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# Pharmacognostical Studies of the Tibetan Crude Drugs (6) On "sPang-rtzi do-bo" Derived from *Pterocephalus* Plants

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# チベット薬物の生薬学的研究（第6報） *Pterocephalus* 属植物に由来する "sPang-rtzi do-bo"

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"sPang-rtzi do-bo / Pantsi dowo[1])" has been used as a remedy in affections such as infectious fever and cardiac disease. The botanical origin was reported to be *Pterocephalus* plants of Dipsacaceae and *Saussurea* plants of Compositae. In order to identify the botanical origin of commercial samples, a comparative anatomical study was carried out on the flower stalk, leaf, and rhizome of plant materials, *Pterocephalus hookeri* (C. B. Clarke) Diels and *P. bretschneideri* (Batalin) Pritzel, which are distributed in the region from China to India through Tibet.

As a result, *P. hookeri* was determined as the origin of commercial samples on the basis of following characteristics: the diameter of the cortical parenchyma cell in the flower stalk, waviness of the anticlinal wall of the epidermal cell in the leaves, and the width of the xylem in the rhizome. Of the samples, six were whole plants, and one rhizome.

Furthermore, it was found that leaves of *P. hookeri* varied morphologically and were grouped into two types: leaves often lobate with serration (from Nepal) and those with entire margin (from China and Tibet)

(Continued from J. Jpn. Bot. **66:** 235–244, 1991)

The Tibetan crude drug, "sPang-rtzi do-bo / Pantsi dowo[1])" has been frequently used in the Tibetan traditional medicine, so-called "gSo-ba rig-pa". According to the literature of Tibetan materia medica, "Shel-gong shel-phreng (1727)", it is used as a remedy for infectious fever (Rims, in terminology of Tibetan medicine), cardiac disease (sNying-tsad), etc. and is prescribed in the several formulas, i.e. "sPang-rtzi 12" (Tsarong 1986), "dPa'-bo 13" (Dash 1988), for carbuncle,

epidemic fever and so on. This drug has been reported to be a whole plant of *Pterocephalus hookeri* (C. B. Clarke) Diels of Dipsacaceae in many references such as "Bod ljongs rgyun spyud krung dbyi'i sman rigs: The useful materia medica of Tibet" (1973), "Qinzang gaoyuan yaowu tujian: The materia medica of Tibetan (Qinghai-Xizang) Plateau" (1978), "Zhongguo minzu yaozhi: The national materia medica of China" (1984), and Molvay (1988). Through our investigation in the region from northwest Sichuan of China to northern India including Tibet and Nepal in 1983, 1986, and 1990 (T. Namba et al., 1985, 1988), commercial crude drugs named "sPang-rtzi" or "sPang-rtzi do-bo" were obtained. From their morphological characteristics, most of them seemed to be derived from a whole plant of *Pterocephalus* species, except a few samples which seemed to be derived either from a seed or a whole plant of the family Compositae.

In this paper, a morphological and anatomical study was carried out on plant materials, *Pterocephalus hookeri* and *P. bretschneideri* (Batalin) Pritzel growing wild around Himalayan region, from Sichuan, China to Nepal through Tibet (Batalin 1895, Clarke 1882, Pritzel 1901, Handel-Mazzetti 1936, Hara 1979, He 1986, Yamazaki 1971). And based on their characteristics, the botanical origin of commercial crude drugs was determined.

Furthermore, in order to explain the waviness of the anticlinal wall of epidermal cells numerically, an application of Image Analyze System was examined.

## Materials and Methods

Plant specimens for comparison and crude drug samples are shown in Table 1.

Transections of flower stalk, leaf, and rhizome were used in microscopy. The materials were prepared by cutting out 1–3 cm of flower stalk, 1/3–1/2 of length of leaf, and ca. 3 cm of rhizome, in each case from the base, respectively.

To measure the degree of waviness of the epidermal cell wall of the leaf, whole leaf was soaked in water, bleached with Eau de Javell solution, and its upper and lower epidermises were stripped off. The microscopic image of epidermal cells was fed into the Image Analyze System (Olympus Optical Co., Ltd. and Nippon Avionics, SP-500 SET) for the treatment of binarization. The numerical expression for the calculation of waviness is as follows:

Waviness (Roughness, SFC) = $(\text{Perimeter})^2/(4\pi \times \text{Area})$. The value of SFC is established between the perimeter and the area in a figure, and it increases as the degree of the waviness becomes higher.

For the observation on Scanning Electron Microscope, xylem elements were isolated from flower stalk by enzymic maceration (Namba 1987).

## Observations

*Pterocephalus hookeri* (C. B. Clarke) Diels (Figs. 1, 2; Table 2). External feature (Fig. 2A): Flower stalk is erect and 14–30 cm in length. Radical leaves are 6–13 cm in length, lanceolate or linear, and often lobed; serrate and pubescent in the specimens from Nepal, whereas entire and slightly pubescent in those from Yunnan, Sichuan, and Tibet. Head is many-flowered, subglobose, and 2.5–3.5 cm across. Corolla is white. Involucral bracts are 2–3 seriate, ovoid, obtuse, and sometimes cuspidate. Akene adnates to the involucel and is crowned with calyx-teeth. Calyx-teeth is pilose and 12–20 in number in the specimens from Nepal, and 20–26 in those from China and Tibet. Rhizome is cylindrical.

Internal structure: Flower stalk (Fig. 1A): The

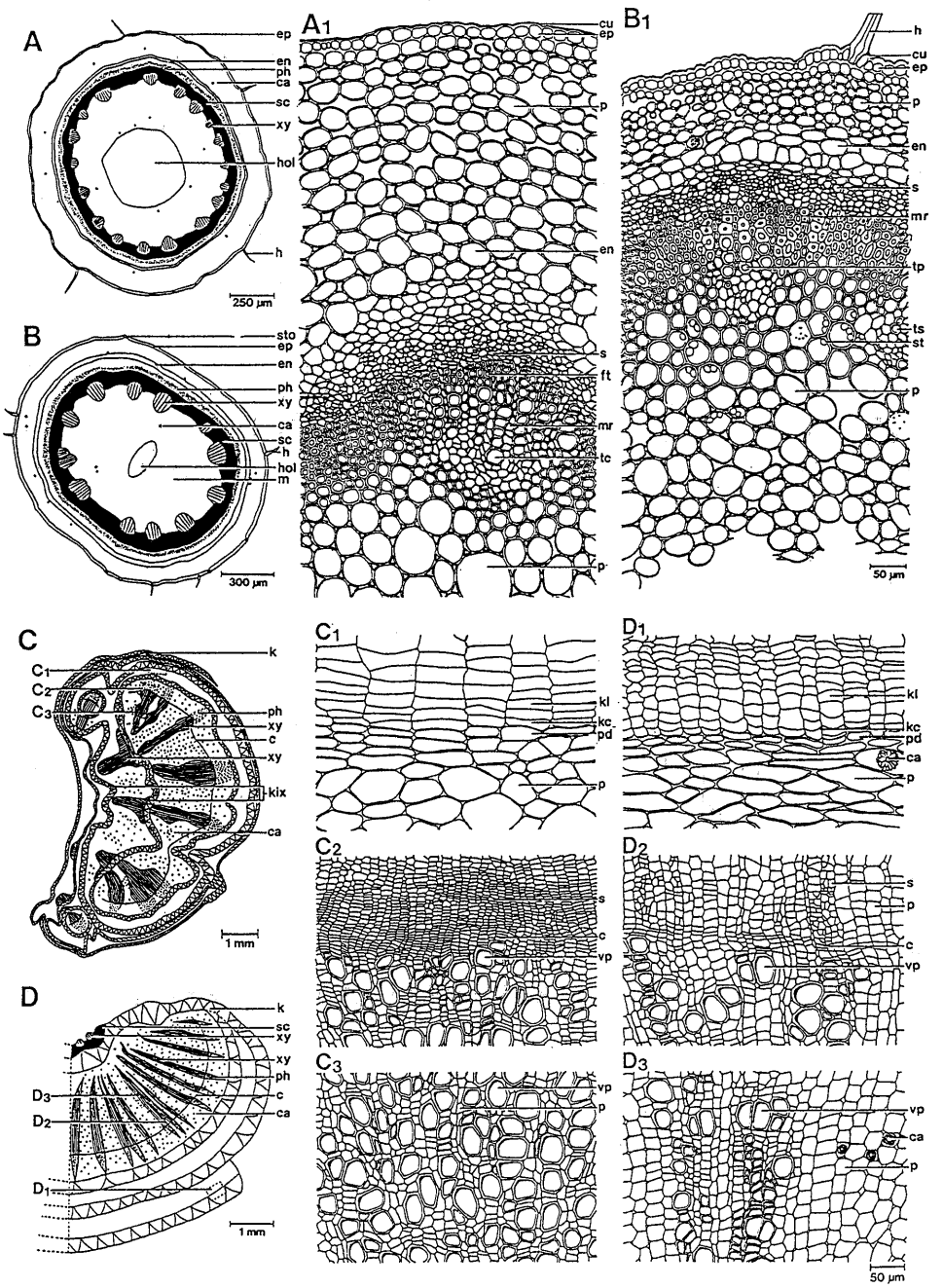


Fig. 1. Diagrams and detailed drawings of flower stalk (A, B) and rhizome (C, D). A, C, *Pterocephalus hookeri* (C. B. Clarke) Diels; B, D, *P. bretschneideri* (Batalin) Pritzel.
(c, cambium; ca, clustered crystal; cu, cuticle; cx, cortex; en, endodermis; ep, epidermis; ft, fiber tracheid; h, hair; hol, hollow; kix, interxylary cork; k, cork; kc, cork cambium; kl, cork layer; m, pith; mr, medullary ray; p, parenchyma cell; pd, phelloderm; ph, phloem; s, sieve tube;sc, sclerenchyma; st starch grain; sto, stoma; tc, scalariform tracheid; tp, pitted tracheid; ts, spiral tracheid; vp, pitted vessel; xy, xylem)

Table 1. Plant materials for comparison.

| Locality | Collector | Date |
|---|---|---|
| *Pterocephalus hookeri* (C. B. Clarke) Diels | | |
| Bai-mar-shan, A-tun-tze (Alt. 3500m), Yunnan Prov., China | Q. W. Wang 69425 [HNWP]* | Sept., 1935 |
| Hongyuan (Alt. 3000–3300m), Aba, Sichuan Prov., China | G. X. Ma et S. Yamaji 90241 [TMPW], [CPU] | July, 1990 |
| Around the Lake Yamzho Yum (Alt. ca. 4000m), Autonomous Region of Tibet | C. Wang et S. Yamaji 90010 [TMPW], [CPU] | Sept., 1990 |
| Manang Dist., Gandaki Zone, Nepal | T. Namba et al. N1731, N1808, N1903 [TMPW] | Aug., 1983 |
| Between Pisang (3250m) and Manang (3620m), Manang Dist., Gandaki Zone, Nepal | T. Namba et al. N2813 [TMPW] | Aug., 1983 |
| Around Mukutinath (3612–3800m), Mustang Dist., Dhaulagiri Zone, Nepal | T. Namba et al. N8042 [TMPW] | Sept., 1986 |
| Between Jharkot (3612m) and Throng Pass (5416m), Mustang Dist., Dhaulagiri Zone, Nepal | T. Namba et al. N8694 [TMPW] | Sept., 1986 |
| Between Rata Manang (2700m) and Pisang (3250m), Manang Dist., Gandaki Zone, Nepal | T. Yoshizawa 793, 810 [TMPW] | Sept., 1989 |
| *Pterocephalus bretschneideri* (Batalin) Pritzel | | |
| Luding, Sichuan (former Xikang) Prov., China | J. Huang et al. 856 [HNWP] | July, 1930 |
| Dajin, Aba, Sichuan Prov., China | X. Li 77611 [HNWP] | June, 1935 |

Crude drug samples.

| Name | Locality | Date of purchase (TMPW No.) |
|---|---|---|
| sPang-rtzi / Pantsi | Sama Vil., Gorkha Dist., Nepal; Am-chi** Jampa Inge in use | Oct., 1963 (No. 8253) |
| sPang-rtzi / Pantsi | Marpha, Mustang Dist., Nepal; purchased from merchant | Aug., 1983 (No. 6032) |
| sPang-rtzi do-bo / Pantsi dowo | Kathmandu, Nepal; Kunsang Tibetan Medical Hall | Sept., 1983 (No. 5800) |
| sPang-rtzi / Pantsi | Jomsom, Mustang Dist., Nepal; Am-chi Tsampa Ngawang in use | Sept., 1986 (No. 7899) |
| sPang-rtzi / Pantsi | Kathmandu, Nepal; Kunfeng Tibetan Medical Hall | Apr., 1991 (No. 11594) |
| sPang-rtzi / Pantsi | Dhumpa, Mustang Dist., Nepal; Am-chi Tsampa Ngawang in use | Apr., 1991 (No. 11385) |
| sPang-rtzi do-bo / Pantsi dowa | Dharamsala, India; Tibetan Medical & Astro. Institute | May, 1991 (No. 11891) |

* Herbarium codes are indicated as follows: HNWP; Botany Department, Northwest Plateau Institute of Biology, Academia Sinica, TMPW; Museum of Materia Medica, Research Institute for Wakan-Yaku, Toyama Medical and Pharmaceutical University, CPU; Department of Pharmacognosy, China Pharmaceutical University. ** Tibetan medical doctor.

diameter of transection is 2.0–3.2 mm. Epidermal cell is 15–30 $\mu$m × 15–25 $\mu$m (tangential × radial) in diameter. Cortical parenchyma cell is 30–70 $\mu$m × 15–50 $\mu$m in diameter. Endodermal cell is stained by Sudan III, 30–50 $\mu$m × 15–30 $\mu$m in diameter, and generally forms a discontinuous ring. Vascular bundles are interconnected by phloem and prosenchyma which consists of libriform fibers and fiber-tracheids, appearing to be a continuous ring (Metcalfe 1965). Xylem con-

tains tracheids with bordered pits, scalariform and spiral thickening, two types of fibers, and parenchyma. The diameter of tracheid is up to 15–30 μm. Starch grain is absent.

Leaf (Fig. 2A): The midrib is convex in both upper and lower sides, and 600–1200 μm in thickness. The shape of lower rib is semicircular. Vascular bundles in midrib are 1–3 in number. In the laminar region, the thickness is 160–410 μm and two rows of palisade parenchyma are observed. Substomatal chamber is as long as a palisade parenchyma and 3–4 times as wide as that. Clustered crystals of calcium oxalate are scattered in ground tissue. In surface view except on vein, the anticlinal wall of epidermal cell shows wavy. The degrees of waviness are computed to be $1.84 \pm 0.30$ (mean ± S.D.) in upper side and $1.92 \pm 0.37$ in lower side. Stomata are observed on both sides and their configuration is anomocytic. Unicellular hairs are 480–800 μm in length on upper side and 580–720 μm on lower side. Glandular hairs consist of one cell of stalk and four cells of head.

Rhizome (Fig. 1C): Rhizome is composed of the segregated strands with necrotic xylem tissues. This isolation is achieved through the production of periderm in the xylem (interxylary cork, Moss 1953) that becomes confluent with external cortical periderm along vascular rays, while no-functioning xylem tissues are cut out. This process is repeated annually as a result of the oldest remaining xylem tissues pruned away. The diameter of the remaining rhizome is 8–10 mm. The rhizome has 3–6(7) layers of cortical periderms and 3–5 layers of interxylary periderms. The cork cell in the outermost cortical periderm measures up to 45–80 μm in tangential diameter. Xylem shows obovate or oblanceolate with some constrictions, and each file consists of 10–40 rows of cells. The width of xylem is up to 500–700 μm. Tracheary elements are vessel members with bordered pits, scalariform, reticulate, spiral thickening, and with simple perforations. Their diameter is up to 55–75 μm. Ray consists of 5–10 rows of parenchyma cells and contains many clustered crystals. Pith is necrotized and obscured.

*Pterocephalus bretschneideri* (Batalin) Pritzel (Figs. 1, 2; Table 2).

External feature (Fig. 2B): Flower stalk is 10–15 cm in length. Radical leaves are 6–12 cm in length, pinnate, parted or dissected, and slightly pubescent. Head is subglobose or hemispherical and 2–2.5 cm across. Corolla is pink or purple. Involucral bracts are 2 seriate and linear in shape. Calyx-teeth is 10–13 in number and slightly pilose. Rhizome is cylindrical.

Internal structure: Flower stalk (Fig. 1B): The transection is 1.0–1.5 mm in diameter. Cortical parenchyma cell is smaller than that of *P. hookeri,* measuring 20–25 μm × 15–20 μm in diameter. Endodermis is obscure, for it is not always stained by Sudan III, but distinguished from cortical parenchyma in retaining cell shape after drying. Starch grains are present in ground tissue.

Leaf (Fig. 2B): The thickness of the leaf is 350–850 μm in the midrib and 130–180 μm in the laminar region. In surface views except on vein, the anticlinal wall of epidermal cell shows almost straight. The degrees of waviness are computed to be $1.38 \pm 0.20$ in upper side, and $1.41 \pm 0.25$ in lower side. Unicellular hairs are 180–210 μm and 160–170 μm in length on the upper and lower sides, respectively.

Rhizome (Fig. 1D): Rhizome is 9–12 mm in diameter and often segregated into strands. But, interxylary periderm does not develop so obviously as in *P. hookeri.* The tangential diameter of cork cell is up to 80–90 μm in the outermost cortical periderm. Xylem is lanceolate or linear in shape,

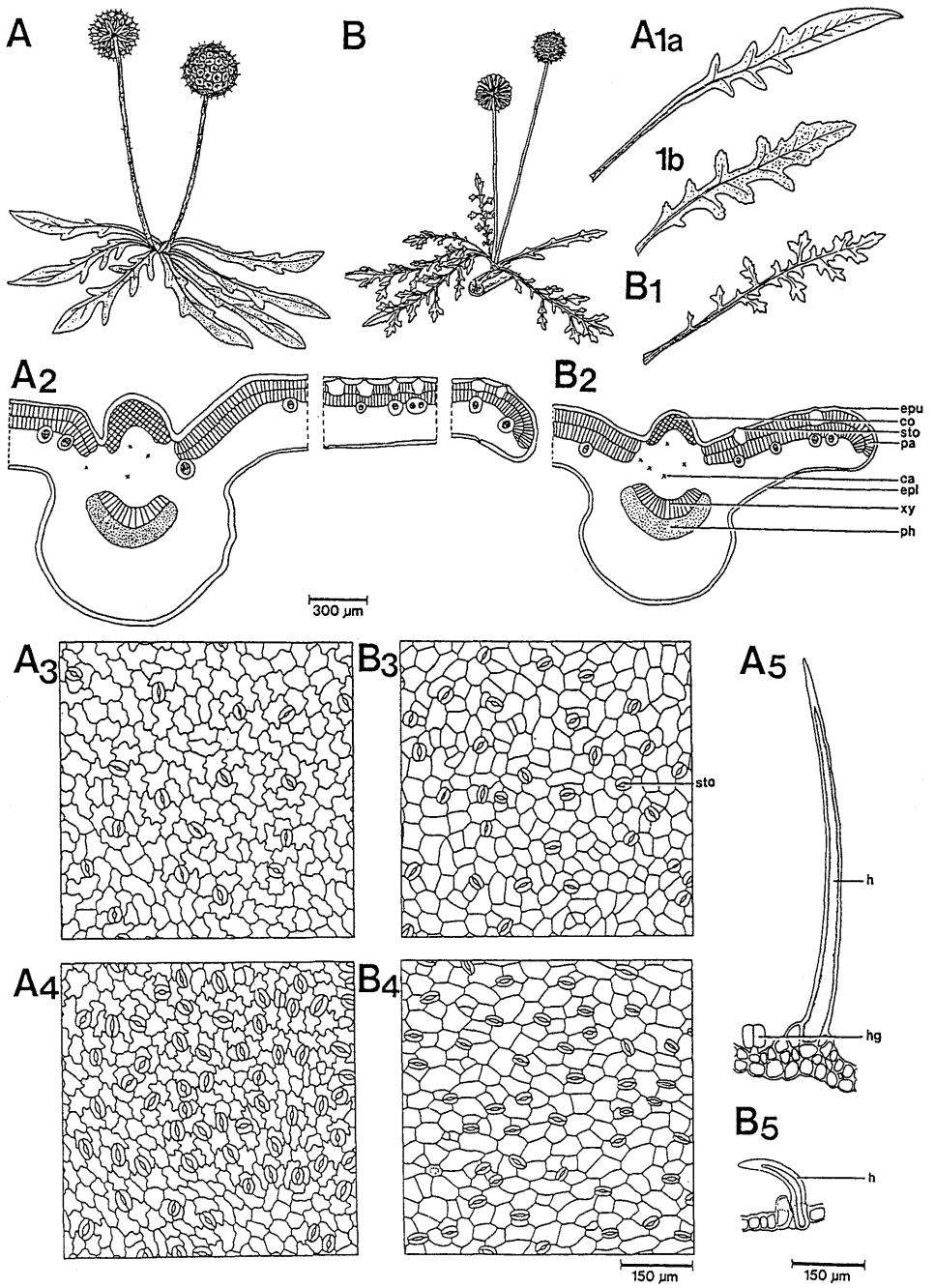


Fig. 2. Sketches of plant bodies and the leaves (1a, Chinese type; 1b, Nepalese type), diagrams of transections of the leaf (2), surface views of the adaxial (3) and abaxial (4) sides of the leaf, and detailed drawings of the hairs with epidermis (5). A, *Pterocephalus hookeri*; B, *P. bretschneideri*. (co, collenchyma; epu, upper epidermis; epl, lower epidermis; hg, glandular hair; pa, palisade parenchyma)

Table 2. The anatomical characteristics of *Pterocephalus hookeri* and *P. bretschneideri*

| | | *P. hookeri* | *P. bretschneideri* |
|---|---|---|---|
| Flower stalk | | | |
| Diameter of cortical parenchyma cell ($\mu$m) | tangential | 30–70 | 20–25 |
| | radial | 15–50 | 15–20 |
| Diameter of endodermal cell ($\mu$m) | tangential | 30–50 | 30–35 |
| | radial | 15–30 | 10–30 |
| Diameter of tracheid ($\mu$m) | | 15–30 | 25–30 |
| Leaf | | | |
| Diameter of upper epidermal cell ($\mu$m) | tangential | 45–80 | 40–60 |
| | radial | 15–30 | 20–40 |
| Waviness of anticlinal wall of epidermal cell (SFC)* | upper side | 1.84±0.30 | 1.38±0.20 |
| | lower side | 1.92±0.37 | 1.41±0.25 |
| Length of hair ($\mu$m) | upper side | 480–800 | 180–210 |
| | lower side | 580–720 | 160–170 |
| Diameter of tracheid ($\mu$m) | | 20–25 | 25–35 |
| Rhizome | | | |
| Tangential diameter of cork cell in the outermost cortical periderm ($\mu$m) | | 45–80 | 80–90 |
| Xylem files Shape | | obovate to oblanceolate | lanceolate to linear |
| Width ($\mu$m) | | 500–700 | 200–300 |
| Number of cell rows | | 10–40 | 2–5 |

Numerals show the maximum value in each section.
*SFC = (perimeter)$^2$/(4$\pi$ × area); mean ± S.D. is indicated.

200–300 $\mu$m in width, and each file consists of 2–5 rows of cells. Ray consists of 5–20 rows of parenchyma cells.

Commercial Samples, "sPang-rtzi do-bo" (Fig. 3; Table 1): Most of the samples consist of whole plants collected in the seasons of flowering and fructification, except one sample (No. 8253) of rhizomes. Three samples were crushed into small pieces, and the other three contained the basal part of the plants with flower stalks, leaves, and rhizomes. The latter leaves are lanceolate, lobate with serration. A small number of involucels with calyx-teeth, which is more than five in number and densely pilose, was also found out in some of them. All samples taste slightly bitter and have no specific odor. The anatomical characteristics of all seven samples correspond to those of *P. hookeri*. Furthermore, two of the latter samples (Nos. 5800, 11385) were found to belong to Nepalese type of this species according to the morphology of radical

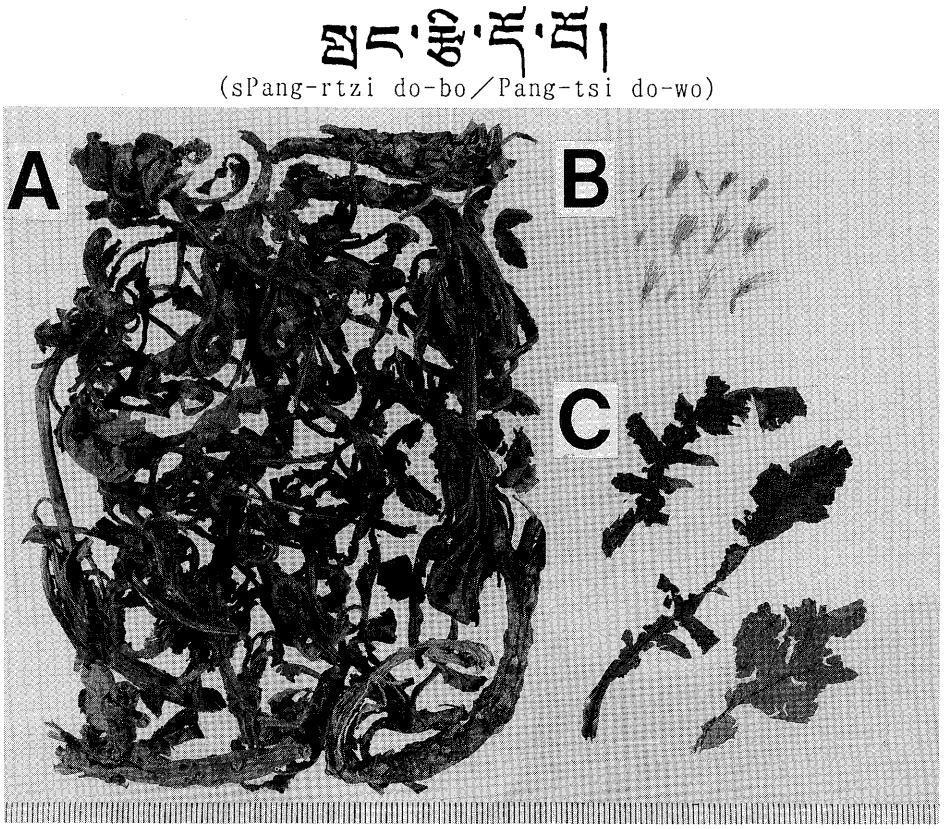


Fig. 3. "sPang-rtzi do-bo" in Kathmandu market of Nepal (A, No. 5800). Involucels and calyx-teeth (B), and leaves (C) as its contents.

leaves.

## Conclusions and Discussions

1. Two species of *Pterocephalus* plants distributing around the Himalayan region can be distinguished from one another in the following characteristics: the diameter of the cortical parenchyma cell of the flower stalk, the waviness of the anticlinal epidermal wall of the leaf, and the width of xylem of the rhizome. Based on this result, the botanical origin of the crude drugs, "sPang-rtzi do-bo" in use, was proved to be *P. hookeri*; the ingredients were whole plants in six commercial samples and rhizomes in one sample. (Table 1)

2. The internal structure of *P. hookeri* does not show geographical variation, but the external feature of leaves varies from entire to lobed. Moreover, according to the morphology of leaf margin, the leaves are grouped into two types: with serration and with entire margin. The specimens from Nepal possess the former leaves, and those from Tibet and China the latter, respectively.

3. In this study, an apparatus, "Image Analyze System", was used for the expression of the degree of waviness of the epidermal cell wall. In this value, the significant difference is found out between *P. hookeri* and *P. bretschneideri* ($P<0.001$). The application of this apparatus is expected to be useful for the histological

taxonomy.

4. Tibetan crude drug, "sPang-rtzi do-bo" is named so due to its habitat in the grassland of the alpine area (Wang 1982), and "rtzi" means "drug" (Zhang 1985, Das 1902). Moreover, other names of this drug are enumerated with their meanings in the parenthesis, such as sPyang-mo (wolf) mde'u-'byin (arrow-head), Thog(top)-dkar (white)-mgo(head), and Zla'i(moon)-bcud(essence). Thus, from the viewpoints of etymology, the appearance and the habitat of *P. hookeri* are reflected in the several names of the drug.

5. According to the Tibetan medical literatures, "Vaidurya ngonpo" (1687) and "Shel-gong shel-phreng" (1727), the crude drug "sPang-rtzi do-bo" in a wide sense is classified into three kinds in detail; "sPang-rtzi do-bo" in a narrow sense, "Lug-rtzi do-bo", and "sPang-rtzi 'byar-bag-can". The drug derived from *P. hookeri* agrees with "sPang-rtzi do-bo" in a narrow sense and/or sPang-rtzi 'byar-bag-can, considering the correspondence between its appearance and the following descriptions: "sPang-rtzi do-bo", with no lobate leaves, long stem, and white flowers like an old man's head, and "sPang-rtzi 'byar-bag-can", with lobate leaves containing sticky juice. The botanical origin of "Lug-rtzi do-bo" is reported to be *Saussurea uniflora* (Meyer 1983) and *S. superba* f. *pygmaea* (Jingzhu bencao 1986). Through our investigations, some of "sPang-rtzi do-bo" in use are considered to be derived from the *Saussurea* plants. These kinds of "sPang-rtzi do-bo" will be studied in future.

6. *Pterocephalus* plants are mostly distributed

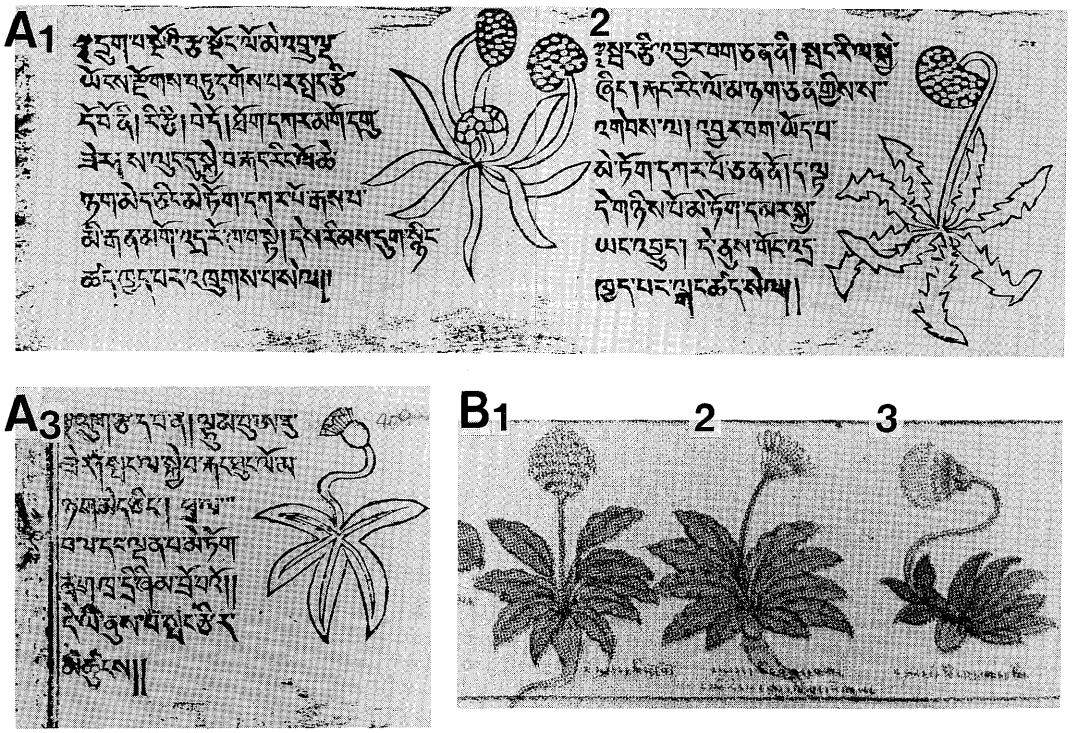


Fig. 4. The descriptions and figures of three kinds of "sPang-rtzi do-bo". They are "sPang-rtzi do-bo (1)", "sPang-rtzi 'byar-bag-can (2)", and "Lug-rtzi do-bo (3)". A, from "mDzes-mtsar mig-rgyan" (Jampal D.J. 19th century); B, from "Sibu yidian xilie guatu quanji" (Namgyal Phuntsog et al. 1986 (revised)).

from Mediterranean to Middle East and Africa (He 1986, Huxley 1977, Kitamura 1960, Tackholm 1974, Watt 1962), but their medicinal use is unknown in Unani, Ayurveda, Jamu, and Chinese traditional medicine. From this fact, it is concluded that the therapeutic use of *Pterocephalus* plant is indigenous to Tibetan medicine.

However, plants of an approximate genus, *Scabiosa,* are reported to be utilized in the system of Homoeopathic medicine (Stuart 1979) and for eye diseases and sterility in the folk medicine of Africa (Watt 1962).

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1) The transliteration of Tibetan into Roman alphabet is based on Tsarong (1981), and is indicated the verbatim spelling and its native pronunciation after the marked '/' at need.

## 要 旨

チベット薬物 "sPang-rtzi do-bo（パンツィー・ドウォ)" は伝染性の熱病や，循環器系疾患に用いられる薬物で，原植物にはマツムシソウ科の *Pterocephalus* 属植物およびキク科のトウヒレン属植物などがあてられるが，確証はない．そこで，この薬物の基源を明らかにする目的で，チベット周辺地域に分布する *Pterocephalus hookeri* (C. B. Clarke) Diels および *P. bretschneideri* (Batalin) Pritzel について比較組織学的検討を行った．両種は花茎の皮層部柔細胞の径，葉の表皮細胞の垂側壁が呈する波状の程度および根茎の木部の幅により区別できた．この結果に基づいて，本属植物に由来すると思われる市場品7点を検討した結果，6点が *P. hookeri* の全草，1点が同種の根茎であった．なお，*P. hookeri* は産地により葉の外部形態が異なり，2タイプに分けられた．すなわち，ネパール産は毛が多く，微鋸歯を有するのに対し，チベット，中国産は毛が少なく，微鋸歯がない．