Tsuneo Namba* and Tadato Tani*: Pharmacognostical studies on the Tibetan herbal medicines (3)**

On “Sagdik”

“Sagdik” has been used for gastroenteric and liver troubles in the Tibetan medicine. It seems to be entire plants originated from Halenia species by the morphological characters of its flowers. No Halenia species have been applied to medicinal purposes in any other medicine than the Tibetan medicine, and so “Sagdik” is noticed as one of the unique herbal drugs in the Tibetan medicine.

As a continuation of our pharmacognostical investigations on the Tibetan herbal medicines, we mentioned here the morphological studies on “Sagdik” and Halenia species in Nepal and its surrounding regions and also referred to the relation between the direction in the Tibetan medicine and that in the Indian and Chinese medicine.


External structures The crude drugs are entire plants with flowers and fruits and prepared to about 30 cm long. They are odourless, and the root is slightly bitter. Stems are yellowish-brown to purplish-yellow in colour. They are about 3 mm in diameter and 4-winged.

Leaves are opposite, sessile, ovate to oblong-lanceolate, acute and 5-nerved. They are 3 to 4 mm long and 1.5 to 2 mm wide. They are longer than the internode length.

Calyx is 4-merous. Sepals are oblong-lanceolate, acute and slightly serrate. They are 5 to 7 mm long and 1 to 3 mm wide. Vascular bundles are 3-nerved near the base and netted at the top part of the sepals. Each lateral vein branches from the main vein and combines with the neighbouring lateral veins. Multicellular hairs are present near the base of each sepal.
Corolla is 4-merous. Corolla lobes are elliptical to ovate and acute. They are 8 to 10 mm long and 3 to 5 mm wide. A pit produced into a long spur is present at the base of each lobe.

Seeds are ellipsoidal and with a concavity at the hilum. Testa is yellow, closely reticulate and smooth.

The roots occasionally branch and are yellowish-brown and 1 to 3 mm in diameter.

**Internal structures in transverse sections**

(Leaf) The upper surface of midrib is slightly concave and the lower is convex. The upper epidermis consists of elliptical cells measuring R=10 to 20 μ and T=30 to 80 μ, which may contain resinous substances. The cell walls are slightly thickened and covered with a cuticle whose surface is finely muricate. Multicellular hairs containing resinous substances occur on the upper epidermis.

The palisade tissue is composed of elliptical to orbicular parenchymatous cells. The vascular bundle is collateral to bicollateral.

Several layers of parenchymatous cells, orbicular to elliptical and slightly thick-walled, occur between the bundle and the lower epidermis. The nature of lower epidermis and the surface of the cuticle is similar to the upper one, but no growth of hairs.

The upper and lower surface of lamina is slightly uneven. The upper epidermis consists of a single layer of rectangular to elliptical cells covered with a thick cuticle whose surface is finely muricate. Resinous cell contents may be seen in the epidermis.

The palisade tissue is made up with two to four rows of thin-walled, tangentially elongated parenchymatous cells. The spongy mesophyll consists of one or two irregular shaped parenchymatous cells between which are many intercellular spaces.

Lateral veins are collateral and veinlets may be hadrocentric.

Numerous cruciferous stomata are present.

(Stem) The outermost epidermis consists of a single layer of rectangular to oblong cells measuring R=15 to 30 μ and T=15 to 35 μ, which contain resinous substances. The outer walls of the epidermal cells are covered with cuticle whose surface is finely muricate.

*) The symbols R and T refer to measurements made in the radial and tangential directions.

List of Abbreviations: cu; cuticle, en; endodermis, ep; epidermis, epL; lower epidermis, epu; upper epidermis, h; hair, mc; mark cell, md; midrib, ph; phloem, sto; stomata, v; vessel, wf; wood fiber, wp; wood parenchyma.
The primary cortex is made up with several layers of thin-walled, oblong to orbicular parenchymatous cells. The parenchyma in wings consists of two or three rows of slightly thick-walled cells, which may also contain some resinous substances.

The endodermis is distinguishable and consists of a single row of rectangular cells measuring $R=8$ to $15\,\mu$ and $T=20$ to $45\,\mu$, whose cell walls are slightly suberised. At the lower stem the endodermal cells may be divided into several cells by thin walls and the Casparian strips are observable.

The pericycle is composed of a layer of tangentially elongated rectangular cells and another parenchymatous cells of the secondary cortex are smaller and thin-walled in which phloem is scattered.

The xylem, which is completely lignified, mainly consists of wood fibers, vessels and wood parenchymatous cells. Fiber-tracheids are occasionally discernible. Several layers of the wood fibers are distributed around the xylem. Their cell walls are thickened, lignified and shaped round. Vessels are distributed evenly throughout the xylem and usually singly or in pairs. They are composed of pitted scalariform and reticulate vessels, which have a diameter of 10 to $20\,\mu$. Smaller spiral vessels are also present. The internal phloem is scattered between the xylem and pith and so the vascular bundle takes on a bicollateral arrangement.

The pith is a wide area of parenchyma containing thin-walled, orbicular cells. The diameter of the medullary cavity is about 0.5 to 1.0 mm.

(Rhizoma) The outermost layer is composed of compressed, tangentially elongated endodermal cells measuring $R=15$ to $25\,\mu$ and $T=150$ to $250\,\mu$. They are divided into 8 to 15 of daughter cells and their walls are suberised and lignified. The parenchyma of primary cortex may remain.

The ratio of the width of the secondary cortex to that of xylem is 30 to 50 percent. The parenchyma beneath the endodermis consists of several layers of slightly thick-walled cells whilst towards the phloem the cells become thin-walled and oblong to orbicular.

The elements of xylem and vessels resemble those of the stem but some vessels may radially arrange. In the innermost part of xylem orbicular vessels usually occur in groups of three. Vasicentric wood fibers and parenchymatous cells may be absent. The phloem also locates inside the xylem. Thus the phloem and the xylem takes on a bicollateral arrangement.

(Root) The lignified and suberised epidermal cells appear rectangular to oblong. Lying beneath the epidermis is several layers of oblong parenchymatous
cells. The parenchyma near the epidermis may be also lignified and suberised.

The rectangular endodermal cells, measuring R=5 to 15 μ and T=10 to 30 μ, may be divided into some daughter cells and the Casparian strips are discernible.

The pericycle consists of smaller parenchymatous cells than endodermal ones. The thin-walled, partially collapsed parenchymatous cells occur on the outer side of the xylem.

The two to four layers of wood fibers, which are thick-walled and orbicular, locate around the completely lignified xylem. No internal phloem is recognized and so vascular bundle takes on a collateral arrangement.

Admixture There is some flowers originated from any other than Halenia species. Calyx is 5-merous. Sepals are lanceolate and acuminate. Vascular bundles are 3-nerved at the base and slightly netted at the top part of the sepals. Each lateral vein branches from the main vein. Multicellular hairs grow on near the base of the each sepals. Unicellular hairs are also present on the margin of the each sepals. Corolla is 5-merous and 3-nerved. Corolla lobes are obovate and acute. An obdeltoid hairy gland is present near the base of each lobes. Filaments are linear. Anthers are oblong.

This admixture seems to be originated from Swertia species by these characters: and may be Swertia erythrosticta Maxim.1)2) or S. multicaulis Don3)5) but not definitely ascertained.

Discussion 1) Halenia species are mainly classified by a) the relation between the length of corolla lobes and spurs, b) the relation between the length of

<table>
<thead>
<tr>
<th></th>
<th>&quot;Sagdik&quot;</th>
<th>H. elliptica</th>
<th>H. perrottetii</th>
<th>H. sibirica</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stem</td>
<td>20 to 50 cm</td>
<td>20 to 50 cm</td>
<td>50 to 70 cm</td>
<td></td>
</tr>
<tr>
<td>Internode length</td>
<td>longer than leaves</td>
<td>longer than leaves</td>
<td>shorter than leaves</td>
<td></td>
</tr>
<tr>
<td>Leaf</td>
<td>5-nerved</td>
<td>5-nerved</td>
<td>5-nerved</td>
<td>3-nerved</td>
</tr>
<tr>
<td>Calyx lobe</td>
<td>3-nerved</td>
<td>3-nerved</td>
<td></td>
<td>1-nerved</td>
</tr>
<tr>
<td>Spur</td>
<td>as long as to longer than the petals</td>
<td>longer than the petals</td>
<td>hardly half as longer as the petals</td>
<td>as long as to longer than the petals</td>
</tr>
</tbody>
</table>
leaves and internodes and c) the number of the nerves in leaves and calyx lobes. Some of the variable characters between "Sagdik" and Halenia species in Nepal and its surrounding regions, Halenia elliptica D. Don$^{1)}$ and $^{3)}$H. perrottetii Griseb.$^{3)}$ and $^{5)}$H. sibirica Borkh.$^{3)}$ are recorded in Table 1.

As mentioned above, the Tibetan drug, "Sagdik", was confirmed to originate from Halenia elliptica D. Don.

2) It is unique in the world that Halenia species have been used for medical purposes. Halenia species may have used as a folk medicine in Tibet and its surrounding regions or may have been used by the morphological resemblance of "Sagdik" and Swertia species, which have been applied to medicinal purposes, as a stomachic, laxative and antipyretic, in the Indian$^{9)}$ and Tibetan medicine$^{13)}$, but not in the Chinese medicine. Actually "Sagdik" has been used for same purposes as drugs originated from Swertia species.

It is interesting that Pozdneev$^{13)}$ regarded "San-djk", Tibetan drug, as "Zi-huā-di-ding" (藏花地丁), Chinese drug, and its original plant as Halenia sibirica Borkh. He probably quoted the scientific name from Tatarinov’s "Catalogus Medicum Sinensium". "Zi-huā-di-ding", used as an antipyretic and antidote in the Chinese medicine, was first recorded on "Pen-ts'ao-kang-mu" (本草綱目) and has many homonyms. According to the literatures$^{14)}$ it originates from Amyblyropis species, Corydalis species, Gentiana species, Swertia species and Viola species. There are some appended figures in "Pen-ts'ao" (本草書) fitted for some of the above plants, but nothing for Halenia species.

It is impossible to guess the reason why Tatarinov regarded "Zi-huā-di-ding" as Halenia species. At that time "Zi-huā-di-ding" originated from Halenia species or from Swertia species may have been on the market in Peking. It seems to be penetrating that Pozdneev identified "San-djk" in Tibetan with this "Zi-huā-di-ding" originated from Halenia or Swertia species.

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References


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"Sagdik" は、チベット地区で、肝臓および消化器系の疾患を主治する目的で用いられてきた生薬である。その基源植物は、花の形態から、リンドウ科のハナイカリ属植物であると思われる。"Sagdik" とネパールおよびその周辺地域に分布するハナイカリ属植物とを比較検討した結果、チベット薬物 "Sagdik" の基源は、Halenia elliptica D. Don と同定し得た。

ハナイカリ属植物を薬用にするのは、未だ世界に類を見ないが、チベットにおいて "Sagdik" と称し、薬用にしているのは、その植物形態が、センブリ属植物と類似していることから、それらと同様の薬効を期待して用いられるようになったものと思われる。このような薬物用法は、おそらく、インドの Ayūr-Veda 医学の薬物用法を基準として行なわれてきたものであろう。しかしながら、ハナイカリ属植物が、チベットおよびその周辺地区で、民間的に古くから用いられていたのではとなっていますとも考えられる。民間的用法の薬物が、一応大系化された民族医学に組入れられる例は数多くあるからである。この点については、中国西部地区の民間薬調査が進んだ後に考察できることであろう。