Morphological Variations of *Aristolochia kaempferi* and *A. tanzawana* (*Aristolochiaceae*) in Japan

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(Accepted on February 4, 2014)

*Aristolochia kaempferi* Willd. is widely distributed in Honshu (Kanto and westwards), Shikoku and Kyushu in Japan, and shows large morphological variation. Within the species, several infraspecific taxa have been recognized, but only one variety, var. *tanzawana* Kigawa, is recently accepted based on the spreading hairs on the nerves of the abaxial side of leaves. Based on an extensive investigation through the whole geographical range of *A. kaempferi*, we found the differences in the flower morphology and the segregation of distribution between var. *kaempferi* and var. *tanzawana*. Here, *A. tanzawana* (Kigawa) Watanabe-Toma & Ohi-Toma is newly recognized in the rank of species.

**Key words:** *Aristolochia kaempferi*, *Aristolochia tanzawana*, *Aristolochiaceae*, var. *kaempferi*, var. *tanzawana*.

The genus *Aristolochia* L. sensu lato (*Aristolochiaceae*) includes over 400 species from temperate to tropical regions worldwide. In the molecular phylogeny, the genus is divided into two lineages each with two subgroups, one with "*Aristolochia*" and "*Pararistolochia*" and another with "*Isotrema*" and "*Endodeca*" (Ohi-Toma et al. 2006). Of them, "*Isotrema*" is characterized by having a gynostemium with three segments, anthera paired on the outer surface of each gynostemium segment, a trilobed perianth, and an apically dehiscent capsule. This group is diversified mainly in East Asia (over 50 species) and Central America (nearly 15 species).

One of the monophyletic groups of "*Isotrema*" is known as the *Aristolochia kaempferi* group consisting of six taxa from Japan through Taiwan to the mainland of China (Watanabe et al. 2006), i.e., *A. kaempferi* Willd. var. *kaempferi* and var. *tanzawana* Kigawa, *A. liukiensis* Hatus., *A. shimadae* Hayata, *A. cucurbitifolia* Hayata, and *A. mollissima* Hance. Of the members, *A. kaempferi* var. *kaempferi*, which is widely distributed in Honshu (Kanto and westwards), Shikoku and Kyushu in Japan (Murata 2006), has often been recognized also in China including Taiwan (cf. Hwang 1981, Huang et al.)
2003), although Ma (1989) recognized Chinese plants as different. This taxonomic confusion is due to the difficulties of finding flowering plants in natural populations and figuring out the 3D shape and coloring of the flowers from herbarium specimens, even though flower morphology has important diagnostic characters for the genus. Based on our recent examinations of literatures, herbarium specimens, and living plants in natural populations, *A. kaempferi* becomes evident to be endemic to Japan.

Under *A. kaempferi*, several infraspecific taxa have been recognized based on leaf variation in Japan and China, but most of them are not accepted in recent floras (Huang et al. 2003, Murata 2006). In the recent flora of Japan (Murata 2006), only one variety, var. *tanzawana* Kigawa, which is endemic to Japan, has been accepted based on the spreading hairs on the nerves of the abaxial side of leaves, perianth limb with nigrescent tiger brindle and dark purple dots inside perianth mouth, but the floral characters have not been emphasized as diagnostic characters (Kigawa 1989, Murata 2006). Recently, we showed the differences of their flower morphology (size, shape and color), and the segregation of the geographical distribution between *A. kaempferi* var. *kaempferi* and var. *tanzawana* based on detailed fieldwork around the Kanto region (Watanabe-Toma et al. 2012). After that we continued and expanded the investigation of the morphological variations of the varieties to the whole geographical range from the Kanto region to Shikoku and Kyushu, we come to the conclusion that var. *tanzawana* should be recognized at the rank of species, as *A. tanzawana*.

**Materials and Methods**

As the proportion of flowering plants of *Aristolochia kaempferi* var. *kaempferi* and var. *tanzawana* is generally very low in most natural populations, we needed to conduct detailed field investigations over a decade. Nevertheless, if flowering plants could not be obtained, we cultivated juvenile plants from the populations several years until flowering. A total 140 flowering plants from 101 locations could be observed (Appendix 1). Their voucher specimens were deposited in the herbarium TI, the University of Tokyo.

The obtained plants were primarily identified as var. *kaempferi* or var. *tanzawana* based on the hairs on the nerves of the abaxial side of leaves. These varieties have flowers consisting of a U-shaped perianth tube and a trilobed-limb with a perianth mouth (Fig. 1), but size, shape and coloring of floral parts are largely variable. In order to examine the morphological variation, for one fresh flower per individual, 13 floral characters (Fig. 1, a–m) were measured with a digital slide caliper and a ruler, and coloring of limb and throat were observed. A pairwise comparison for the floral measurements between var. *kaempferi* and var. *tanzawana* was conducted. If F-test indicated unequal variances of the two samples, t-test with a correction for the unequal variances was conducted. Here, because the plants with intermediate floral morphology between the varieties are rarely found along the border of their distribution range (Watanabe-Toma et al. 2012, see **Taxonomic treatment**), these morphological intermediates

![Fig. 1. Floral characters measured.](image-url)
were not included in the comparison.

Herbarium specimens in Japanese herbaria (TI, HIRO-MY, KPM, KYO, MAK, MBK, OSA, SHO, TNS, TUS, and WMNH) were examined to check leaf variation and the geographical distribution.

**Results and Discussion**

*Variation of leaves and plant sizes*

For all examined samples, *Aristolochia kaempferi* var. *kaempferi* and var. *tanzawana* were clearly distinguished by the hairs on nerves of abaxial side of leaves. In both varieties, the leaf shape shows large variation (Fig. 2); leaf lamina is cordate, ovate to narrowly ovate, triangular with cordate or round lateral lobes at base, and obtuse or acuminate apex, or is slender in the middle lobe, auriculate at base. The leaf shape variation is often observed within an individual. Even without flowers, plants having narrowly ovate leaves with auriculate base were sometimes identified as *A. shimadae* (= *A. onoei* Franch. & Sav. ex Koidz. and *A. kaempferi* Willd. var. *trilobata* Franch. & Sav.), although the species is clearly distinguished from *A. kaempferi* based on the flower morphology (Murata 2006, see “Key to the species”). Because plants having such leaves are sometimes observed in both species, it is difficult to distinguish between *A. shimadae* and *A. kaempferi* based on only leaf shape.

Flowering plants of var. *kaempferi* are a
large woody climber with a long underground stem. On the other hand, flowering plants of var. *tanzawana* shows large size variation; large woody climbers (over 10 m) at lowlands in the western part of the range (western Shizuoka and Aichi Pref.s.) and small vine like herbs (under 30 cm) having several flowers in the mountain region of southern Yamanashi Pref.

**Floral variation**

The flower of *Aristolochia kaempferi* var. *kaempferi* generally have a perianth tube constricted to a utricle, a yellowish limb with fine reddish to dark purplish striae, and fine reddish to dark purple colored or densely dotted throat. The lower lobe of the limb is little longer than upper lobes and incurved apically or not. The shape of the perianth mouth varies form round to depressed ovate. The coloring of limb, perianth mouth, and throat are largely varied (Fig. 3), for example, the whole or the basal lobe of a limb is sometimes densely patterned by dark purple striae, and in rare cases a limb is entirely black-purple or whitish yellow without striae.

For the flowers of var. *tanzawana*, the outside of the perianth tube is covered with velvety hairs, the limb is densely patterned by dark purple striae, and the throat is spotted by dark purple leopard brindle (Fig. 4: 1–12). Some plants have the entirely black-purple limb. In comparison with var. *kaempferi*, var. *tanzawana* has significantly larger size of flowers (Table 1), whose perianth tube is not much constricted at a utricle (“f/g” in Table 1). Thus, *A. kaempferi* var. *tanzawana* found to be clearly distinguished from var. *kaempferi* based on flower morphology.

**Geographical distribution**

Based on the detailed fieldwork and herbarium specimens, the geographical distribution of *Aristolochia kaempferi* var. *kaempferi* and var. *tanzawana* was figured out (Fig. 5). Var. *kaempferi* is widely distributed from the Kanto region and the Pacific side of central Honshu through the Setouchi side of Chugoku region, Shikoku and Kyushu to Tanegashima and Yakushima Islands. Around the Kanto and Izu regions, the Ise-Shima region (Mie Pref.) of the eastern part of the Kii Peninsula, and the southern part of Kyusyu (Miyazaki and Kagoshima Pref.s.), moderate numbers of flowering plants were observed, but few flowering plants could be found in other regions. The geographical range of var. *tanzawana* is from mountain regions of Kanagawa, Yamanashi, and Shizuoka Pref.s. (but not in Mt. Fuji), through lowlands in a western part of Shizuoka Pref. to Aichi Pref. and a southern part of Gifu Pref., and is distantly isolated around Mt. Tsukuba (Ibaraki Pref.) in the north Kanto region. The geographical ranges of the varieties are mostly segregated, although the varieties rarely live in intimate proximity to each other (cf. around mountains in the Kanto distinct and around the northwestern part of Aichi Pref.).

**Taxonomic consideration**

On the investigation through the whole geographical range, we concluded that *Aristolochia kampteri* var. *tanzawana* should be recognized as a morphologically and geographically distinct species from var. *kaempferi*, although each of the two varieties is paraphyletic due to past geographical isolation and subsequent secondary gene flow as well as other taxa of the *A. kaempferi* group according to the molecular phylogeographic analyses (Watanabe et al. 2006, 2008).

In the literature survey, it was revealed that *Aristolochia lineata* Duch. ex Decne., which was known only from a drawing of Japanese collections of M. Delessert (see the digital image in herbarium MPU; http://www.herbier-mpu.org/zoomify/zoomify.php?fichier=MPU018703) and was treated as a synonym of *A. kaempferi* var. *kaempferi* (Murata 2006), seems to have similar floral characteristics (i.e., dotted throat, densely striate on the whole of the limb, and...

perianth tube not much constricted to a utricle) to var. *tanzawana*. Because we cannot evaluate the hairs on the nerves of abaxial side of leaves in the drawing and the detailed locality is not indicated, we depended on the description of *A. lineata* that the whole of plant is glabrous and smooth. Therefore, we regard *A. lineata* as a synonym of *A. kaempferi* var. *kaempferi*.

In the examination of herbarium specimens, two specimens in MAK from the Ise-Shima

Table 1. Size variation in the floral characters of *Aristolochia kaempferi* var. *kaempferi* and var. *tanzawana* (= *A. tanzawana*), using 96 and 44 individuals, respectively.

<table>
<thead>
<tr>
<th>Character</th>
<th>Var. <em>kaempferi</em></th>
<th>Var. <em>tanzawana</em></th>
<th>t-test (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average ± SD (mm*)</td>
<td>Average ± SD (mm*)</td>
<td></td>
</tr>
<tr>
<td>Height of perianth (a)</td>
<td>26.73 ± 3.07</td>
<td>36.61 ± 3.75</td>
<td>0.00</td>
</tr>
<tr>
<td>Height of limb (b)</td>
<td>16.77 ± 2.13</td>
<td>22.35 ± 2.56</td>
<td>0.00</td>
</tr>
<tr>
<td>Width of perianth mouth (c)</td>
<td>7.04 ± 1.28</td>
<td>9.56 ± 1.71</td>
<td>0.00**</td>
</tr>
<tr>
<td>Height of perianth mouth (d)</td>
<td>5.21 ± 1.28</td>
<td>7.08 ± 1.52</td>
<td>0.00</td>
</tr>
<tr>
<td>Height of utricle (e)</td>
<td>8.19 ± 1.53</td>
<td>10.63 ± 1.78</td>
<td>0.00</td>
</tr>
<tr>
<td>Width of utricle mouth (f)</td>
<td>3.96 ± 0.58</td>
<td>6.72 ± 1.10</td>
<td>0.00**</td>
</tr>
<tr>
<td>Width of utricle (g)</td>
<td>7.77 ± 1.45</td>
<td>10.52 ± 1.13</td>
<td>0.00</td>
</tr>
<tr>
<td>Width of limb (h)</td>
<td>20.04 ± 3.16</td>
<td>25.23 ± 3.32</td>
<td>0.00</td>
</tr>
<tr>
<td>Length of utricle (i)</td>
<td>17.85 ± 2.63</td>
<td>23.51 ± 2.83</td>
<td>0.00</td>
</tr>
<tr>
<td>Length of ovary (j)</td>
<td>10.01 ± 1.71</td>
<td>11.35 ± 1.43</td>
<td>0.00</td>
</tr>
<tr>
<td>Length of terminal pedicel (k)</td>
<td>26.41 ± 7.21</td>
<td>31.79 ± 6.47</td>
<td>0.00</td>
</tr>
<tr>
<td>Length of based pedicel (l)</td>
<td>3.44 ± 4.22</td>
<td>3.55 ± 4.05</td>
<td>0.89</td>
</tr>
<tr>
<td>Length of bract (m)</td>
<td>5.36 ± 1.59</td>
<td>5.72 ± 1.60</td>
<td>0.25</td>
</tr>
<tr>
<td>Constriction of perianth tube (f/g)</td>
<td>0.52 ± 0.08</td>
<td>0.64 ± 0.09</td>
<td>0.00</td>
</tr>
</tbody>
</table>

*Except for the value of "f/g".*

**The variances were unequal in both samples by the F-test.
region (J. Umemura s.n., 14 May 1893, and K. Uno 22684), were annotated as “Aristolochia simaensis Hiyama” (the meaning of the species epithet is probably the regional name) by Dr. K. Hiyama in 1960, but this name was not published. Plants in the natural populations of the Ise-Shima region have a whitish perianth tube and a limb with fine reddish purple striae in the upper part and reddish purple reticulation in the lower part (Fig. 3: 6, 12), and a fine reddish purple pedicel that is sometimes longer than the plants in other regions (data not shown). We do not recognize these of plants as a distinct taxonomic group at this time, because the range of morphological variation is not discrete from total variation range of other *A. kaempferi*.

**Taxonomic treatment**

*Aristolochia kaempferi* Willd. in Sp. Pl. 4: 152 (1805). **Type**: JAPAN. E. Kaempfer, Icones selectae plantarum, quas in Japonia, t. 49 (1791). [Fig. 3, 1–30]


Woody, twining perennial climbers 2–10 m long or more. Young branches pale green, terete, pubescent; old branches gray, terete, striate. Leaf
lamina cordate, ovate to narrowly ovate, base cordate, sometimes with round lateral lobes at base, apex obtuse or acuminate, or angustate in the middle lobe with auricules at base, to 3–18 cm long, 4–20 cm wide, herbaceous to leathery, adaxial surface green or light green and sparsely pubescent, abaxial surface grayish green and shortly hairy; nerves prominent on abaxial surface, with appressed hairs; petiole 1.5–9 cm long. Flowers April to June, solitary in axil of prophylls of lateral branches; pedicel light green or rarely fine reddish purple, 18.5–41.5 mm long; bract usually at base of pedicel, ovate, 3.5–7 mm long. Perianth tube U-shaped, 2–3 cm, 5–10.5 mm wide at utricle, upper 1/3 more slenderer (3.5–4.5 mm wide), outside whitish yellow to creamy, pubescent, inside greenish yellow with purple markings, smooth, and throat dotted reddish to dark purple; mouth round to depressed ovate, 3.5–5.5 mm high, 5.5–8 mm wide; limb broadly obovate, shallowly trilobed, incurved apically or not, 16–23 mm high, 13.5–30.0 mm wide in front view, smooth, yellowish with fine reddish to dark purple striae, sometimes densely striate or reticulate in the lower part, rarely entire black-purple or whitish yellow without striae. Stamens 6, adnate to style column, anthers oblong; stigmatic lobes 3, triangular; ovary inferior. Capsules May to August, pubescent, cylindrical to narrowly ellipsoid, with 6 developed ridges, 2.5–5 cm long, dehiscent from apex. Seeds flat, narrowly oval, 5 mm long.

Japanese name: Ôba-uma-no-suzu-kusa (Ôba-muma-no-sudzu-kusa; Matsumura in Nippon Shokubutsuimeii, p. 18, 1884).

和名: オオバウマノスズクサ（松村）

Chromosome number: 2n = 32 (Sugawara and Murata 1992).

Distribution: JAPAN (endemic). Pacific side and the western part of Honshu (Chiba, Tokyo, Kanagawa, Yamanashi, Shizuoka, Aichi, Mie, Kyoto, Nara, Wakayama, Hyogo, Okayama, Hiroshima, and Yamaguchi Pref.s.), through Shikoku (Kagawa, Tokushima, Ehime and Kochi Pref.s.) and Kyusyu (Fukuoka, Oita, Saga, Nagasaki, Kumamoto, Miyazaki and Kagoshima Pref.s.) to Tanegashima and Yakushima Islands, in altitude 0 m to 1,000 m. Except in Chiba, Kanagawa, Shizuoka and Mie (the Ise-Shima) Prefs. and south Kyusyu, the flowering plants of the species are rare. In some areas, cf. Osaka, central part of the Kii peninsula and Yakushima Island, some specimens of juveniles were collected, but flowering plants have not been observed. The species was recorded in Nagano Pref., central Honshu (Shimizu 1997), but we have confirmed neither living plants nor herbarium specimens.

Representative specimens examined: JAPAN. Chiba: Minami-Boso, K. Watanabe & T. Ohi-Toma K642 (TI); Kimitsu, Mt. Kanou, without collector name, May 1881 (TNS). Tokyo: Izu-Oshima Island, T. Ohi-Toma & T. Ideno K656 (TI). Kanagawa: Kamakura, K. Watanabe K162 (TI); Oiso, K. Watanabe-Toma & T. Ohi-Toma K645 (TI); Kiyokawa, K. Watanabe-Toma & T. Ohi-Toma K658, K659 (TI); Yamakita, Yaga, K. Watanabe-Toma & T. Ohi-Toma K663 (TI); Hadano, Kominoge, K. Watanabe-Toma & T. Ohi-Toma K691, K692 (TI); between Mt. Takatori and Mt. Nenbutsu, K. Watanabe-Toma & T. Ohi-Toma K694 (TI); Odawara, Kuno, K. Watanabe-Toma & T. Ohi-Toma K698 (TI); Ashigara, K. Watanabe-Toma & T. Ohi-Toma K699 (TI); Hakone, Gora, K. Watanabe-Toma & T. Ohi-Toma K701 (TI); Hadano, Imaizumi, K. Watanabe-Toma & T. Ohi-Toma K734 (TI); Mt. Takamatsu, T. Ohi-Toma K741 (TI). Yamanashi: Mt. Kanga-dake, T. Ohi-Toma K754 (TI). Shizuoka: Amagi, T. Ideno D-518 (TI); Shuzenji, K. Watanabe-Toma & T. Ohi-Toma K680 (TI); Gotenba, T. Ohi-Toma K574 (TI); Otome Pass, K. Watanabe-Toma & T. Ohi-Toma K676 (TI); Kan-nami, K. Watanabe-Toma & T. Ohi-Toma K681 (TI); Fuji, Kuwasaki, K. Watanabe K497, K500 (TI); Fujinomiya, Hoshiyama, K. Watanabe K590 (TI); Fujinomiya, Mt. Myoyo, K. Watanabe-Toma & T. Ohi-Toma K740 (TI); Fujinomiya, Mt. Shiratori, K. Watanabe-Toma & T. Ohi-Toma K745 (TI); Shizuoka, Makigaya, K. Watanabe K90 (TI); Shizuoka, Kanbara, K. Watanabe-Toma & T. Ohi-Toma K705 (TI); Mt. Takakusa, K. Watanabe K589 (TI); Shizuoka, Yuyama, K. Watanabe-Toma K689 (TI); Shizuoka, Yui, K. Watanabe-Toma & T. Ohi-Toma K736, K737 (TI); Fujieda, Okabe, K. Watanabe-Toma & T. Ohi-Toma K749 (TI); Aichi: Inuyama, K. Watanabe-Toma & T. Ohi-Toma K791 (TI). Mie: Mt. Asama, K. Watanabe K408 (TI); Shima, Kawachi, J. Unemura s.n., 14 May 1893 (MAK); Toba, K. Uno 22684 (MAK); Ise, Tashiro-dani, G. Murata 19506 (MAK); Ise, Ouchiya-mura, S. Suzuki s.n., 4 Jun 1933 (TUS).

Woody, twining perennial climbers to 1 m long or more, sometimes scendent perennial vines. Young branches pale green, terete, pubescent; old branches gray, terete, striate or green on scendent vines. Leaf lamina cordate, ovate to narrowly ovate, triangular, base cordate, sometimes with round lobes at base, apex obtuse or acuminate, or angustate in the middle lobe, auricules at base, to 3–18 cm long, 4–16 cm wide, herbaceous to leathery, adaxial surface green or light green and densely pubescent, abaxial surface grayish green and hairy; nerves prominent on abaxial surface, with spreading hairs; petiole 1.5–10 cm long. Flowers April to July, solitary or a few in axil of prophylls of lateral branches; pedicel light green, 20–45 mm long; bract usually at base of pedicel, ovate, 4–7.5 mm long. Perianth tube U-shaped, 3–4.5 cm tall, 8–13 mm wide at utricle, upper 1/3 slightly slender (4.5–8.5 mm wide), outside whitish yellow to creamy, velvety-pubescent, inside greenish yellow with purple markings, smooth, and throat spotted with dark purple leopard brindle; mouth round to depressed ovate near the center of the limb, 4–10 mm high, 7–14.5 mm wide; limb round to broadly obovate in front view, shallowly trilobed, 18–31 mm high, 19.5–32.5 mm wide in front view, smooth, whitish to greenish yellow with dark purple striae or sometimes entirely black-purple. Stamens 6, adnate to style column, anthers oblong; stigmatic lobes 3, triangular; ovary inferior. Capsules May to August, pubescent, cylindrical to narrowly ellipsoidal, with 6 undeveloped ridges, 3.5–6 cm long, dehiscent from apex. Seeds flat, narrowly oval, 5 mm long.

Japanese name: Tanzawa-umanosuzukusa

Aristolochia tanzawana (Kigawa) Watanabe-Toma & Ohi-Toma, stat. nov. [Fig. 4, 1–12]

Chromosome number: $2n = 32$ (the plant from Mt. Ogasa, Shizuoka Pref., identified as *A. onoei* in Sugawara and Murata 1992).

Distribution: JAPAN (endemic). Honshu (Ibaraki, Kanagawa, Yamanashi, Shizuoka, Aichi, and Gifu Prefs.), at an altitude of 100–1,500 m. In Gifu, only juveniles without flowers were recently found. In Kigawa (1989), one locality in Nagano was recorded on their figures, but we could not confirm their specimens.


**Key to the species of the *Arisaema kaempferi* group in the Japanese mainland, excluding Nansei Islands:**

1a. Throat of perianth tube yellow without dots. Perianth limb usually dark purple without striae, lobes of limbs recurved, obtangular in front view ................................................. *A. shimadai*

1b. Throat of perianth tube with reddish to dark purple dots or spots. Perianth limb usually yellow or greenish yellow with striae, rarely entire black-purple or whitish yellow without striae, broadly obovate or round in front view .. 2

2a. Hairs on nerves of the abaxial side of leaves appressed. Perianth tube 2–3 cm tall, outside pubescent, much constricted above the utricle. Throat of perianth tube dotted with reddish to dark purple. Perianth limb usually yellow with fine reddish to dark purplish striae, sometimes densely striate or reticulate on in the lower part, rarely entire black-purple or whitish yellow without striae .................................................. *A. kaempferi*

2b. Hairs on nerves of the abaxial side of leaves spreading. Perianth tube 3–4.5 cm tall, outside velvety-pubescent, not much constricted above the utricle. Throat of perianth tube spotted with dark purple leopard brindle. Perianth limb usually whitish to greenish yellow with dark purple striae or sometimes entire black-purple .. ........................................... *A. tanzawana*

* Aristolochia kaempferi × A. tanzawana *. [Fig. 4, 13–15].

Plants with their intermediate floral morphology, which are rarely found along the eastern border of the distribution range of *A. kaempferi* and *A. tanzawana*, are putative hybrids. The floral morphology is variable, and several types are observed. The plants are genetically heterozygous of the parental species on the tentative genotyping by nuclear DNA genes, although the authors are still investigating the detail by multi-locus analyses and artificial crossings.

We would like to thank the curators of TI, KPM, KYO, MAK, SHO, TNS, and TUS for allowing us to examine herbarium specimens, to S. Mukai (HIRO-MY), N. Tanaka (MBK), M. Yokogawa (OSA) and A. Naito (WMNH) for providing digital images, to T. Ideno and K. Mizunashi for cultivating plants in Koishikawa Botanical Garden, and to T. Sugawara, T. Shiraiwa, Y. Ito, Y. Yamaguchi, K. Sasamura, Y. Yamashita, S. Iio and H. Suga for providing materials and supporting our field work. This work was partly supported by Sasakawa Scientific Research Grant from The Japan Science Society to K.W. on 2003–2004, Yamaguchi Encourage Scholarship Foundation for TO on 2011–2012, and Fujiwara Natural History Foundation for TO on 2012.

References


Appendix 1.
List of plants examined for floral characters. Their voucher specimens are deposited in TI.

Aristolochia kaempferi var. kaempferi

**Chiba:** Tohno sho, K. Watanabe-Toma & T. Ohi-Toma K582; Minami-Boso, K. Watanabe & T. Ohi-Toma K643. **Tokyo:** Mt. Takao, K. Watanabe K290.


**Kyoto:** Minami-Yamashiro, K. Watanabe K576. **Wakayama:** Nachi-Katsuura, K. Watanabe K129; Yawakawa Valley, K. Watanabe et al. K564, K565; Kusshimoto, K. Watanabe-Toma & T. Ohi-Toma K795. **Hyogo:** Sumoto, Inohara, K. Watanabe et al. K362,
Aristolochia kaempferi var. tanzawana = A. tanzawana


Appendix 2.
List of the voucher specimens of Aristolochia shimadai with flowers in Fig. 5.