China” (2005 and 2010 edition). And M. philippinensis was also recorded by the appendix “Pharmacopoeia of the People’s Republic of China” (1977 edition). However, the “Pharmacopoeia of the People’s Republic of China” (2010 edition and earlier) has not accepted the quality standard of them.

China is the native producing region of 6 species of Moghania and 1 varieties, and 6 species of them are popularly used in traditional Chinese herbs in southwest of China. M. philippinensis (Merr. et Rolfe) Li and M. macrophylla (Willd.) O. Kuntze are widely distributed in southwest of China, such as Yunnan, Guangxi, Guangdong, Jiangxi, Fujian, Taiwan, Hunan, Sichuan Province of China and so on, especially in Guangxi and Yunnan Province of China. Their dried roots have the good medicinal functions of alleviating the pain of wind-dampness, lumbar, arthralgia, and lumbar muscle strain, gynaecopathy, breast diseases, impotence and seminal emission and so on. And they are also used by Hani, Dai, Zhuang and Yao Nationality. But their wild resources and cultivated resources

Table 2
Comparison of morphological characters of the three species of the whole plant of M.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>M. macrophylla (Willd.) O. Kuntze</th>
<th>M. latifolia Benth</th>
<th>M. glutiosa (Prain) Y.T.Wei</th>
</tr>
</thead>
<tbody>
<tr>
<td>The whole plant</td>
<td>About 0.5−3 m, erect, shrub</td>
<td>About 1−2 m, erect, shrub</td>
<td>About 0.5−1 m, erect, suffrutescent, ramose</td>
</tr>
<tr>
<td>Young stem</td>
<td>Columniform bivious ridge, and densely covered soft hair.</td>
<td>Triangular prism, and densely covered ferrugineous soft hair.</td>
<td>Columniform, and densely covered golden base-expanded glandular hair and grey hair.</td>
</tr>
<tr>
<td>Dried root</td>
<td>Grey or brown-red colored, and infarctate and heavy</td>
<td>Brown red colored, not infarctate and heavy easy to smashed</td>
<td>Papery or thick papery, covered with brown and red glandular dots.</td>
</tr>
<tr>
<td>Ternated compound</td>
<td>Papery or thin leathery, covered no hair except main vein of lower surface, and lower surface with brown and black glandular dots.</td>
<td>Papery or thick papery, covered with brown and black glandular dots.</td>
<td>Papery or thick papery, covered with brown and red glandular dots.</td>
</tr>
<tr>
<td>Form and size of blade</td>
<td>8−15 × 4−7 cm, the lower side is not white-grey color.</td>
<td>8−14 or more longer × 4−6 cm or broader, the lower side is white-grey color.</td>
<td>4−9 × 1−5−3 cm, young leaf purple colored; the lower side is white-grey color.</td>
</tr>
<tr>
<td>Common petiole</td>
<td>3−6 cm</td>
<td>3−10 cm</td>
<td>1.5−4 cm</td>
</tr>
<tr>
<td>Raceme</td>
<td>2−6 mm</td>
<td>2−6 mm</td>
<td>2−6 mm</td>
</tr>
<tr>
<td>Common pedicel</td>
<td>Almost no</td>
<td>Almost no</td>
<td>1−10 cm</td>
</tr>
<tr>
<td>Pedicel</td>
<td>Almost no</td>
<td>Almost no</td>
<td>Almost no</td>
</tr>
<tr>
<td>Flowers</td>
<td>Petal is red-purple with campionate calyx. Androecium is diadelphous. Ovary is elliptic covered soft hair with thin style.</td>
<td>Pod is elliptic with 1−1.6 cm long and 7−9 mm wide, brown, covered short soft hair.</td>
<td>Pod is elliptic with 1−1.6 cm long and 0.5−0.7 cm wide, covered light golden base-expanded glandular hair and grey hair.</td>
</tr>
<tr>
<td>Pod</td>
<td>Pod is elliptic with 1−1.6 cm long and 7−9 mm wide, brown, covered short soft hair. The apex has a small acute beak.</td>
<td>Pod is elliptic with 1−1.6 cm long and 7−8 mm wide, covered ferrugineous short soft hair.</td>
<td>Pod is elliptic with 1−1.4 cm long and 0.5−0.7 cm wide, covered light golden base-expanded glandular hair.</td>
</tr>
<tr>
<td>Seed</td>
<td>1−2, globose and black, about 2 mm</td>
<td>1−2, globose and black, about 2 mm</td>
<td>1−2, almost globose and brown-black, about 2 mm</td>
</tr>
<tr>
<td>Florescence</td>
<td>From June to September</td>
<td>The whole year</td>
<td>From Feb to May</td>
</tr>
<tr>
<td>Fructescence</td>
<td>From Oct to Dec</td>
<td>The whole year</td>
<td>From Feb to May</td>
</tr>
<tr>
<td>Surrounding</td>
<td>200−1500 m</td>
<td>560−2100 m</td>
<td>About 1400 m</td>
</tr>
</tbody>
</table>
are not enough to satisfy the sustainable needs of traditional Chinese medicinal market for making of "Female Moghania Tablet".

In addition to that of them, *M. strobilifera* (Linn.) Ait, *M. latifolia* Benth and *M. glutiosa* (Prain) Y.T.Wei are still medical used in some local region in southwest of China. And they are also regarded as having the same medicinal function as that of them. They are popularly medical used by Hani, Dai, Zhuang Yao and Dai Nationality of China.³ To ensure their effective usage, the most urgent requirement is to guarantee authenticity. A few studies have been carried out for this purpose. However, systematic information of microscopic authentication and morphoanatomy has not been reported for the three species in this area. In order to distinguish the three species and find out whether the local medical used species of *M. latifolia* Benth and *M. glutiosa* (Prain) Y.T.Wei have any other similarities with *M. macrophylla* (Willd.) O. Kuntze or not, which is recorded in appendix of “Pharmacopoeia of the People’s Republic of China” (2005¹ and 2010²). Microscopic authentication was adopted, since it is a facile, inexpensive, and objective method which has been successfully applied in “Pharmacopoeia of the People’s Republic of China”,³ the American Herbal Pharmacopoeia (Upton, 2003), and the Japanese Pharmacopoeia (Society of Japanese Pharmacopoeia, 2001). Microscopy technique was also frequently reported in the literature for authentication.⁵–⁷

A series of related studies of *M.* has been conducted by our research group.⁸ In order to get fresh material of *M.*, we made on-site investigations in Guangxi, Yunnan and Sichuan Province of China and collected both fresh wild and cultivated plants of *M. macrophylla* (Willd.) O. Kuntze, *M. latifolia* Benth and *M. glutiosa* (Prain) Y.T.Wei.
2. Materials and methods

2.1. Materials

Three species of *M*. were collected during flowering and fruiting time from Guangxi, Yunnan and Sichuan province of China, and authenticated by Prof. Yuan Liu (Ethnic Medicine Institute, Southwest University for Nationalities, Chengdu, PR. China), Bin Dai (Ethnic Medicine Institute of Guangxi, Nanning, PR. China) and Chaozhong Peng (Yunna Branch, Institute of Medicinal Plant Development). Voucher specimens were deposited in the Herbarium of Ethnic-herbs, Ethnic Medicine Institute, Southwest University for Nationalities (SWUN) (Table 1).

2.2. Apparatus

All the transverse sections of the materials were prepared using a KD-1508 microtome (Jinhua Kedi Instruments, China). An imaging system consisting of an optical microscope equipped with a micrometer and a digital camera for acquisition of photographs (BX41 standard laboratory microscope of Olympus, Japan) was used for photography.

2.3. Reagents

FAA (50% ethanol: formaldehyde: Glacial acetic acid = 89: 5: 6) and ethanol series (in gradient of 30%–100%) were prepared for specimen fixation and dehydration, respectively. Safranine T in 50% alcohol, and safranine-fast green solution were prepared for specimen staining. Chloral hydrate and diluted glycerin. Three samples were studied for the key authentication features.

2.4. Methods

Fresh materials of three species of *M*. were divided into appropriate sizes and fixed in FAA. Samples were passed through the traditional ethanol and dimethylbenzene series, embedded in paraffin according to the technique described by Ruzin (1999), and then sliced with a microtome to suitable thickness and stained with safranine-fast green (Berlyn and Miksche, 1976; Johansen, 1940) and finally mounted in Canada balsam for observation. Leaves of the samples were prepared according to the practical peeling technique and clearing method (Berlyn and Miksche, 1976; Leng Ping-sheng, Wang Wen-he, et al. 2007). The samples of three species of *M*. were powdered and cleared in chloral hydrate, then mounted in glycerin. Three samples were studied for the key authentication features.

3. Results

3.1. Plant morphology

The gross morphology between three species is quite different from each other. We listed the distinguishable characters in Table 2 and showed them in Fig. 1.

3.2. Microscopic characteristics

Characteristic microscopic differences of three species in transverse section of root, stem, leaf and petiole; and surface view of leaf under epidermis; and herbs dissociation and powders are summarized in Table 3 and pictures of the three species are shown in Figs. 2–6.

3.2.1. Microscopic characteristics of transverse sections

3.2.1.1. Root. *M. macrophylla* (Wild.) O. Kuntze: The outline is almost circular. Phellem layer is 5–6 layers tangentially prolonged brown cork cells, arranged closely. The outer-layer is sometimes ruptured and exfoliated. The cortex consisted of 2–3 layers parenchyma cells, oval or subrounded, arranged loosely. Phloem and xylem fiber are bundled; the cortex and phloem are narrow, but xylem is very wide with the ratio of 5–7; cambium is not obvious; phloem and xylem rays are composed of 3–6 layers of cells; two or three vessel bundles are closely packed together occasionally, majority of them radially arranged in xylem; parenchyma cells of cortex and phloem contained brown-red inclusion about 14–16 μm in diameter, stone cell about 8–20 μm in diameter, calcium oxalate crystal about 7–13 μm in diameter, starch grain about 50–60 μm in diameter and except a few of them existed in xylem rays.

### Table 3

Main comparison of transverse sections, dissociation and powders of root, stem, leaf and petiole of *M.*

<table>
<thead>
<tr>
<th>Taxon</th>
<th><em>M. macrophylla</em> (Willd.) O. Kuntze</th>
<th><em>M. latifolia</em> Benth</th>
<th><em>M. glutiosa</em> (Prain) Y.T.Wei</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown-red inclusion (μm)</td>
<td>9–35; a lot of; root, stem, leaf and petiole</td>
<td>10–35; a little; root, stem, leaf and petiole</td>
<td>10–30; a lot of; root, stem, leaf and petiole</td>
</tr>
<tr>
<td>Calcium oxalate crystal (μm)</td>
<td>5–35; a lot of; root, stem, leaf and petiole</td>
<td>5–25; a little; root, stem, leaf and petiole</td>
<td>5–100; a lot of; root, stem, leaf and petiole</td>
</tr>
<tr>
<td>Stone cell (μm); quantity, local site</td>
<td>5–50; a lot of; root, stem, leaf and petiole</td>
<td>10–45; a little; root, stem, leaf and petiole</td>
<td>10–35; a lot of; root, stem, leaf and petiole</td>
</tr>
<tr>
<td>Epidermal cells of stem and leaf</td>
<td>Non-glandular hair</td>
<td>Has</td>
<td>A lot of and longer than others</td>
</tr>
<tr>
<td>Type</td>
<td>Non-glandular hair in Glandular hair</td>
<td>No</td>
<td>A lot of basal expanded</td>
</tr>
<tr>
<td>Width</td>
<td>2.40–3.03</td>
<td>2.11–2.63</td>
<td>Paracytic</td>
</tr>
<tr>
<td>Stomatal index</td>
<td>10.8–12.1</td>
<td>29.3–31.7</td>
<td>7.2–8.4</td>
</tr>
</tbody>
</table>
The microscopic characteristics of root of the other species are similar to *M. macrophylla* (Willd.) O. Kuntze, but there are also some differences among them. For example, the size and density of brown-red inclusion, stone cell and calcium oxalate crystal are different from each other.

Micrographs of detailed comparison of three species are shown in Table 3 and Fig. 2.

3.2.1.2. Stem. *M. macrophylla* (Willd.) O. Kuntze: The outline is five irregularly waved curving shaped. The epidermal cells are square and single-layered, covered with thin cuticle and single or 2–3 cells non-glandular hair and contained the green and brown-red inclusion. Cortex is narrow and consisted of 4–5 layers parenchyma cells with brown inclusion about 9–22 μm in diameter, a lot of stone cells about 5–20 μm in diameter. The phloem and vascular bundle is narrow and parenchyma cell contained stone cell about 10–25 μm in diameter, brown inclusion about 14–22 μm in diameter, brown-red inclusion about 9–35 μm in diameter, and calcium oxalate crystal about 10–30 μm in diameter. Two or five vessel bundles are closely packed together occasionally, majority of them radially arranged in xylem. Pith is very wide.

The microscopic characteristics of stem of other species are similar to *M. macrophylla* (Willd.) O. Kuntze, but there are also some differences among them. For example, glandular hair and the

<table>
<thead>
<tr>
<th>S. No</th>
<th><em>M. macrophylla</em> (Willd.) O. Kuntze</th>
<th><em>M. Lattifolia</em> Benth</th>
<th><em>M. ghetiossa</em> (Prain) Y.T. Wei</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><img src="image.png" alt="Image A" /></td>
<td><img src="image.png" alt="Image B" /></td>
<td><img src="image.png" alt="Image C" /></td>
</tr>
<tr>
<td>B</td>
<td><img src="image.png" alt="Image D" /></td>
<td><img src="image.png" alt="Image E" /></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td><img src="image.png" alt="Image F" /></td>
<td><img src="image.png" alt="Image G" /></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td><img src="image.png" alt="Image H" /></td>
<td><img src="image.png" alt="Image I" /></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td><img src="image.png" alt="Image J" /></td>
<td><img src="image.png" alt="Image K" /></td>
<td></td>
</tr>
</tbody>
</table>

quantity of inclusion, stone cell and calcium oxalate crystal are different from each other. Micrographs of detailed comparison of three species are shown in Table 3 and Fig. 3.

3.2.1.3. Leaf and petiole

3.2.1.3.1. Leaf. *M. macrophylla* (Willd.) O. Kuntze: Bifacial leaf, both upper and lower epidermises are composed of oblong or subrounded and single-layered cells that are arranged closely and covered with cuticle. Upper epidermis is covered consisted of 2–3 cells non-glandular hair. Stomata can be observed in lower epidermis. The palisade tissues are 1–2 layer, do not pass through midrib; spongy cells are 1–2 layer, oval, arranged loosely with broad intercellular space and contained brown inclusion and calcium oxalate crystal. Vascular bundle of lateral veins can be observed. Vascular bundles of the midrib are of the ectophloic type, half circular-shaped, and enclosed by 8–9 layer parenchyma cells under upper epidermis and 4–5 layer parenchyma cells under lower epidermis. The cambium is not conspicuous.

The anticlinal walls of the leaf epidermal cells are wavy. Stomata type is paracytic, which is 2.40–3.03 × 16.67–19.69 μm dispersedly distributed, and guard cell is kidney-shaped and 2 subsidiary cells with cuticula trace. The palisade ratio is 10.8–12.1.

Micrographs of detailed comparison of three species are shown in Table 3 and Fig. 4.

3.2.1.3.2. Leaf petiole. *M. macrophylla* (Willd.) O. Kuntze: Almost circular with five irregularly waved curving shaped. Epidermis is composed of oblong or subrounded and single-layered cells that are arranged closely with brown inclusion and single cell non-glandular hair. Vascular bundle is 6–7 ringed and ectophloic type. Fiber bundle is 2–4 layer and waved ringing. Cambium is not obvious. Single or 2–3 vessel bundles are closely packed together occasionally, majority of them radially arranged in xylem. Pith is very wide with red-purple inclusion in parenchyma cell. Upper epidermis of leaf wings is covered with cuticle, and lower epidermis of leaf wings is covered nonglandular hair. Vascular bundle of lateral vein can be observed in the cortex of leaf wings. Micrographs of detailed comparison of three species are shown in Table 3 and Fig. 5.

3.2.2. Microscopic characteristics of dissociation and powders

3.2.2.1. Root. *M. macrophylla* (Willd.) O. Kuntze: Light brown color. Cork cell is quadrate, about 31–52 μm in length. Vessel is mainly pitted vessel, 226–271 μm in length, 33–60 μm in width; Sometimes reticulate vessel can be observed. Fiber is single or bundle, thin and long, linear cell cavity and obvious pit, 487–736 μm in

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Fig. 3. (continued)
length, 21–33 μm in width; parenchyma cell, which is rounded the fiber, contained calcium oxalate crystal with thick wall a little lignification or none lignification, called crystal fiber sheaths. Red—purple or brown inclusion can be observed. Stone cell is circle round or irregular shape with grey or brown color, a little pit about 20–50 μm in diameter. Calcium oxalate crystal is about 20–35 μm in diameter. Starch grains are observed occasionally.

Micrographs of detailed comparison of three species are shown in Table 3 and Fig. 6A.

3.2.2.2. Stem. *M. macrophylla* (Willd.) O. Kuntze: Grass green color. Cork cell is quadrate, about 20–53 μm in length. Vessel is mainly pitted vessel, 210–230 μm in length, 50–65 μm in width; sometimes reticulate vessel can be observed. Fiber is single or bundle, thin and long, linear cell cavity and obvious pit, 150–360 μm in length, 10–15 μm in width; parenchyma cell, which is rounded the fiber, contained calcium oxalate crystal with thick wall a little lignification or none lignification, called crystal fiber sheaths. Brown-red or brown-grey inclusion can be observed. Calcium oxalate crystal is white-grey color and about 5–20 μm in diameter. Stomata are obvious.

Micrographs of detailed comparison of three species are shown in Table 3 and Fig. 6B.

3.2.2.3. Leaf. *M. macrophylla* (Willd.) O. Kuntze: Tender green color. Upper epidermic cell is irregularly small quadrate, about 9–18 μm in length; the anticlinal wall of lower epidermic cell is waved curve, and paracytic type stomata is observed in lower epidermic; single non-glandular hair and the epipetalous trace is obvious. Parenchyma cell, which is rounded the fiber, contained calcium oxalate crystal. Vessel is scalariform, 90–250 μm in length, 12–26 μm in width. Fiber is slender and long cell, 180–360 μm in length, 8–15 μm in width. Brown-red or brown-grey inclusion can be observed. Calcium oxalate crystal is white-grey color and about 5–20 μm in diameter. Stomata are obvious.

Micrographs of detailed comparison of three species are shown in Table 3 and Fig. 6C.

3.3. Key to the three species of *M*.  

1. Twig and anthotaxy is densely covered with basal expanded golden long glandular hair and grey slender hair; Epidermis of stem and leaf is covered glandular hair. *M. glutiosa* (Prain) Y.T.Wei

2. They have not above characters.

2. Root is large and thick; the lower side of leaf is not white—grey color. *M. macrophylla* (Willd.) O. Kuntze

2. Root is not large and thick; the lower side of leaf is white—grey color and leaflet is wider than others. *M. latifolia* Benth.

4. Discussion

1. In this article, some reliable morphologic characteristics were specified for identification of the three species of *Moghania.*
Morphologic structure of *M. macrophylla* (Willd.) O. Kuntze is peculiar compared to the other species. Pod of *M. macrophylla* (Willd.) O. Kuntze is elliptic with 1–1.6 cm long and 7–9 mm wide, brown, covered short soft hair, while that of *M. latifolia* Benth. is covered ferrugineous short soft hair and *M. glutiosa* (Prain) Y.T.Wei. is covered light golden base-expanded glandular hair. Common pedicel of *M. macrophylla* (Willd.) O. Kuntze and *M. latifolia* Benth. are almost no, while that of *M. glutiosa* (Prain) Y.T.Wei. is from 1 to 10 cm. All of these microscopic characteristics made of *Moghania* easily recognizable. Root of *M. macrophylla* (Willd.) O. Kuntze is large and thick, and petiole has narrow wings, but others are not; the lower side of leaf of *M. latifolia* Benth. and *M. glutiosa* (Prain) Y.T.Wei. is white—grey color, but that of *M. macrophylla* (Willd.) O. Kuntze is not.

2. Compared with the *M. macrophylla* (Willd.) O. Kuntze, the histological structures of *M. Latifolia* Benth. and *M. glutiosa* (Prain) Y.T.Wei. were similar to some extent. Twig and anthotaxy of *M. glutiosa* (Prain) Y.T.Wei. is densely covered with basal expanded golden long glandular hair and grey slender hair, and epidermis of stem and leaf is covered glandular hair and non-glandular hair, while that of other species just only have soft hair and non-glandular hair. *M. macrophylla* (Willd.) O. Kuntze and *M. glutiosa* (Prain) Y.T.Wei. have a large number of calcium oxalate crystal, brown-red or brown inclusion and stone cell in parenchyma cell of cortex, phloem and pith, while *M. Latifolia* Benth. has a little that of them.

3. According to the morphologic and histological structures results of this article, we have found that *M. glutiosa* (Prain) Y.T.Wei. has almost the same large number of calcium oxalate crystal, brown-red or brown inclusion and stone cell in parenchyma cell of cortex, phloem and pith as *M. macrophylla* (Willd.) O. Kuntze, which were recorded in appendix of “Pharmacopoeia of the People’s Republic of China” (2005 and 2010 edition), but *M. latifolia* Benth. has a little that of them.

Though there are some reports,12–20 (The State Pharmacopoeia Committee of China, 2010) of *M.* we didn’t find systematic information of microscopic authentication and morphoanatomy about three species in this area. What’s more, for the sake of offering a scientific database to ensure their safety and efficacy, it will be worthwhile doing further correlative studies. We can still authenticate and distinguish every species by the microscopic features revealed in our study. We constructed a key to the three species to allow convenient classification.

4. To some extent, authentication by microscopy has advantages compared with chemical analysis. Fewer samples are required, at lower cost, with easier operation, and greater accuracy. This is especially true when the materials must be stored before authentication, due to chemical changes that may occur depending on the storage environment. Authentication by microscopy has a greater reliability, since the features observed are more stable.
In brief, several species of *M.* are available or presented as mixtures in the herbal markets for use in TCM. Some of them can be distinguished based on their macroscopic characteristics, but some cannot, especially when the herbs are in a dried and matted condition. In such cases, discrimination can be very difficult. Light microscopy should be of great use in identifying these materials.

**Acknowledgments**

The authors appreciated the National Major Scientific and Technological Special Project of the State Ministry of Science and Technology (2011ZX09307-002-01), the Pillar Program of Ministry of Science and Technology of the People’s Republic of China (2012BAI27B07), the China Natural Science Foundation (No. 81173653), the Science & Technology Department of Pillar Program Sichuan Province (2011S20233), and the Follow-up Plan for the Outstanding Youth Academic and Technical Pacemaker of Sichuan Province (2011JQ0051), and the Programming Plan of Aba Teachers College (ASB-17) for financial support.

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