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## Reinstatement of *Isotrema*, a new generic delimitation of *Aristolochia* subgen. *Siphisia* (Aristolochiaceae)

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### Abstract

*Aristolochia* subgen. *Siphisia*, comprising 98 species, is mainly distributed in East and South Asia, with some scattered in North and Central America. It has often been recognized as one of three subgenera of *Aristolochia* and can be distinguished from both remaining subgenera (*Aristolochia* subgen. *Aristolochia* and *Aristolochia* subgen. *Pararistolochia*) by morphological synapomorphies such as a strongly curved perianth with a 3-lobed limb, and especially the 3-lobed gynostemium, anthers paired on the outer surface of each gynostemium segment. However, recent cladistic analyses based on morphological characters and molecular data suggested that *Aristolochia* s.l. should be divided into four genera in two subtribes. In this study, a comprehensive analysis of molecular data of two plastid genic spacers (*rps16-trnK* and *petB-petD*), and two nuclear genes (*phyA* and *ITS2*) with an extensive sampling of Asian and American species was conducted. The combined datasets confirmed that *Aristolochia* subgen. *Siphisia* should be treated as an independent genus. Then *Isotrema* is reinstated here with 87 new combinations for the most comprehensive enumeration.

**Keywords:** *Aristolochia*, *Isotrema*, Isotrematinae, molecular phylogeny, taxonomy

## 1. Introduction

### 1.1 Taxonomy

*Aristolochia* Linnaeus (1753: 960) sensu lato (s.l.) was considered to be the largest genus in Aristolochiaceae and comprises about 550 species (González 2012). Traditionally, it was divided into three subgenera, viz., subgen. *Aristolochia*, subgen. *Siphisia* (Duch.) Schmidt (1935: 236) and subgen. *Pararistolochia* (Hutch. & Dalziel) Schmidt (1935: 241) (Duchartre 1854, 1864, Schmidt 1935, Ma 1989, González 1999, González & Stevenson 2000, Wanke *et al.* 2006). According to Do *et al.* (2016), *Aristolochia* subgen. *Siphisia* comprises about 78 species, 58 of which occur in East and South Asia, while the remaining 20 species are restricted to North and Central America. With many new species discovered and some species revised in recent years (Barringer 1997, 2014, Hansen & Phuphathanaphong 1999, Xu *et al.* 2011, Yao 2012, Huang *et al.* 2013, 2015, Wu *et al.* 2013, 2015, Do *et al.* 2014a, 2014b, 2015a, 2015b, 2016, 2017, 2018, 2019, Lu & Wang 2014, Zhu *et al.* 2015, 2016, 2017a, 2017b, 2018a, 2018b, Gong *et al.* 2018, Yang *et al.* 2018), this subgenus is hitherto known to comprise 98 species and one subspecies, 81 species and one subspecies of which occur in East and South Asia while 17 species are found in North and Central America. It can be distinguished from the other two subgenera, *Aristolochia* subgen. *Aristolochia* and *Aristolochia* subgen. *Pararistolochia* by morphological synapomorphies, such as a strongly curved perianth with a 3-lobed limb, and especially the 3-lobed gynostemium, anthers paired on the outer surface of each gynostemium segment.

Back to the history, the systematic position of these 3-lobed gynostemium species is controversial. They have successively been recognized as an independent genus by different authors: *Isotrema* Rafinesque (1819a: 195)

(Rafinesque 1819b, Huber 1960, 1985, 1993, Wu *et al.* 2003, 2006, 2011, Eberhard *et al.* 2015, Liu *et al.* 2015), *Hocquartia* Dumortier (1822: 30) or *Siphisia* Rafinesque (1828: 62) (Rafinesque 1836, Klotzsch 1859). The infrageneric classification of *Aristolochia* s.l. was initially put forward by Duchartre (1854, 1864) and optimized by Bentham & Hooker (1880), Solereder (1889) and Schmidt (1935). Since then, the 3-lobed gynostemium species were ascribed to *Aristolochia* subgen. *Siphisia* by most researchers (Hwang 1988, Ma 1989, González 1999, González & Stevenson 2000, Murata *et al.* 2001, Adams *et al.* 2005, Xu *et al.* 2011, Do *et al.* 2015a, 2015b, Wu *et al.* 2015, Zhu *et al.* 2018b). More details were summarized by González & Stevenson (2002), Ohi-Toma *et al.* (2006) and Ohi-Toma & Murata (2016).

Furthermore, Ohi-Toma & Murata (2016) discussed the nomenclatural history, typification and authorship of the names *Aristolochia* subgen. *Siphisia*, *Isotrema*, *Siphisia*, and *Endodeca* Rafinesque (1828: 62) in details. And this make it much clear for present work.

## 1.2 Phylogenetic controversy

Recently, several different studies on phylogenetic relationships within *Aristolochia* s.l. were proposed through morphological and molecular methods. Murata *et al.* (2001) conducted phylogenetic analysis of two subgenera *Siphisia* and *Aristolochia* using *matK* sequences, and supported the monophyly of the genus *Aristolochia* s.l. in both MP and NJ trees and recognized two distinct lineages. González & Stevenson (2002) examined the relationships within *Aristolochia* s.l. based on 72 morphological characters, suggesting that *Aristolochia* s.l. should be divided into four genera in two subtribes: *Aristolochia* s.s. and *Pararistolochia* Hutchinson & Dalziel (1927: 75) in Aristolochiinae, and *Endodeca* and *Isotrema* in Isotrematinae. Similarly, the consistent conclusion was obtained by Kelly & González (2003) based on more comprehensive morphological analysis. According to the analysis of *trnL-trnF* sequences, Neinhuis *et al.* (2005) presented a molecular phylogeny of *Aristolochia* s.l., and their study was also in accordance with González & Stevenson (2002). The sequences of plastid genes (*rbcL* and *matK*) and nuclear region (*phyA*) were also used to conduct molecular phylogeny by Ohi-Toma *et al.* (2006), for the convinced relationships among the major genera and subgenera of *Aristolochia* s.l. The phylogenetic trees indicate that *Aristolochia* s.l. consists of two lineages that correspond to the subtribes Isotrematinae and Aristolochiinae. With reference to differentiation of chromosome numbers, the Isotrematinae clade is characterized by  $2n = 32$ , while the Aristolochiinae clade has chromosome numbers of  $2n = 6, 12, 14$  or  $16$  (Ohi-Toma *et al.* 2006). Wanke *et al.* (2006) applied morphological and molecular methods to investigate relationships within 30 species of *Aristolochia*. The two methods both support the recognition of three subgenera within two lineages, while the relationships of 20 species within subgen. *Aristolochia* is conflicting.

In sum, some researchers proposed that *Aristolochia* s.l. should be divided into four genera in two subtribes: *Aristolochia* and *Pararistolochia* in Aristolochiinae, *Endodeca* and *Isotrema* in Isotrematinae (González and Stevenson 2002, Kelly & González 2003, Neinhuis *et al.* 2005, Ohi-Toma *et al.* 2006). However, others suggested a subdivision of *Aristolochia* s.l. into three subgenera: *Aristolochia*, *Siphisia* and *Pararistolochia* (Wanke *et al.* 2006, 2007). Comparing different systems, the subgen. *Aristolochia* and subgen. *Pararistolochia* are congruent with the genera *Aristolochia* s.s. and *Pararistolochia* of the subtribe Aristolochiinae respectively, and the subgen. *Siphisia* is correspond to the subtribe Isotrematinae. In addition, these researches mainly focused on clarifying the relationships of high ranks in Aristolochiaceae, rather than infrageneric relationships or only employed a few species of Asian region. For lacking of materials within subgen. *Siphisia* from Asia especially from China, previous studies only resolved phylogenetic relationships at the family-level or restricted in the New World species or only employed a few species of the subgen. *Siphisia* (Ohi-Toma *et al.* 2006, Wanke *et al.* 2006, 2007, González *et al.* 2014), or mainly focused on a geographical small East Asian species complex (Watanabe *et al.* 2006, 2008). Furthermore, some new species were discovered from Asia in recent years (Hansen & Phupathanaphong 1999, Xu *et al.* 2011, Yao 2012, Huang *et al.* 2013, 2015, Wu *et al.* 2013, 2015, Do *et al.* 2014a, 2015a, 2015b, 2016, 2017, 2018, 2019, Lu & Wang 2014, Zhu *et al.* 2015, 2017a, 2017b, 2018a, 2018b, Gong *et al.* 2018, Yang *et al.* 2018). It is urgent to provide a molecular phylogeny of subgen. *Siphisia* based on an extensive sampling of Asian species. A robust phylogeny with extensive and intensive sampling will be constructed to clarify the phylogenetic relationships among species, which will also provide assistance for the taxonomy of this subgenus.

## 1.3 Objectives

We aim to: 1) reconstruct the robust phylogenetic relationships of the genus *Aristolochia* s.l. and confirm the monophyly of subgen. *Siphisia*; 2) propose the new generic circumscription for subgen. *Siphisia* as *Isotrema*.

## 2. Materials and Methods

### 2.1 Field investigation and specimen examination

In the past decade, we have collected more than 100 samples and several hundreds of specimens of *Aristolochia* in the field work, with an emphasis on the subgen. *Siphisia*, from East Asia, especially from China. All of these materials are deposited in the herbarium of Shanghai Chenshan Botanical Garden (CSH) as well as the herbarium of Kunming Institute of Botany, Chinese Academy of Sciences (KUN).

### 2.2 Taxon sampling, DNA extraction, amplification and sequencing

We have sampled 63 species (plastid sequences) or 58 species (nuclear genes) and one subspecies of subgen. *Siphisia*, 21 taxa of the subgenera *Pararistolochia* and *Aristolochia* in the phylogenetic analyses. *Saruma henryi* and *Asarum caudigerellum* (plastid sequences) or *Asarum yakusimense* (nuclear genes) were selected as outgroups. The datamatrix for phylogeny reconstruction includes 96 accessions of plastid sequences (*rps16-trnK* and *petB-petD* spacer), 86 accessions of nuclear genes (*phyA* and *ITS2* gene), and 21 accessions representing 10 species of Aristolochiaceae retrieved from GenBank. Details of the sample information and GenBank accessions are provided in Appendix.

Genomic DNA was isolated from silica-gel dried leaf tissue or herbarium specimens using Plant Genomic DNA Kit (TIANGEN, China). The nuclear-encoded phytochrome A (*phyA*) gene of the phytochrome gene family was selected for the ease of PCR amplification and low copy number. The DNA fragments of approximately 690 bp long were amplified using the locus-specific primers (*PHYA-AristoF* and *PHYA-AristoR*) designed by Ohi-Toma *et al.* (2006). *ITS2* was used as a candidate barcoding marker for species identification of *Aristolochia* with medicinal use, and were amplified using primers (*ITS-Aris-390F* and *ITS4*) and following PCR conditions of White *et al.* (1990) and Dechbumroong *et al.* (2018). The plastid spacers *petB-petD* and *rps16-trnK* were amplified following the procedure of Wagner *et al.* (2012).

### 2.3 Phylogenetic analyses

Raw sequences data were assembled and manually edited using the program Sequencher 4.5 (Genecodes Ann Arbor, MI), and deposited in GenBank (accession numbers are listed in Appendix). These sequences were aligned automatically using Clustal W (Higgins *et al.* 1994) implemented in MEGA 6.0 (Koichiro *et al.* 2013) and adjusted manually. Numbers of indel sites, events and diversity indices were calculated using DnaSP v5 (Rozas *et al.* 2003). Regions of uncertain homology were excluded from the data matrix prior to phylogenetic reconstructions. The best-fitting substitution model for the data set was estimated in the program ModelFinder (Kalyaanamoorthy *et al.* 2017), according to the Akaike information criterion (AIC).

Maximum likelihood phylogenies were constructed by a fast and effective stochastic algorithm using IQ-TREE v1.6.2 (Nguyen *et al.* 2015) with the adjusted model according to Bayesian Information Criterion (BIC) and the robustness of the topology was estimated using 2000 bootstrap replicates. Bayesian Inference (BI) was conducted using the program MrBayes v3.1 (Ronquist & Huelsenbeck 2003). The Markov Chain Monte Carlo (MCMC) analysis was run for 2,000,000 generations, sampling every 1000 generations. Convergence among chains and effective sample size (ESS > 200) were assessed using Tracer v1.6 (Rambaut *et al.* 2014), discarding the first 25% trees of each run as burn-in. The 50% majority-rule consensus topology and the posterior probabilities (pp) were determined from the remaining trees. The phylogenetic trees were visualized and annotated using Figtree v1.4 (Rambaut 2012).

### 2.4 Tests for data incongruence

The incongruence length difference (ILD) test (Farris *et al.* 1995a, 1995b) was performed using PAUP\* 4.0b10 (Swofford 2002) to assess conflict between the datasets of nuclear and plastid partitions for phylogenetic reconstruction. Congruence between datasets is assessed, with  $P < 0.05$  defined as strong signals of phylogenetic conflicts.

## 3. Results

### 3.1 DNA polymorphism

The final nuclear dataset comprised 64 accessions and the alignment length is 1215 base pairs, with parsimony-informative characters (PIC) equal to 288 and nucleotide diversity (Pi) of 0.07732. Among these markers, the *ITS2* region has the highest average sequence divergence value (Pi = 0.13298). The two plastid regions of *petB-petD* and

*rps16-trnK* spacer were combined, yielding a matrix with the aligned length of 1795bp. The variable sites for each region is 154 and 92, respectively. The *rps16-trnK* spacer has the lowest PIC (30) and sequence divergence value (Pi = 0.02343). The plastid region *petB-petD* possesses the most PIC (91), and the highest substitution ratio (si/sv = 80) among the four fragments (TABLE 1).

**TABLE 1** Alignment characteristics of the chloroplast DNA datasets (*petB-petD* and *rps16-trnK*) and nuclear DNA regions (*phyA* and *ITS2*) excluding sequences of outgroups. PIC, the parsimony informative characters; si, transitional pairs; sv, transversional pairs; pi, nucleotide diversity.

Loci	<i>rps16-trnK</i>	<i>petB-petD</i>	Combined (plastid)	<i>ITS2</i>	<i>phyA</i>	Combined (nuclear)
No. of taxa	69	93	68	75	73	64
si/sv	700/30	800/10	1516/11	357/23	655/23	1019/44
PIC	30	91	49	142	154	288
Variable sites	92	154	131	220	237	444
Singleton sites	62	63	82	78	83	156
Gc%	28.2	37.8	33.3	66.8	42.7	51.8
Model	TVM+F+I+G4	K3Pu+F+G4	TVM+F+I+G4	GTR+F+I+G4	TPM3u+F+I+G4	SYM+I+G4
Indel sites/events	34/20	58/22	48/25	37/22	58/36	92/55
Indel diversity	2.264	1.609	2.597	1.714	2.244	3.985
Length	959	856	1795	495	723	1215
Pi	0.02343	0.02248	0.01130	0.13298	0.05855	0.07732

### 3.2 Molecular phylogeny

The ILD test indicated significant incongruence between nuclear and plastid topology (P = 0.001). Therefore, the phylogenetic trees were reconstructed using plastid and nuclear datasets, separately.

The Bayesian inference recovered a topology similar to the consensus tree generated by maximum likelihood analyses. As shown in Figs. 1 & 2, species of *Aristolochia* s.l. clustered together as a monophyletic clade with strong support in both nuclear gene tree and plastid gene tree, with posterior probability (pp) value of 1.00/1.00 and bootstrap (bp) value of 100%/100% for plastids and nuclear phylogeny, respectively. The group was divided into two well-supported clades representing the subtribe Isotrematinae (I) (pp = 1.00, bp = 100% for plastid regions; pp = 1.00, bp = 98% for the nuclear genes) and the subtribe Aristolochiinae (II) (pp = 1.00, bp = 100% for plastid regions and nuclear genes). In the Isotrematinae (I) clade, *Aristolochia serpentaria* of *Endodeca* is a sister to all the remaining *Siphisia* species (pp = 1.00, bp = 100%), and species of the subgen. *Siphisia* mainly grouped into four subclades in plastid phylogeny.

## 4. Discussion

### 4.1 The monophyly of *Isotrema* (subgen. *Siphisia*)

The plastid and nuclear phylogenies reveal distinct genetic divergence between the subtribes Isotrematinae and Aristolochiinae and monophyletic origin of both clades with strong support (Figs. 1 & 2. Isotrematinae: pp = 1.00 for plastid and nuclear regions, bp = 100% for plastid and 98% for nuclear; Aristolochiinae: pp = 1.00 for plastid and nuclear regions, bp = 100% for plastid and 99% for nuclear). Within the clade Isotrematinae, the monophyly of *Isotrema* (subgen. *Siphisia*) has also been testified based on phylogenetic analysis of several nuclear/plastid regions (Murata *et al.* 2001, Neinhuis *et al.* 2005, Ohi-Toma *et al.* 2006, Wanke *et al.* 2006). The *Endodeca* clade of Isotrematinae, as represented by *A. serpentaria*, is a sister group to the subgen. *Siphisia* clade in the plastid phylogeny (Fig. 1). Furthermore, the number of gene copies of the *phyA*, *APETALA3* (*AP3*), and *PISTILLATA* (*PI*) genes varies across different subtribes, from single-copy for the subtribe Aristolochiinae to at least two copies for some species of the subtribe Isotrematinae (such as *Aristolochia kaempferi* group), suggesting ancient polyploidization events in the genus *Aristolochia* (Stellari *et al.* 2004, Jaramillo & Kramer 2004, Ohi-Toma *et al.* 2006, Watanabe *et al.* 2008). Gene duplication events have also been detected in five species of *Isotrema* (subgen. *Siphisia*) for the *trnH* region, while only one *trnH* gene in four species of *Aristolochia* s.s., as revealed by comparative chloroplast genomics of nine species of



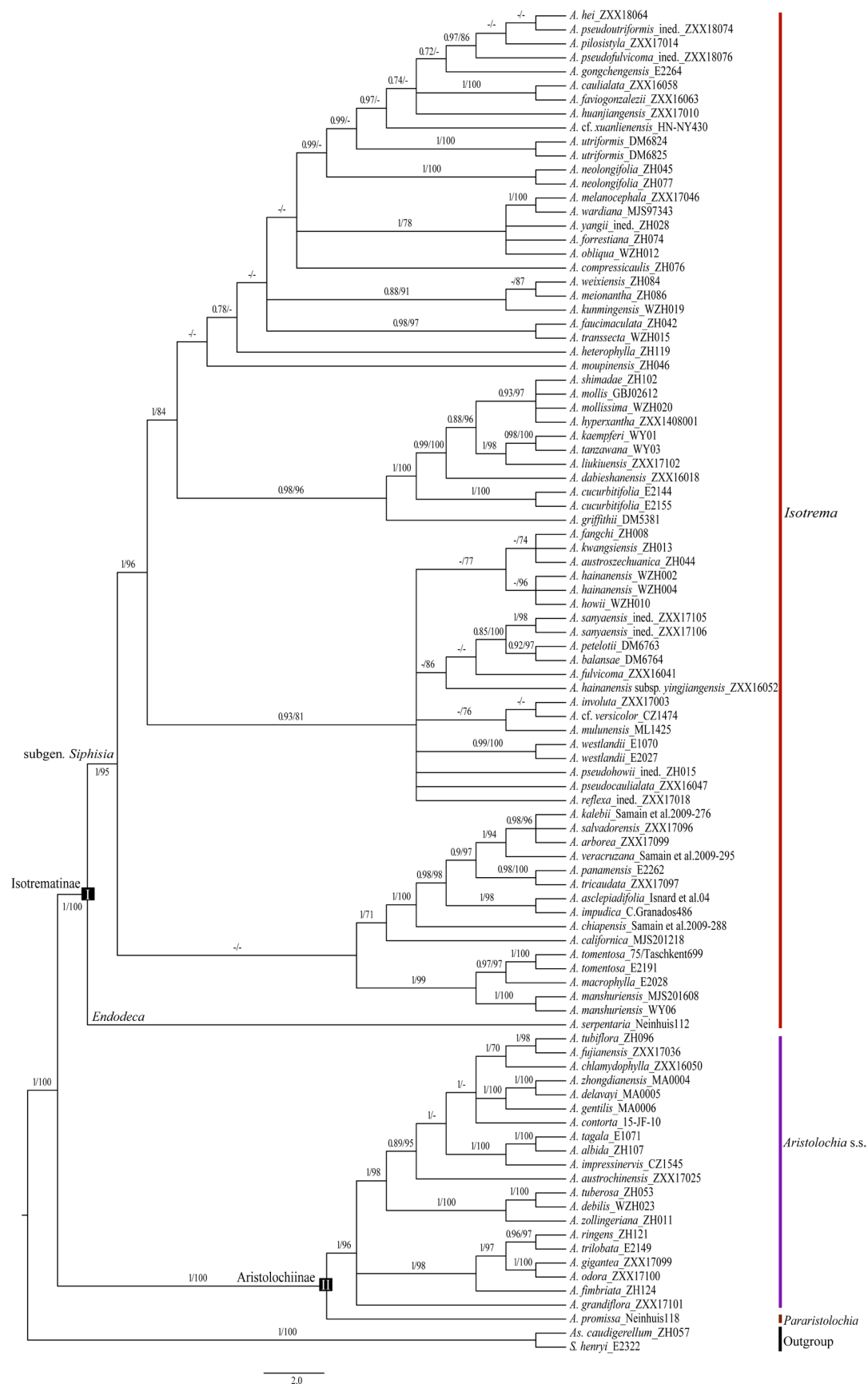
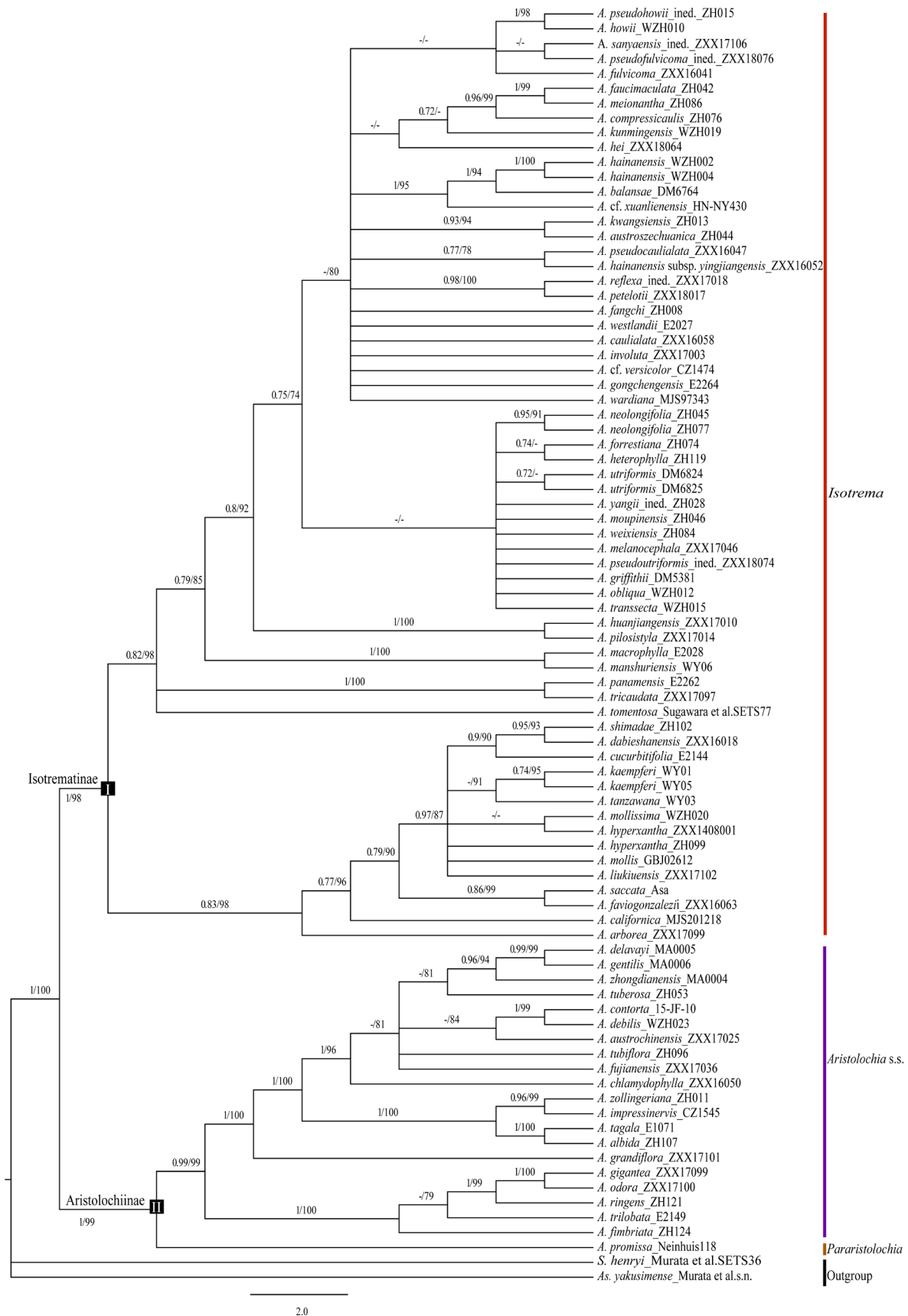


FIGURE 1 Bayesian phylogeny of the genus *Isotrema* (subgen. *Siphisia*) based on two plastid datasets. Values on branches represent Bayesian posterior probabilities and ML bootstrap, respectively. “-” indicates value < 70.



**FIGURE 2** Bayesian phylogeny of the genus *Isotrema* (subgen. *Siphisia*) based on the combined nuclear dataset of *phyA* and *ITS2*. Values on branches represent posterior probabilities and ML bootstrap, respectively. “ - ” indicates index value < 70.

*Aristolochia* s.l. (Zhou *et al.* 2017, Li *et al.* 2019). Moreover, *Isotrema* (subgen. *Siphisia*) can be distinguished from *Aristolochia* s.s. by morphological synapomorphies, such as a strongly curved perianth with a 3-lobed limb, and especially the 3-lobed gynostemium, anthers paired on the outer surface of each gynostemium segment. Thirdly, the *Isotrematinae* clade is characterized by the chromosome number  $2n = 32$ , which differs from that of the *Aristolochiinae* clade ( $2n = 6, 12, 14, 16, 34$ ) (Gregory 1956, Ma 1989, Goldblatt & Johnson 1991, Sugawara & Murata 1992, Ohi-Toma *et al.* 2006, Berjano *et al.* 2009).

Based on molecular phylogeny and chromosome numbers, as well as morphology, we suggest that the monophyletic clade consisting of the subgen. *Siphisia* clade and *Endodeca* clade should be treated as an independent genus, for which the name *Isotrema* should be adopted. Within this genus, 98 species and one subspecies are recognized, which occur in East and South Asia, and in North and Central America.

## 5. Taxonomic treatment

*Isotrema* Raf., *Amer. Monthly Mag. & Crit. Rev.* 4(3): 195, 1819  $\equiv$  *Siphisia* Raf., *Med. Fl.* 1: 62, 1828, nom. illeg. (Art. 52.1)  $\equiv$  *Isiphia* Raf., *Med. Fl.* 2: 232, 1830, nom. nud.  $\equiv$  *Siphidia* Raf., *Gard. Mag. & Reg. Rural Domest. Improv.* 8: 247, 1832, nom. nud. et orth. var. pro *Siphisia* Raf. (fide Jackson, *Index Kew.* 2: 915, 1895)  $\equiv$  *Niphus* Raf., *Gard. Mag. & Reg. Rural Domest. Improv.* 8: 247, 1832, nom. nud. et nom. alt. pro *Siphisia* Raf. (fide Farr *et al.*, *Regnum Veg.* 102: 1178, 1979)  $\equiv$  *Aristolochia* [unranked] *Siphisia* Duch., *Ann. Sci. Nat., Bot., sér. 4*, 2: 29, 1854  $\equiv$  *Siphisia* Raf. [unranked] *Eusiphisia* Klotzsch, *Monatsber. Königl. Preuss. Akad. Wiss. Berlin* 1859: 602, 1859 (“1860”), nom. inval.  $\equiv$  *Aristolochia* sect. *Siphisia* (Duch.) Duch. in Candolle, *Prodr.* 15(1): 435, 1864  $\equiv$  *Aristolochia* subg. *Siphisia* (Duch.) O.C. Schmidt in Engler & Prantl, *Nat. Pflanzenfam., ed. 2*, 16B: 236, 1935 – Type: *Isotrema siphio* (L’Hér.) Raf. ex B.D. Jacks., *Index Kew.* 1: 1240, 1893 ( $\equiv$  *Aristolochia siphio* L’Hér., *Stirp. Nov.*: 13, t. 7, 1785).

$\equiv$  *Hocquartia* Dumort., *Comment. Bot.*: 30, 1822 – Type (designated by Pfeifer in *Ann. Missouri Bot. Gard.* 53: 122, 1966): *Hocquartia macrophylla* (Lam.) Dumort., *Comment. Bot.*: 30, 1822 ( $\equiv$  *Aristolochia macrophylla* Lam., *Encycl.* 1: 255, 1783).

$\equiv$  *Endodeca* Raf., *Med. Fl.* 1: 62, 1828  $\equiv$  *Aristolochia* [unranked] *Asterolytes* Duch., *Ann. Sci. Nat., Bot., sér. 4*, 2: 29, 1854  $\equiv$  *Aristolochia* sect. *Asterolytes* (Duch.) Duch., *Candolle, Prodr.* 15(1): 433, 1864  $\equiv$  *Siphisia* Raf. [unranked] *Brachycalyx* Klotzsch, *Monatsber. Königl. Preuss. Akad. Wiss. Berlin* 1859: 604, 1859 (“1860”), nom. inval. – Type: *Endodeca hastata* Raf., *Fl. Tellur.* 4: 99, 1838 ( $\equiv$  *Aristolochia hastata* Nutt., *Gen. N. Amer. Pl.* 2: 200, 1818, nom. illeg.).

$\equiv$  *Psophiza* Raf., *Fl. Tellur.* 4: 99, 1838 – Type: *Psophiza undulata* Raf., *Fl. Tellur.* 4: 99, 1838 ( $\equiv$  *Aristolochia serpentaria* L. in Bigelow, *Amer. Med. Bot.* 3: 82, t. 49, 1820 sensu Rafinesque (1828), non *Aristolochia serpentaria* L., *Sp. Pl.*: 961, 1753).

$\equiv$  *Pteriphis* Raf., *Fl. Tellur.* 4: 99, 1838 – Type: *Pteriphis tripteris* (Raf.) Raf., *Fl. Tellur.* 4: 99, 1838 ( $\equiv$  *Aristolochia tripteris* Raf., *Fl. Ludov.*: 24, 1817).

$\equiv$  *Aristolochia* [unranked] *Hexodon* Duch., *Ann. Sci. Nat., Bot., sér. 4*, 2: 29, 1854  $\equiv$  *Aristolochia* sect. *Hexodon* (Duch.) Duch., *Candolle, Prodr.* 15(1): 438, 1864 – Type: not designated.

$\equiv$  *Dasyphonion* Raf., *First Cat. Gard. Transylv. Univ.*: 13, 1824, nom. nud.

$\equiv$  *Siphisia* Raf. [unranked] *Nepenthesia* Klotzsch, *Monatsber. Königl. Preuss. Akad. Wiss. Berlin* 1859: 603, 1859 (“1860”), nom. inval.

$\equiv$  *Siphisia* Raf. [unranked] *Pentodon* Klotzsch, *Monatsber. Königl. Preuss. Akad. Wiss. Berlin* 1859: 604, 1859 (“1860”), nom. inval.

The Chinese name is given as **Guan Mu Tong Shu** “关木通属” (Wu *et al.* 2003, 2006, 2011, Editorial Committee of FRPS 2004, Liu *et al.* 2015).

Climbing shrub, rarely erectshrub or small rhizomatous herbs. Old woody stems mostly with a thick-corky and fissured bark. Leaves alternate, rarely opposite, veins pinnate or palmately 3–7 from base, margin entire, rarely 3–7-lobed. Flowers solitary, fasciculate or in cymose, axillary or cauligerous. Perianth uniseriate, zygomorphic. Calyx lobes fused, tube geniculately curved; limb discoid, saccate or subpeltate; lobes 3. Ovary inferior, 6-loculed; carpels fully connate; gynostemium 3-lobed. Stamens 6, filaments absent; anthers 6, extrorse, adnate in 3 pairs to the base of gynostemium, opposite lobes. Fruit dry capsules, dehiscing from the base (basipetally), valves 6, rarely 3. Seeds flat or plano-convex, with fleshy funicle, persistent on seed as a membranous elaiosome.

Ninety-eight species and one subspecies. Distributed in East and South Asia and in North and Central America.<sup>1</sup>

1. We list all the known taxa of *Isotrema*, including 87 necessary new combinations, with the necessary homotypic synonyms and heterotypic synonyms. However, we must emphasize that some synonyms may be rehabilitated in the future. For more detailed nomenclature of *Isotrema*, *Siphisia*, and *Endodeca*, and their related infrageneric taxa of *Aristolochia* (Aristolochiaceae), please consult Ohi-Toma & Murata (2016). To facilitate finding the references for the basionyms and synonyms, we do not abbreviate those references in the nomenclatural treatments.



- Isotrema annamense* (Do, Neinhuis & Wanke) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.**  $\equiv$  *Aristolochia annamensis* Do, Neinhuis & Wanke, *Phytotaxa* 220 (1): 70, 2015.  
Distribution: Vietnam.
- Isotrema arboreum* (Linden) Eb. Fisch., *Syllabus* (ed. 13) 4: 154, 2015, as ‘arborea’  $\equiv$  *Aristolochia arborea* Linden, *Catalogue des Plantes Exotiques* 13: 6, 1858.  
Distribution: Mexico; Mesoamerica.
- Isotrema asclepiadifolium* (Brandege) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.**  $\equiv$  *Aristolochia asclepiadifolia* Brandege, University of California Publications in Botany 6(8): 178, 1915.  
Distribution: Mexico.
- Isotrema austroszechuanicum* (C.P. Tsien & C.Y. Cheng) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.**  $\equiv$  *Aristolochia austroszechuanica* C.P. Tsien & C.Y. Cheng, *Journal of Wuhan Botanical Research* 5(3): 221, fig. 2, 1987.  
Distribution: China: Chongqing, Guizhou, Sichuan.
- Isotrema austroyunnanense* (S.M. Hwang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.**  $\equiv$  *Aristolochia austroyunnanensis* S.M. Hwang, *Acta Phytotaxonomica Sinica* 19 (2): 228, fig. 8, 1981.  
Distribution: China: Guangxi, Yunnan.
- Isotrema baenzigeri* (B. Hansen & Phuph.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.**  $\equiv$  *Aristolochia baenzigeri* B. Hansen & Phuph., *Nordic Journal of Botany* 19: 575, 1999.  
Distribution: Thailand.
- Isotrema balansae* (Franch.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.**  $\equiv$  *Aristolochia balansae* Franch., *Journal de Botanique (Morot)* 12(19–20): 311, 1898.  
Distribution: Vietnam.
- Isotrema bambusifolium* (C.F. Liang ex H.Q. Wen) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.**  $\equiv$  *Aristolochia bambusifolia* C.F. Liang ex H.Q. Wen, *Guihaia* 12 (3): 217, 1992.  
Distribution: China: Guangxi.
- Isotrema bidoupense* (Do) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.**  $\equiv$  *Aristolochia bidouensis* Do, *Nordic Journal of Botany* 34:513, 2016.  
Distribution: Vietnam.
- Isotrema bullatum* (Pfeifer) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.**  $\equiv$  *Aristolochia bullata* Pfeifer, *Annals of the Missouri Botanical Garden* 53(2): 134, 1966.  
 $\equiv$  *Aristolochia kalebii* Beutelsp., *Lacandonia* 1(1): 8, 2007.  
Distribution: Mexico; Mesoamerica.
- Isotrema californicum* (Torr.) H. Huber, *Mitteilungen der Botanischen Staatssammlung München* 3: 550, 1960.  $\equiv$  *Aristolochia californica* Torr., *Reports of explorations and surveys: to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean, made under the direction of the Secretary of War* 4(5): 128, 1857.  
Distribution: North America: California.
- Isotrema cathcartii* (Hook. f.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.**  $\equiv$  *Aristolochia cathcartii* Hook. f., *The Flora of British India* 5 (13): 77, 1886.  
Distribution: Bhutan; China: Xizang, Yunnan; India; Myanmar; Nepal; Sikkim.
- Isotrema caulialatum* (C.Y. Wu ex J.S. Ma & C.Y. Cheng) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.**  $\equiv$  *Aristolochia caulialata* C.Y. Wu ex J.S. Ma & C.Y. Cheng, *Acta Phytotaxonomica Sinica* 27(4): 294, 1989.  
Distribution: China: Yunnan.

- Isotrema championii* (Merr. & Chun) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia championii* Merr. & Chun, *Sunyatsenia* 5(4): 47, 1940. ≡ *Aristolochia longifolia* Champion ex Benth (1854: 116), *nom. illeg.*, non *Aristolochia longifolia* Roxburgh, 1832. ≡ *Hocquartia championii* (Merr. & Chun) Migo, *Bulletin of the Shanghai Science Institute* 14(4): 334, 1944. (For typification see Do *et al.* 2015c).  
Distribution: China: Guangdong, Hongkong.
- Isotrema coadunatum* (Backer) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia coadunata* Backer, *De Tropische Natuur* 8: 154, 1919. (For typification see Hou 1983).  
Distribution: Indonesia; Malaysia.
- Isotrema cucurbitifolium* (Hayata) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia cucurbitifolia* Hayata, *Icones Plantarum Formosanarum nec non et Contributiones ad Floram Formosanam* 5: 137, 1915.  
Distribution: China: Taiwan.
- Isotrema cucurbitoides* (C.F. Liang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia cucurbitoides* C.F. Liang, *Acta Phytotaxonomica Sinica* 13(2): 15, 1975.  
Distribution: China: Guangxi.
- Isotrema dabieshanense* (C.Y. Cheng & W. Yu) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia dabieshanensis* C.Y. Cheng & W. Yu, *Bulletin of Botanical Research* 12(1): 110, 1992.  
Distribution: China: Anhui, Hubei.
- Isotrema dilatatum* (Brown) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia dilatata* Brown, *Bulletin of Miscellaneous Information, Royal Gardens, Kew* 1911: 274, 1911.  
= *Aristolochia gourigangaica* Nair, *Bulletin of the Botanical Survey of India* 10: 332, 1969. (For more details see Do *et al.* 2015d).  
Distribution: India.
- Isotrema fangchi* (Y.C. Wu ex L.D. Chow & S.M. Hwang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia fangchi* Y.C. Wu ex L.D. Chow & S.M. Hwang, *Flora of China* 5: 263, 2003.  
Distribution: China: Guangdong, Guangxi, Guizhou, Yunnan; Vietnam.
- Isotrema faucimaculatum* (H. Zhang & C.K. Hsien) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia faucimaculata* H. Zhang & C.K. Hsien, *Acta Academiae Medicinae Sichuan* 15(1): 13, 1984.  
Distribution: China: Sichuan, Yunnan.
- Isotrema faviogonzalezii* (T.V. Do, S. Wanke & C. Neinhuis) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia faviogonzalezii* T.V. Do, S. Wanke & C. Neinhuis, *Systematic Botany* 40(3): 672, 2015.  
Distribution: China: Yunnan; Vietnam.
- Isotrema feddei* (H. Lév.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia feddei* H. Lév., *Repertorium Specierum Novarum Regni Vegetabilis* 12(3): 287, 1913.  
Distribution: China: Yunnan.
- Isotrema forrestianum* (J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia forrestiana* J.S. Ma, *Acta Botanica Yunnanica* 11(3): 321, 1989.  
Distribution: China: Yunnan.
- Isotrema fulvicomum* (Merr. & Chun) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia fulvicoma* Merr. & Chun, *Sunyatsenia* 5(1–3): 48, 1940. ≡ *Hocquartia fulvicoma* (Merr. & Chun) Migo, *Bulletin of the Shanghai Science Institute* 14(4): 334, 1944.  
Distribution: China: Hainan.
- Isotrema gongchengense* (Y.S. Huang, Y.D. Peng & C.R. Lin) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia gongchengensis* Y.S. Huang, Y.D. Peng & C.R. Lin, *Annales Botanici Fennici* 52(5–6): 397, 2015.  
Distribution: China: Guangxi.

- Isotrema grande*** (Craib) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia grandis* Craib, *Bulletin of Miscellaneous Information, Royal Gardens, Kew* 1914: 10, 1914.  
Distribution: Thailand.
- Isotrema griffithii*** (Hook. f. et Thomson ex Duchartre) C.E.C. Fisch, *Bulletin of Miscellaneous Information* 1940(5): 198, 1940. ≡ *Aristolochia griffithii* Hook. f. & Thomson ex Duch., *Prodromus Systematis Naturalis Regni Vegetabilis* 15: 437, 1864.  
Distribution: China: Xizang; Bhutan; Myanmar; Nepal; Sikkim.
- Isotrema hainanense*** (Merr.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia hainanensis* Merr., *Philippine Journal of Science* 21(4): 341, 1922. ≡ *Hocquartia hainanensis* (Merr.) Migo, *Bulletin of the Shanghai Science Institute* 14(4): 334, 1944.  
= *Aristolochia carinata* Merr. & Chun, *Sunyatsenia* 2: 219, 1935.  
Distribution: China: Guangxi, Hainan, Yunnan; Vietnam.
- Isotrema hainanense* subsp. *yingjiangense*** (X.X. Zhu & J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia hainanensis* subsp. *yingjiangensis* X.X. Zhu & J.S. Ma, *Phytotaxa* 332(3): 273, 2017.  
Distribution: China: Yunnan.
- Isotrema heterophyllum*** (Hemsl.) Stapf, *Botanical Magazine*, pl. 8957, 1923. ≡ *Aristolochia heterophylla* Hemsl., *Journal of the Linnean Society, Botany* 26(176): 361, 1891. ≡ *Aristolochia kaempferi* Willd. f. *heterophylla* (Hemsl.) S.M. Hwang, *Acta Phytotaxonomica Sinica* 19(2): 230, 1981.  
= *Aristolochia setchuenensis* Franch., *Journal de Botanique (Morot)* 12(19–20): 312, 1898.  
= *Aristolochia setchuenensis* var. *holotricha* Diels, *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 29(2): 310, 1900.  
= *Isotrema chrysops* Stapf, *Courties' Botanical Magazine* 148: t. 8957, 1923.  
= *Isotrema lasiops* Stapf, *Courties' Botanical Magazine* 148: sub t. 8957, in adnot, 1923.  
= *Aristolochia chrysops* (Stapf) E.H. Wilson ex Rehder, *Journal of the Arnold Arboretum* 22(4): 574, 1941.  
Distribution: China: Chongqing, Gansu, Hubei, Hunan, Shaanxi, Sichuan.
- Isotrema howii*** (Merr. & Chun) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia howii* Merr. & Chun, *Sunyatsenia* 5(1–3): 46, 1940. ≡ *Hocquartia howii* (Merr. & Chun) Migo, *Bulletin of the Shanghai Science Institute* 14(4): 334, 1944.  
Distribution: China: Hainan.
- Isotrema huanjiangense*** (Yan Liu & L. Wu) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia huanjiangensis* Yan Liu & L. Wu, *Annales Botanici Fennici* 50: 413, 2013.  
Distribution: China: Guangxi, Guizhou.
- Isotrema hyperxanthum*** (X.X. Zhu & J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia hyperxantha* X.X. Zhu & J.S. Ma, *Phytotaxa* 313(1): 69, 2017.  
Distribution: China: Zhejiang.
- Isotrema impudicum*** (J.F. Ortega) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia impudica* J.F. Ortega, *Biótica: Publicación del Instituto Nacional de Investigaciones sobre Recursos Bióticos, Xalapa* 12: 213, 1987.  
Distribution: Mexico.
- Isotrema involutum*** (X.X. Zhu, Z.X. Ma & J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia involuta* X.X. Zhu, Z.X. Ma & J.S. Ma, *Phytotaxa* 332(3): 269, 2017.  
Distribution: China: Yunnan.
- Isotrema jianfenglingense*** (Han Xu, Y.D. Li & H.Q. Chen) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia jianfenglingensis* Han Xu, Y.D. Li & H.Q. Chen, *Novon* 21(2): 287, 2011.  
Distribution: China: Hainan.
- Isotrema kaempferi*** (Willd.) H. Huber, *Mitteilungen der Botanischen Staatssammlung München* 3: 550, 1960. ≡ *Aristolochia kaempferi* Willd., *Species Plantarum. editio quarta* 4(1): 152, 1805.

- = *Aristolochia lineata* Duch., *Revue Horticole (Paris) IV*, 3: 284, 1854.
- = *Aristolochia kaempferi* var. *longifolia* Franch. & Sav., *Enumeratio plantarum: in Japonia sponte crescentium hucusque rite cognitarum, adjectis descriptionibus specierum pro regione novarum, quibus accedit determinatio herbarum in libris japonicis So mokou zoussetz xylographice delineatarum* 1: 419, 1875.
- = *Aristolochia kaempferi* f. *lineata* (Duch.) Makino, *Botanical Magazine, Tokyo* 24: 125, 1910.
- = *Aristolochia kaempferi* f. *longifolia* (Franch. & Sav.) Makino, *Botanical Magazine, Tokyo* 24: 125, 1910.
- = *Aristolochia kaempferi* var. *pallescens* Nakai, *Rep. Veg. Isl. Shikashima Iyo*: 38, 1927.
- Distribution: Japan.
- Isotrema kunmingense*** (C.Y. Cheng & J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia kunmingensis* C.Y. Cheng & J.S. Ma, *Acta Phytotaxonomica Sinica* 27(4): 296, 1989.
- Distribution: China: Guizhou, Yunnan.
- Isotrema kwangsiense*** (Chun & F.C. How) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia kwangsiensis* Chun & F.C. How, *Acta Phytotaxonomica Sinica* 13(2): 12, 1975.
- Distribution: China: Guangxi, Guizhou.
- Isotrema ledongense*** (Han Xu, Y.D. Li & H.J. Yang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia ledongensis* Han Xu, Y.D. Li & H.J. Yang, *Novon* 21(2): 285, 2011.
- Distribution: China: Hainan.
- Isotrema liangshanense*** (Z.L. Yang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia liangshanensis* Z.L. Yang, *Journal of Wuhan Botanical Research* 6(1): 31, 1988.
- = *Aristolochia compressicaulis* Z.L. Yang in Do *et al.*, *Phytotaxa* 221(2): 198, 2015, **syn. nov.**
- Distribution: China: Chongqing, Sichuan.
- Isotrema liukiense*** (Hatusima) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia liukiensis* Hatusima, *Journal of Japanese Botany* 26(12): 371, 1951.
- Distribution: Japan.
- Isotrema longlinense*** (Yan Liu & L. Wu) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia longlinensis* Yan Liu & L. Wu, *Novon* 23(4): 491, 2015.
- Distribution: China: Guangxi.
- Isotrema macrophyllum*** (Lam.) C.F. Reed, *Phytologia* 12(7): 415, 1965. ≡ *Aristolochia macrophylla* Lam., *Encyclopédie Méthodique, Botanique* 1(1): 255, 1783.
- = *Aristolochia siphon* L'Hér., *Stirpes Novae aut Minus Cognitae* 13, 1784.
- = *Isotrema siphon* (L'Herit) Raf. *American monthly magazine and critical review* 4: 195, 1819.
- Distribution: North America: Ontario, Georgia, Kentucky, Maryland, North Carolina, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia, and possibly escaped from cultivation in Connecticut, Massachusetts, New Jersey, New York, and Vermont.
- Isotrema malacophyllum*** (Standl.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia malacophylla* Standl., *Proceedings of the Biological Society of Washington* 33(12): 65, 1920.
- Distribution: Mexico; Mesoamerica.
- Isotrema manshuriense*** (Kom.) H. Huber, *Mitteilungen der Botanischen Staatssammlung München* 3: 550, 1960. ≡ *Aristolochia manshuriensis* Kom., *Acta Horti Petropolitani (Trudy Imperatorskago S.-Peterburgskago Botaničeskago Sada)* 22(1): 112, 1903.
- ≡ *Hocquartia manshuriensis* (Kom.) Nakai, *The Forest Experiment Station, Government General of Chosen, keijyō, Japan* 21: 27, 1936.
- Distribution: China: Gansu, Heilongjiang, Henan, Hubei, Jilin, Liaoning, Shaanxi, Shanxi; North Korea; Russia; South Korea.
- Isotrema meionanthum*** (Hand.-Mazz.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia yunnanensis* var. *meionantha* Hand.-Mazz., *Anzeiger der Akademie der Wissenschaften in Wien. Manthematisch-naturwissenschaftliche Klasse* 61: 163, 1924. ≡ *Aristolochia meionantha* (Hand.-Mazz.) X.X. Zhu & J.S. Ma, *Phytotaxa* 261(2): 142, 2016.
- Distribution: China: Yunnan.

- Isotrema melanocephalum*** (X.X. Zhu & J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia melanocephala* X.X. Zhu & J.S. Ma, *Novon* 26(3): 298, 2018.  
Distribution: China: Yunnan.
- Isotrema mirabile*** (S.M. Hwang) X.X. Zhu, S. Liao & J.S. Ma, **comb. & stat. nov.** ≡ *Aristolochia kaempferi* f. *mirabilis* S.M. Hwang, *Acta Phytotaxonomica Sinica* 19(2): 230, 1981.  
Distribution: China: Sichuan.
- Isotrema molle*** (Dunn) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia mollis* Dunn, *Journal of the Linnean Society, Botany* 38(267): 364, 1908. Non: *Aristolochia mollis* Standl. & Steyererm, *Publications of the Field Museum of Natural History, Botanical Series* 23(4): 155, 1944.  
Distribution: China: Fujian, Guangdong, Hongkong.
- Isotrema mollissimum*** (Hance) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia mollissima* Hance, *Journal of Botany, British and Foreign* 17(202): 300, 1879.  
Distribution: China: Anhui, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shandong, Shanghai, Zhejiang.
- Isotrema moupinense*** (Franch.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia moupinensis* Franch., *Nouvelles archives du muséum d'histoire naturelle, sér. 2*, 10: 79, 1887.  
= *Aristolochia jinshanensis* Z.L. Yang & S.X. Tan, *Bulletin of Botanical Research, Harbin* 7(2): 129, 1987.  
Distribution: China: Chongqing, Guizhou, Sichuan, Yunnan.
- Isotrema mulunense*** (Y.S. Huang & Yan Liu) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia mulunensis* Y.S. Huang & Yan Liu, *Annales Botanici Fennici* 50(3): 175, 2013.  
Distribution: China: Guangxi.
- Isotrema nakaoui*** (Maek.) A.R. Sm., *Curtis's Botanical Magazine* 178: t. 576, 1970. ≡ *Aristolochia nakaoui* Maek., *Acta Phytotaxonomica et Geobotanica* 15(6): 173, 1954.  
Distribution: Bhutan; Nepal.
- Isotrema neinhuisii*** (Do) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia neinhuisii* Do, *Annales Botanici Fennici* 54(4–6): 204, 2017.  
Distribution: Vietnam.
- Isotrema neolongifolium*** (J.L. Wu & Z.L. Yang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia neolongifolia* J.L. Wu & Z.L. Yang, *Journal of Wuhan Botanical Research* 5(3): 223, 1987.  
Distribution: China: Chongqing, Guangxi, Guizhou, Hubei, Hunan, Sichuan, Yunnan.
- Isotrema nuichuaense*** (V.T. Do & H.T. Luu) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia nuichuaensis* V.T. Do & H.T. Luu, *Annales Botanici Fennici*, 56(1–3): 108, 2019.  
Distribution: Vietnam.
- Isotrema obliquum*** (S.M. Hwang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia obliqua* S.M. Hwang, *Acta Phytotaxonomica Sinica* 19(2): 226, 1981. (For more details see Zhu *et al.* 2017b).  
Distribution: China: Yunnan.
- Isotrema ovatifolium*** (S.M. Hwang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia ovatifolia* S.M. Hwang, *Acta Phytotaxonomica Sinica* 19(2): 226, 1981.  
= *Aristolochia jinjiangensis* Hao Zhang & C.K. Hsieh, *Acta Academiae Medicinae Sichuan* 15(1): 12, 1984.  
Distribution: China: Guizhou, Sichuan, Yunnan.
- Isotrema panamense*** (Standl.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia panamensis* Standl., *Journal of the Washington Academy of Sciences* 15(1): 5, 1925.  
Distribution: Panama.



- Isotrema paracletum*** (Pfeifer) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia paracleta* Pfeifer, *Ann. Miss. Bot. Gard.* 53: 135, 1966. ≡ *Aristolochia mollis* Standl. & Steyerl., *Publications of the Field Museum of Natural History, Botanical Series* 23(4): 155, 1944, nom. illeg., non *Aristolochia mollis* Dunn, 1908.  
= *Aristolochia chiapensis* J.F. Ortega & R.V. Ortega, *Acta Botánica Mexicana* 44: 2, 1998.  
Distribution: Guatemala.
- Isotrema petelotii*** (O.C. Schmidt) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia petelotii* O.C. Schmidt, *Repertorium Specierum Novarum Regni Vegetabilis* 32: 95, 1933.  
Distribution: China: Yunnan; Vietnam.
- Isotrema pilosistylum*** (X.X. Zhu & J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia pilosistyla* X.X. Zhu & J.S. Ma, *Novon* 26(3): 301, 2018.  
Distribution: China: Yunnan.
- Isotrema platanifolium*** (Klotzsch) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Siphisia platanifolia* Klotzsch, *Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin* 1859: 603, 1859. ≡ *Aristolochia platanifolia* (Klotzsch) Duch., *Prodromus Systematis Naturalis Regni Vegetabilis* 15(1): 437, 1864.  
Distribution: Bhutan; India; Nepal; Sikkim.
- Isotrema pseudocaulialatum*** (X.X. Zhu, J.N. Liu & J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia pseudocaulialata* X.X. Zhu, J.N. Liu & J.S. Ma, *Phytotaxa* 364(1): 55, 2018.  
Distribution: China: Yunnan.
- Isotrema punjabense*** (Lace) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia punjabensis* Lace, *Bulletin of Miscellaneous Information, Royal Gardens, Kew* 1911: 273, 1911. (For more details see Do *et al.* 2015c).  
Distribution: India; Nepal.
- Isotrema quangbinhense*** (Do) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia quangbinhensis* Do, *PhytoKeys* 33: 52, 2014.  
Distribution: Vietnam.
- Isotrema reticulatum*** (Nutt.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia reticulata* Nutt., *Transactions of the American Philosophical Society, new series* 5(6[2]): 162, 1835. ≡ *Siphisia reticulata* (Nutt.) Klotzsch, *Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin* 1859: 604, 1859.  
Distribution: North America: Arkansas, Louisiana, Oklahoma, Texas.
- Isotrema saccatum*** (Wall.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia saccata* Wall., *Plantae Asiaticae Rariores* 2(2): 2, 1830. ≡ *Siphisia saccata* (Wall.) Klotzsch, *Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin* 1859: 603, t. 2, f. 11, 1859.  
= *Siphisia angustifolia* Kl., *Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin* 1859: 603, 1859.  
= *Aristolochia saccata* var. *angustifolia* (Kl.) Duch., *Prodromus Systematis Naturalis Regni Vegetabilis* 15(1): 436, 1864.  
= *Aristolochia saccata* var. *dilatata* Hook. f., *The Flora of British India* 5(13): 77, 1886.  
Distribution: Nepal; Sikkim.
- Isotrema salvadorensis*** (Standl.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia salvadorensis* Standl., *Journal of the Washington Academy of Sciences* 13(16): 367, 1923.  
Distribution: El Salvador.
- Isotrema salweenense*** (C.Y. Cheng & J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia salweenensis* C.Y. Cheng & J.S. Ma, *Acta Phytotaxonomica Sinica* 27(4): 295, 1989.  
Distribution: China: Yunnan.
- Isotrema scytophyllum*** (S.M. Hwang & D.Y. Chen) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia scytophylla* S.M. Hwang & D.Y. Chen, *Acta Phytotaxonomica Sinica* 19(2): 224, 1981.  
Distribution: China: Guangxi, Guizhou.

***Isotrema serpentarium*** (L.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia serpentaria* L., *Species Plantarum* 2: 961, 1753. ≡ *Endodeca serpentaria* (L.) Raf., *Medical Flora* 1: 62, 1828. ≡ *Pistolochia serpentaria* (L.) Raf., *Flora Telluriana* 4: 98, 1836.  
 = *Aristolochia polyrrhizos* Spreng., *Systema Vegetabilium, editio decima sexta* 3: 754, 1826.  
 = *Endodeca dodecandra* Raf., *Medical Flora* 1: 62, 1828.  
 = *Aristolochia officinalis* T. Nees, *Pl. Officin.* t. 144, 1830.  
 = *Endodeca bartonii* Klotzsch, *Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin* 1859: 600, 1859.  
 = *Endodeca polyrrhizos* (Spreng.) Klotzsch, *Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin* 1859: 601, 1859.  
 = *Aristolochia serpentaria* var. *hastata* (Nutt.) Alph. Wood, *A Class-book of Botany* ed. 2b: 602, 1861.  
 = *Aristolochia sagittata* Muhl. ex Duch., *Prodromus Systematis Naturalis Regni Vegetabilis* 15(1): 434, 1864.  
 = *Aristolochia serpentaria* var. *bartonii* (Klotzsch) Duch., *Prodromus Systematis Naturalis Regni Vegetabilis* 15(1): 433, 1864.  
 = *Aristolochia serpentaria* var. *laxa* Duch., *Prodromus Systematis Naturalis Regni Vegetabilis* 15(1): 434, 1864.  
 = *Aristolochia nashii* Kearney, *Bulletin of the Torrey Botanical Club* 21(11): 485, 1894.  
 = *Aristolochia convolvulacea* Small, *Bulletin of the Torrey Botanical Club* 24(7): 335, 1897.  
 = *Endodeca serpentaria* var. *hastata* (Nutt.) C.F. Reed, *Phytologia* 50: 461, 1982.  
 Distribution: North America: Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, West Virginia.

***Isotrema shimadae*** (Hayata) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia shimadae* Hayata, *Icones Plantarum Formosanarum nec non et Contributiones ad Floram Formosanam* 6: 36, 1916.  
 = *Aristolochia kaempferi* var. *trilobata* Franch. & Sav., *Enumeratio plantarum: in Japonia sponte crescentium hucusque rite cognitarum, adjectis descriptionibus specierum pro regione novarum, quibus accedit determinatio herbarum in libris japonicis So mokou zoussetz xylographice delineatarum* 1: 419, 1875.  
 = *Aristolochia kaempferi* f. *trilobata* (Franch. & Sav.) Makino, *Botanical Magazine, Tokyo* 24: 125, 1910.  
 = *Aristolochia onoei* Franch. & Sav. ex Koidz., *Acta Phytotaxonomica et Geobotanica* 8: 50, 1939.  
 Distribution: China: Taiwan; Japan.

***Isotrema singalangense*** (Korth. ex Ding Hou) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia singalangensis* Korth. ex Ding Hou, *Blumea* 29(1): 224, 1983.  
 Distribution: Indonesia.

***Isotrema sinoburmanicum*** (Y.H. Tan & B. Yang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia sinoburmanica* Y.H. Tan & B. Yang, *PhytoKeys* 94: 15, 2018.  
 Distribution: China: Yunnan; Myanmar.

***Isotrema stevensii*** (Barringer) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia stevensii* Barringer, *Novon* 3(4): 321, 1993.  
 Distribution: Nicaragua.

***Isotrema steyermarkii*** (Standl.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia steyermarkii* Standl., *Publications of the Field Museum of Natural History, Botanical Series* 22(5): 329, 1940.  
 Distribution: Guatemala.

***Isotrema tadungense*** (T.V. Do & T.H. Luu) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia tadungensis* T.V. Do & T.H. Luu, *Systematic Botany* 40(3): 677, 2015.  
 Distribution: Vietnam.

***Isotrema tanzawanum*** (Kigawa) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia kaempferi* var. *tanzawana* Kigawa, *Bulletin of the Kanagawa Prefectural Museum (Natural Sciences)* 18: 17, 1989. ≡ *Aristolochia tanzawana* (Kigawa) Watanabe-Toma & Ohi-Toma, *Journal of Japanese Botany* 89(3): 160, 2014.  
 Distribution: Japan.

***Isotrema thibeticum*** (Franch.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia thibetica* Franch., *Journal de Botanique (Morot)* 12(19–20): 313, 1898. ≡ *Aristolochia kaempferi* f. *thibetica* (Franch.) S.M. Hwang, *Acta Phytotaxonomica Sinica* 19(2): 230, 1981.

Distribution: China: Sichuan.

*Isotrema thwaitesii* (Hooker) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia thwaitesii* Hooker, *Curtis's Botanical Magazine* 82, pl. 4918, 1856. ≡ *Siphisia thwaitesii* (Hook.) Klotzsch, *Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin* 1859: 604, 1859. (For more details see Barringer, 1993).

Distribution: China: Guangdong, Hongkong.

*Isotrema tomentosum* (Sims) H. Huber, *Mitteilungen der Botanischen Staatssammlung München* 3: 550, 1960. ≡ *Aristolochia tomentosa* Sims, *Curtis's Botanical Magazine* 33: pl. 1369. 1811.

Distribution: North America: Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, Tennessee, Texas.

*Isotrema tongbiguanense* (J.Y. Shen, Q.B. Gong & S. Landrein) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia tongbiguanensis* J.Y. Shen, Q.B. Gong & S. Landrein, *Taiwania* 63(3): 183, 2018.

= *Aristolochia bhamoensis* T.V. Do & Jian W. Li, *Nordic Journal of Botany* 36(8): e01909, 2018, **syn. nov.**

Distribution: China: Yunnan; Myanmar.

*Isotrema tonkinense* (T.V. Do & S. Wanke) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia tonkinensis* T.V. Do & S. Wanke, *Systematic Botany* 40(3): 678, 2015.

Distribution: Vietnam.

*Isotrema transsectum* Chatterjee, *Kew Bulletin* 3(1): 64, 1948. ≡ *Aristolochia transsecta* (Chatterjee) C.Y. Wu ex S.M. Hwang, *Acta Phytotaxonomica Sinica* 19(2): 231, 1981.

Distribution: China: Yunnan; Myanmar.

*Isotrema tricaudatum* (Lem.) H. Huber, *Mitteilungen der Botanischen Staatssammlung München* 3: 551, 1960. ≡ *Aristolochia tricaudata* Lem., *L'illustration Horticole* 12: 97, 1865.

Distribution: Mexico; Mesoamerica.

*Isotrema utriforme* (S.M. Hwang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia utriformis* S.M. Hwang, *Acta Phytotaxonomica Sinica* 19(2): 228, 1981.

Distribution: China: Yunnan; Vietnam.

*Isotrema vallisicola* (T.L. Yao) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia vallisicola* T.L. Yao, *PhytoKeys* 14: 16, 2012.

Distribution: Malaysia.

*Isotrema veracruzanium* (J.F. Ortega) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia veracruzana* J.F. Ortega, *Biótica: Publicación del Instituto Nacional de Investigaciones sobre Recursos Bióticos, Xalapa* 12(3): 209, 1987.

Distribution: Mexico.

*Isotrema versicolor* (S.M. Hwang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia versicolor* S.M. Hwang, *Acta Phytotaxonomica Sinica* 19(2): 224, 1981.

Distribution: China: Yunnan.

*Isotrema wardianum* (J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia wardiana* J.S. Ma, *Acta Phytotaxonomica Sinica* 27(5): 348, 1989.

Distribution: India, Myanmar.

*Isotrema weixiense* (X.X. Zhu & J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia weixiensis* X.X. Zhu & J.S. Ma, *Phytotaxa* 230(1): 54, 2015.

Distribution: China: Yunnan.

*Isotrema westlandii* (Hemsl.) H. Huber, *Mitteilungen der Botanischen Staatssammlung München* 3: 551, 1960. ≡ *Aristolochia westlandii* Hemsl., *Journal of Botany, British and Foreign* 23(273): 286, 1885. ≡ *Hocquartia westlandii* (Hemsl.) Migo, *Bulletin of the Shanghai Science Institute* 14(4): 334, 1944.

Distribution: China: Guangdong, Hongkong.

*Isotrema wuanum* (Z.W. Liu & Y.F. Deng) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia wuana* Z.W. Liu & Y.F. Deng, *Novon* 19(3): 370, 2009. ≡ *Aristolochia macrocarpa* C.Y. Wu & S.K. Wu ex D.D. Tao, *Flora Xizangica* 1: 585, 1983, nom. illeg., non *Aristolochia macrocarpa* Duchartre, 1864.

Distribution: China: Xizang, Yunnan.

*Isotrema xuanlienense* (N.T.T. Huong, B.H. Quang & J.S. Ma) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia xuanlienensis* N.T.T. Huong, B.H. Quang & J.S. Ma, *Phytotaxa* 188(4): 176, 2014.

Distribution: Vietnam.

*Isotrema yujungianum* (C.T. Lu & J.C. Wang) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia yujungiana* C.T. Lu & J.C. Wang, *Taiwan Journal of Forest Science* 29(4): 293, 2014.

Distribution: China: Taiwan.

*Isotrema yunnanense* (Franch.) X.X. Zhu, S. Liao & J.S. Ma, **comb. nov.** ≡ *Aristolochia yunnanensis* Franch., *Journal de Botanique (Morot)* 12(19–20): 313, 1898.

Distribution: China: Yunnan.

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## References

- Adams, C.A., Baskin, J.M. & Baskin, C.C. (2005) Trait stasis versus adaptation in disjunct relict species: evolutionary changes in seed dormancy-breaking and germination requirements in a subclade of *Aristolochia* subgenus *siphisia* (Piperales). *Seed Science Research* 15: 161–173.  
<https://doi.org/10.1079/SSR2005207>
- Barringer, K. (1993) On *Aristolochia thwaitesii* Hooker (Aristolochiaceae). *Novon* 3: 321–323.  
<https://doi.org/10.2307/3391376>
- Barringer, K. (1997) *Aristolochia*. In: Flora of North America Editorial Committee (Eds.) *Flora of North America north of Mexico*. vol. 3. Oxford University Press, New York, pp. 45–50.
- Barringer, K. (2014) 94. Aristolochiaceae. In: Ulloa, C.U. (Ed.) *Flora Mesoamericana*, vol. 2 (3). Missouri Botanical Garden Press, St. Louis, pp. 1–17.

- Bentham, G. & Hooker, J.D. (1880) *Genera Plantarum*, vol. 3 (1). Reeve & Co, London, 459 pp.  
<https://doi.org/10.5962/bhl.title.747>
- Berjano, R., Roa, F., Talavera, S. & Guerra, M. (2009) Cytotaxonomy of diploid and polyploid *Aristolochia* (Aristolochiaceae) species based on the distribution of CMA/DAPI bands and 5S and 45S rDNA sites. *Plant Systematics and Evolution* 280: 219–227.  
<https://doi.org/10.1007/s00606-009-0184-6>
- Dechbumroong, P., Aumnouypol, S., Denduangboripant, J. & Sukrong, S. (2018) DNA barcoding of *Aristolochia* plants and development of species-specific multiplex PCR to aid HPTLC in ascertainment of *Aristolochia* herbal materials. *PLoS ONE* 13: e0202625.  
<https://doi.org/10.1371/journal.pone.0202625>
- Do, T.V. & Li, J.W. (2018) *Aristolochia bhamoensis* sp. nov. (Aristolochiaceae) and a diagnostic key to all known *A.* subgen. *Siphisia* species from Myanmar. *Nordic Journal of Botany* 38: e01909.  
<https://doi.org/10.1111/njb.01909>
- Do, T.V., Luu, T.H., Wanke, S. & Neinhuis, C. (2015b) Three new species and three new records of *Aristolochia* subgenus *Siphisia* from Vietnam including a key to the Asian species. *Systematic Botany* 40: 671–691.  
<https://doi.org/10.1600/036364415X689140>
- Do, T.V., Neinhuis, C. & Wanke, S. (2014b) New synonyms of *Aristolochia cambodiana* Pierre ex Lecomte (Aristolochiaceae). *Thai Forest Bulletin (Botany)* 42: 96–99.
- Do, T.V., Neinhuis, C. & Wanke, S. (2015a) A new species of *Aristolochia* subgenus *Siphisia* (Aristolochiaceae) from central Vietnam. *Phytotaxa* 220: 69–76.  
<https://doi.org/10.11646/phytotaxa.220.1.6>
- Do, T.V., Neinhuis, C. & Wanke, S. (2015c) Validation of the name *Aristolochia compressicaulis* and lectotypification of *A. championii* and *A. punjabensis* (Aristolochiaceae). *Phytotaxa* 221: 198–200.  
<https://doi.org/10.11646/phytotaxa.221.2.11>
- Do, T.V., Neinhuis, C. & Wanke, S. (2015d) Taxonomic notes on *Aristolochia dilatata* Brown from India: Lectotypification and a new synonym. *Bangladesh Journal of Botany* 44: 455–458.  
<https://doi.org/10.3329/bjb.v44i3.38554>
- Do, T.V., Nghiem, T.D., Wanke, S. & Neinhuis, C. (2014a) *Aristolochia quangbinhensis* (Aristolochiaceae), a new species from Central Vietnam. *PhytoKeys* 33: 51–59.  
<https://doi.org/10.3897/phytokeys.33.6094>
- Do, T.V., Truong, C.Q. & Huynh, H.T.T. (2017) *Aristolochia neinhuisii* (Aristolochiaceae), a new species from Vietnam. *Annales Botanici Fennici* 54: 203–208.  
<https://doi.org/10.5735/085.054.0602>
- Do, T.V., Vu, T.T.H., Luu, H.T. & Nguyen, T.T. (2019) *Aristolochia nuichuaensis* (subg. *Siphisia*, Aristolochiaceae), a new species, an updated key and a checklist to the species of *Siphisia* in Vietnam. *Annales Botanici Fennici* 56: 107–113.  
<https://doi.org/10.5735/085.056.0116>
- Do, T.V., Wanke, S. & Neinhuis, C. (2016) *Aristolochia bidoupsensis* sp. nov. from southern Vietnam. *Nordic Journal of Botany* 34: 513–516.  
<https://doi.org/10.1111/njb.01066>
- Duchartre, P. (1854) Tentamen methodicae divisionis generis *Aristolochia*, additis descriptionibus complurium novarum specierum novique generis *Holostylis*. *Annales des Sciences Naturelles*, 4a. Sér. 2: 29–76.
- Duchartre, P. (1864) Aristolochiaceae. In: Candolle, A.P. de (Ed.) *Prodromus systematis naturalis regni vegetabilis*, vol. 15. Masson, Paris, pp. 421–498.
- Dumortier, B.C.J. (1822) *Commentationes botanicae. Observations botaniques, dédiées à la Société d'Horticulture de Tournay*. Tournay: Imprimerie de Ch. Casterman-Dien., pp. [i]+116+[1], 1 tbl.
- Eberhard, F., Wolfgang, F. & Inge, T. (2015) *Syllabus of Plant Families A. Engler's Syllabus der Pflanzenfamilien Part 4: Pinopsida (Gymnosperms), Magnoliopsida (Angiosperms) p.p.: Subclass Magnoliidae [Amborellanae to Magnolianae, Lilliana p.p. (Acorales to Asparagales)]. Orchidaceae*. Bortraeger Science Publisher, Stuttgart, German, 495 pp.
- Editorial Committee of FRPS (2004) *Flora Reipublicae Popularis Sinicae* 1. Science Press, Beijing, 1044 pp.
- Farris, J.S., Källersjö, M., Kluge, A.G. & Bult, C. (1995a) Constructing a significance test for incongruence. *Systematic Biology* 44: 570–572.  
<https://doi.org/10.1093/sysbio/44.4.570>
- Farris, J.S., Källersjö, M., Kluge, A.G. & Bult, C. (1995b) Testing significance of incongruence. *Cladistics* 10: 315–319.  
<https://doi.org/10.1111/j.1096-0031.1994.tb00181.x>
- Goldblatt, P. & Johnson, D.E. (1991) Index to plant chromosome numbers for 1988–1989. *Monographs in Systematic Botany from the Missouri Botanical Garden* 30: 1–243.
- Gong, Q.B., Landrein, S., Xi, H.C., Ma, X.D., Yang, Z.H., He, K.W. & Shen, J.Y. (2018) *Aristolochia tongbiguanensis*, a new species of



- Aristolochiaceae from Yunnan, China. *Taiwania* 63: 183–187.
- González, F. & Stevenson, D.W. (2000) Gynostemium development in *Aristolochia* (Aristolochiaceae). *Botanische Jahrbücher für Systematik* 122: 249–291.
- González, F. & Stevenson, D.W. (2002) A phylogenetic analysis of the subfamily Aristolochioideae (Aristolochiaceae). *Revista de la Academia Colombiana de Ciencias Exactas* 26: 25–60.
- González, F. (1999) Inflorescence morphology and the systematics of Aristolochiaceae. *Systematics and Geography of Plants* 68: 159–172.  
<https://doi.org/10.2307/3668598>
- González, F. (2012) Florística y sistemática filogenética innecesariamente disyuntas: El caso de *Aristolochia*, *Euglypha* y *Holostylis* (Aristolochiaceae). *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 36: 193–202.
- González, F., Wagner, S.T., Salomo, K., Samain, M.S., Isnard, S., Rowe, N.K., Neinhuis, C. & Wanke, S. (2014) Present trans-Pacific disjunct distribution of *Aristolochia* subgenus *Isotrema* (Aristolochiaceae) was shaped by dispersal, vicariance and extinction. *Journal of Biogeography* 41: 380–391.  
<https://doi.org/10.1111/jbi.12198>
- Gregory, M.P. (1956) A phyletic rearrangement in the Aristolochiaceae. *American Journal of Botany* 43: 110–122.  
<https://doi.org/10.1002/j.1537-2197.1956.tb10472.x>
- Hansen, B. & Phuphatthaphong, L. (1999) Two new species of *Aristolochia* (Aristolochiaceae) from Thailand. *Nordic Journal of Botany* 19: 575–579.  
<https://doi.org/10.1111/j.1756-1051.1999.tb01141.x>
- Higgins, D.G., Thompson, J.D. & Gibson, T.J. (1994) Clustal W: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, position-specific gap penalties and weight matrix choice. *Nucleic Acids Research* 22: 4673–4680.  
<https://doi.org/10.1093/nar/22.22.4673>
- Hou, D. (1983) Florae Malesianae Praecursores LXV. Notes on Aristolochiaceae. *Blumea* 29: 223–249.  
<https://doi.org/10.3390/ijms18091839>
- Huang, Y.S., Peng, R.C., Tan, W.N., Wei, G.F. & Liu, Y. (2013) *Aristolochia mulunensis* (Aristolochiaceae), a new species from limestone areas in Guangxi, China. *Annales Botanici Fennici* 50: 175–178.  
<https://doi.org/10.5735/085.050.0308>
- Huang, Y.S., Peng, Y.D., Huang, B.Y., Lv, H.Z. & Lin, C.R. (2015) *Aristolochia gongchengensis* (Aristolochiaceae), a new species from the limestone areas in Guangxi, China. *Annales Botanici Fennici* 52: 396–400.  
<https://doi.org/10.5735/085.052.0522>
- Huber, H. (1960) Zur Abgrenzung der Gattung *Aristolochia* L. *Mitteilungen der Botanischen Staatssammlung München* 3: 531–553.
- Huber, H. (1985) Samenmerkmale und Gliederung der Aristolochiaceen. *Botanische Jahrbücher für Systematik* 107: 277–320.
- Huber, H. (1993) Aristolochiaceae. In: Kubitzki, K., Rohwer, J.G. & Bittrich, V. (Eds.) *The families and genera of vascular plants*. Springer, Berlin, pp. 129–137.  
[https://doi.org/10.1007/978-3-662-02899-5\\_10](https://doi.org/10.1007/978-3-662-02899-5_10)
- Hutchinson, J. & Dalziel, J.M. (1927) Aristolochiaceae. In: Hutchinson, J. & Dalziel, J.M. (Eds.) *Flora of west tropical Africa*, vol. 1. Crown Agents for the Colonies, London, pp. 75–78.
- Hwang, S.M. (1988) *Aristolochia* Linnaeus. In: Kiu, H.S. & Ling, Y.R. (Eds.) *Flora Reipublicae Popularis Sinicae* 24. Science Press, Beijing, pp. 199–245.
- Jaramillo, M.A. & Kramer, E.M. (2004) *APETALA3* and *PISTILLATA* homologs exhibit novel expression patterns in the unique perianth of *Aristolochia* (Aristolochiaceae). *Evolution and Development* 6: 449–458.  
<https://doi.org/10.1111/j.1525-142X.2004.04053.x>
- Kalyanamoorthy, S., Minh, B.Q., Wong, T.K.F., Haeseler, A.V. & Jermini, L.S. (2017) ModelFinder: fast model selection for accurate phylogenetic estimates. *Nature Methods* 14: 587–589.  
<https://doi.org/10.1038/nmeth.4285>
- Kelly, L.M. & González, F. (2003) Phylogenetic relationships in Aristolochiaceae. *Systematic Botany* 28: 236–249.
- Klotzsch, F. (1859) Die Aristolochiaceae des Berliner Herbariums. *Monatsberichte der Königlich Preussische Akademie des Wissenschaften zu Berlin* 1859: 571–626.
- Koichiro, T., Glen, S., Daniel, P., Alan, F. & Sudhir, K. (2013) MEGA6: Molecular Evolutionary Genetics Analysis Version 6.0. *Molecular Biology and Evolution* 30: 2725–2729.  
<https://doi.org/10.1093/molbev/mst197>
- Li, X.Q., Zuo, Y.J., Zhu, X.X., Liao, S. & Ma, J.S. (2019) Complete chloroplast genomes and comparative analysis of sequences evolution among seven *Aristolochia* (Aristolochiaceae) medicinal species. *International Journal of Molecular Sciences* 20: 1045.  
<https://doi.org/10.3390/ijms20051045>
- Linnaeus, C. (1753) *Species Plantarum* 2. Impensis Laurentii Salvii, Holmiae [Stockholm], pp. 561–1200.

- Liu, B., Ye, J.F., Liu, S., Wang, Y., Yang, Y., Lai, Y.J., Zeng, G. & Lin, Q.W. (2015) Families and genera of Chinese angiosperms: a synoptic classification based on APG III. *Biodiversity Science* 23: 225–231.  
<https://doi.org/10.17520/biods.2015052>
- Lu, C.T. & Wang, J.C. (2014) *Aristolochia yujungiana* (Aristolochiaceae): a new species from Taiwan. *Taiwan Journal of Forest Science* 29: 291–299.
- Ma, J.S. (1989) A revision of *Aristolochia* Linn. from E. & S. Asia. *Acta Phytotaxonomica Sinica* 27: 321–364.
- Mathews, S. & Donoghue, M.J. (2000) Basal angiosperm phylogeny inferred from duplicate phytochromes A and C. *International Journal of Plant Sciences* 161: S41–S55.  
<https://doi.org/10.1086/317582>
- Murata, J., Ohi-Thoma, T., Wu, S., Darnaedi, D., Sugawara, T., Nakanishi, T. & Murata, H. (2001) Molecular phylogeny of *Aristolochia* (Aristolochiaceae) inferred from *matK* sequences. *Acta phytotaxonomica et geobotanica* 52: 75–83.
- Neinhuis, C., Wanke, S., Hilu, K.W., Müller, K. & Borsch, T. (2005) Phylogeny of Aristolochiaceae based on parsimony, likelihood, and Bayesian analyses of *trnL-trnF* sequences. *Plant Systematics and Evolution* 250: 7–26.  
<https://doi.org/10.1007/s00606-004-0217-0>
- Nguyen, L.T., Schmidt, H.A., Von Haeseler, A. & Minh, B.Q. (2015) IQ-TREE: a fast and effective stochastic algorithm for estimating maximum-likelihood phylogenies. *Molecular Biology and Evolution* 32: 268–274.  
<https://doi.org/10.1093/molbev/msu300>
- Ohi-Toma, T. & Murata, J. (2016) Nomenclature of *Isotrema*, *Siphisia*, and *Endodeca*, and their related infrageneric taxa of *Aristolochia* (Aristolochiaceae), *Taxon* 65: 152–157.  
<https://doi.org/10.12705/651.11>
- Ohi-Toma, T., Sugawara, T., Murata, H., Wanke, S., Neinhuis, C. & Murata, J. (2006) Molecular phylogeny of *Aristolochia* sensu lato (Aristolochiaceae) based on sequences of *rbcL*, *matK*, and *phyA* genes, with special reference to differentiation of chromosome numbers. *Systematic Botany* 31: 481–492.  
<https://doi.org/10.1600/036364406778388656>
- Rafinesque, C.S. (1819a) Art. 3. The genera of North-American plants: and a catalogue of the species to the year. By Thomas Nuttall, F. L. S. & Co. 2 vols. 12mo. Philadelphia 1818. *American Monthly Magazine and Critical Review* 4: 184–196.
- Rafinesque, C.S. (1819b) Prodrome des nouveaux genres de plantes observés en 1817 et 1818 dans l'intérieur des États-Unis d'Amérique. *Journal de Physique, de Chimie, d'Histoire Naturelle et des Arts* 89: 96–107.
- Rafinesque, C.S. (1828) *Medical Flora; or, Manual of the medical botany of the United States of North America*, vol. 1. Atkinson & Alexander, Philadelphia, 268 pp.  
<https://doi.org/10.5962/bhl.title.524>
- Rafinesque, C.S. (1836) *Flora Telluriana* 2. Philadelphia, 112 pp.
- Rambaut, A. (2012) Figtree v1.4. Available from: <http://tree.bio.ed.ac.uk/software/figtree/> (accessed 9 April 2019)
- Rambaut, A., Suchard, M.A., Xie, D. & Drummond, A.J. (2014) Tracer v.1.6. Available from: <http://tree.bio.ed.ac.uk/software/tracer/> (accessed 9 April 2019)
- Ronquist, F. & Huelsenbeck, J.P. (2003) MrBayes 3: bayesian phylogenetic inference under mixed models. *Bioinformatics* 19: 1572–1574.  
<https://doi.org/10.1093/bioinformatics/btg180>
- Rozas, J., Sánchez-DelBarrio, J.C., Messeguer, X. & Rozas, R. (2003) Dnasp, dna polymorphism analyses by the coalescent and other methods. *Bioinformatics* 19: 2496–2497.  
<https://doi.org/10.1093/bioinformatics/btg359>
- Schmidt, O.C. (1935) Aristolochiaceae. In: Engler, A. & Prantl, K. (Eds.) *Die natürlichen Pflanzenfamilien*, vol. 2, 16B. Engelmann, Leipzig, pp. 204–242.
- Solereder, H. (1889) Aristolochiaceae. In: Engler, A. & Prantl, K. (Eds.) *Die natürlichen Pflanzenfamilien*, III (1). Engelmann, Leipzig, pp. 264–273.
- Stellari, G.M., Jaramillo, M.A. & Kramer, E.M. (2004) Evolution of the *APETALA3* and *PISTILLATA* lineages of MADS-box-containing genes in the basal angiosperms. *Molecular Biology and Evolution* 21: 506–519.  
<https://doi.org/10.1093/molbev/msh044>
- Sugawara, T. & Murata, J. (1992) Chromosome numbers of eight species of *Aristolochia* (Aristolochiaceae) from East Asia. *Acta Phytotaxonomica Et Geobotanica* 43: 27–30.
- Swofford, D.L. (2002) *PAUP\*: phylogenetic analysis using parsimony (\*and other methods) Version 4*. Sinauer Associates, Sunderland.
- Wagner, S.T., Isnard, S., Rowe, N.P., Samain, M.-S., Neinhuis, C. & Wanke, S. (2012) Escaping the lianoid habit: Evolution of shrub-like growth forms in *Aristolochia* subgen. *Isotrema* (Aristolochiaceae). *American Journal of Botany* 99: 1609–1629.  
<https://doi.org/10.3732/ajb.1200244>
- Wanke, S., González, F. & Neinhuis, C. (2006) Systematics of pipevines: Combining morphological and fast-evolving molecular charac-

- ters to investigate the relationships within subfamily Aristolochioideae (Aristolochiaceae). *International Journal of Plant Sciences* 167: 1215–1227.  
<https://doi.org/10.1086/508024>
- Wanke, S., Jaramillo, M., Borsch, T., Samain, M., Quandt, D. & Neinhuis, C. (2007) Evolution of Piperales - *matK* gene and *trnK* intron sequence data reveal lineage specific resolution contrast. *Molecular Phylogenetics and Evolution* 42: 477–497.  
<https://doi.org/10.1016/j.ympev.2006.07.007>
- Watanabe, K., Kajita, T. & Murata, J. (2006) Chloroplast DNA variation and geographical structure of the *Aristolochia kaempferi* group (Aristolochiaceae). *American Journal of Botany* 93: 442–453.  
<https://doi.org/10.3732/ajb.93.3.442>
- Watanabe, K., Ohi-Toma, T. & Murata, J. (2008) Multiple hybridization in the *Aristolochia kaempferi* group (Aristolochiaceae): Evidence from reproductive isolation and molecular phylogeny. *American Journal of Botany* 95: 885–896.  
<https://doi.org/10.3732/ajb.2007331>
- White, T., Bruns, T., Lee, S. & Taylor, J. (1990) Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. *PCR Protocols* 38: 315–322.  
<https://doi.org/10.1016/B978-0-12-372180-8.50042-1>
- Wu, L., Xu, W.B., Huang, Y.S. & Liu, Y. (2015) *Aristolochia longlinensis* (Aristolochiaceae), a new species from Western Guangxi, China. *Novon* 23: 490–493.  
<https://doi.org/10.3417/2011105>
- Wu, L., Xu, W.B., Wei, G.F. & Liu, Y. (2013) *Aristolochia huanjiangensis* (Aristolochiaceae), a new species from Guangxi, China. *Annales Botanici Fennici* 50: 413–416.  
<https://doi.org/10.5735/085.050.0608>
- Wu, Z.Y., Lu, A.M., Tang, Y.C., Chen, Z.D. & Li, D.Z. (2003) *The Families and Genera of Angiosperms in China, a Comprehensive Analysis*. Science Press, Beijing, 1209 pp.
- Wu, Z.Y., Sun, H., Zhou, Z.K., Li, D.Z. & Peng, H. (2011) *Floristics of Seed Plants from China*. Science Press, Beijing, 485 pp.
- Wu, Z.Y., Zhou, Z.K., Sun, H., Li, D.Z. & Peng, H. (2006) *The Areal -Types of Seed Plants and Their Origin and Differentiation*. Yunnan Science & Technology Press, Kunming, 566 pp.
- Xu, H., Li, Y.D., Yang, H.J. & Chen, H.Q. (2011) Two new species of *Aristolochia* (Aristolochiaceae) from Hainan Island, China. *Novon* 21: 285–289.  
<https://doi.org/10.3417/2009116>
- Yang, B., Ding, H.B., Zhou, S.S., Zhu, X.X., Li, R., Mya, B.M. & Tan, Y.H. (2018) *Aristolochia sinoburmanica* (Aristolochiaceae), a new species from north Myanmar. *PhytoKeys* 94: 13–22.
- Yao, T.L. (2012) *Aristolochia vallisicola* (Aristolochiaceae), a new species from Peninsular Malaysia. *PhytoKeys* 14: 15–22.  
<http://dx.doi.org/10.3897/phytokeys.14.3354>
- Zhou, J.G., Chen, X.L., Cui, Y.X., Sun, W., Li, Y.H., Wang, Y., Song, J.Y. & Yao, H. (2017) Molecular structure and phylogenetic analyses of complete chloroplast genomes of two *Aristolochia* medicinal species. *International Journal of Molecular Sciences* 18: 1839.
- Zhu, X.X., Liao, S., Zhang, L., Wang, Z.H., Du, C. & Ma, J.S. (2016) The taxonomic revision of Asian *Aristolochia* (Aristolochiaceae) I: Confirmation and illustration of *A. austroszechuanica*, *A. faucimaculata* and *A. yunnanensis* var. *meionantha* from China. *Phytotaxa* 261: 137–146.  
<https://doi.org/10.11646/phytotaxa.261.2.3>
- Zhu, X.X., Zhang, L., Hua, Z.X., Chen, G.F., Liao, S. & Ma, J.S. (2015) *Aristolochia weixiensis*, a new species of Aristolochiaceae from Yunnan, China. *Phytotaxa* 230: 54–60.
- Zhu, X.X., Liao, S., Sun, Z.P., Zhen, A.G. & Ma, J.S. (2017a) The taxonomic revision of Asian *Aristolochia* (Aristolochiaceae) II: Identities of *Aristolochia austroyunnanensis*, *A. dabieshanensis* and *A. hyperxantha*—a new species from Zhejiang, China. *Phytotaxa* 313: 61–76.  
<https://doi.org/10.11646/phytotaxa.313.1.4>
- Zhu, X.X., Liao, S., Ma, Z.X., Xu, B., Wang, Z.H., Wang, Y. & Ma, J.S. (2017b) The taxonomic revision of Asian *Aristolochia* (Aristolochiaceae) III: Two new taxa of *Aristolochia* and morphological revision for the flower character of *A. obliqua* from Yunnan, China. *Phytotaxa* 332: 269–279.  
<https://doi.org/10.11646/phytotaxa.332.3.3>
- Zhu, X.X., Liao, S., Liu, J.N., Zhang, C. & Ma, J.S. (2018a) The taxonomic revision of Asian *Aristolochia* (Aristolochiaceae) IV: lectotypification. of *A. caulialata*, with a new species from Yunnan, China—*A. pseudocaulialata*. *Phytotaxa* 364: 49–60.  
<https://doi.org/10.11646/phytotaxa.364.1.2>
- Zhu, X.X., Shen, B., Sun, Z.P., Chen, B., Liao, S. & Ma, J.S. (2018b) Two new species of *Aristolochia* (Aristolochiaceae) from Yunnan, China. *Novon* 26: 298–306.

**APPENDIX** List of taxa used in phylogenetic analyses, with voucher information and GenBank accession numbers. For each sample, GenBank accession numbers are given in the order of (a) *petB-petD*, (b) *rps16-trnK*, (c) *phyA* and (d) *ITS2*. Sequences generated in Wagner *et al.* (2012), Ohi-Toma *et al.* (2006) and Mathews & Donoghue (2000) are retrieved from Genbank and marked with asterisk (\*). Missing sequence is represented by a dash (-).

**Taxon; Voucher specimen (Herbarium); Accession numbers**

***Aristolochia* L. subgenus *Siphisia***

*Aristolochia arborea* Linden: Zhu X.X. ZXX17098 (CSH), (a) MK619036, (b) MK619175, (c) MK619107, (d) MK618951;

*Aristolochia asclepiadifolia* Brandegee: Isnard *et al.* 04 (MEXU, DR), (a) JX485533\*, (b) JX485473\*;

*Aristolochia austroszechuanica* C.P. Tsien & C.Y. Cheng ex C.Y. Cheng & J.L. Wu: Zhu & Hua. ZH044 (CSH), (a) MK618982, (b) MK619139, (c) MK619067, (d) MK618905;

*Aristolochia balansae* Franch.: Deng & Ma. DM6764 (CSH), (a) MK619057, (b) MK619193, (c) MK619124, (d) MK618970;

*Aristolochia californica* Torr.: Ma. MJS201218 (CSH), (a) MK619012, (b) MK619158, (c) MK619086, (d) MK618930;

*Aristolochia caulialata* C.Y. Wu ex J.S. Ma & C.Y. Cheng: Zhu. ZXX16058 (CSH), (a) MK619018, (b) MK619161, (c) MK619092, (d) MK618936;

*Aristolochia chiapensis* J. Ortega & R. Ortega: Samain *et al.* 2009-288 (MEXU, DR), (a) JX485528\*, (b) JX485468\*;

*Aristolochia compressicaulis* Z.L. Yang: Zhu & Hua. ZH076 (CSH), (a) MK618987, (b) MK619142, (c) MK619069, (d) MK618909;

*Aristolochia cucurbitifolia* Hayata.: Wang. E2144 (CSH), (a) MK619007, (b) MK619154, (c) MK619085, (d) MK618928; Wang. E2155 (CSH), E2155, (a) MK619009, (b) MK619155;

*Aristolochia dabieshanensis* C.Y. Cheng & W. Yu: Zhu. ZXX16018 (CSH), (a) MK619006, (b) MK619153, (c) -, (d) MK618927;

*Aristolochia fangchi* Y.C. Wu ex L.D. Chow & S.M. Hwang: Zhu & Hua. ZH008 (CSH), (a) MK618974, (b) MK619131, (c) -, (d) MK618898;

*Aristolochia faucimaculata* Hao Zhang & C.K. Hsieh: Zhu & Hua. ZH042 (CSH), (a) MK618981, (b) MK619138, (c) MK619066, (d) MK618904;

*Aristolochia faviogonzalezii* T.V. Do, S. Wanke & C. Neinhuis: Zhu. ZXX16063 (CSH), (a) MK619019, (b) MK619162, (c) MK619093, (d) MK618937;

*Aristolochia forrestiana* J.S. Ma: Zhu & Hua. ZH074 (CSH), (a) MK618992, (b) MK619146, (c) MK619074, (d) MK618913;

*Aristolochia fulvicoma* Merr. & Chun: Zhu *et al.* ZXX16041 (CSH), (a) MK619014, (b) MK619160, (c) MK619088, (d) MK618932;

*Aristolochia gongchengensis* Y.S. Huang, Y.D. Peng & C.R. Lin: Liao. E2264 (CSH), (a) MK619030, (b) MK619169, (c) MK619102, (d) MK618945;

*Aristolochia griffithii* Hook. f. & Thomson ex Duch.: Deng. DM5381 (CSH), (a) MK619048, (b) MK619184, (c) MK619119, (d) MK618963;

*Aristolochia hainanensis* Merr.: Wang. WZH004 (CSH), (a) MK619050, (b) MK619186, (c) MK619121, (d) MK618965; Wang. WZH002 (CSH), E737, (a) MK619049, (b) MK619185, (c) MK619120, (d) MK618964;

*Aristolochia hainanensis* subsp. *yingjiangensis* X.X. Zhu & J.S. Ma: Zhu. ZXX16052 (CSH), (a) MK619017, (b) -, (c) MK619091, (d) MK618935;

*Aristolochia hei* sp. nov. ined.: Zhu. ZXX18064 (CSH), (a) MK619044, (b) MK619180, (c) MK619116, (d) MK618960;

*Aristolochia heterophylla* Hemsl.: Zhu & Liao. ZH119 (CSH), (a) MK618998, (b) MK619150, (c) MK619080, (d) MK618919;

*Aristolochia howii* Merr. & Chun: Wang. WZH010 (CSH), (a) MK619051, (b) MK619187, (c) MK619122, (d) MK618966;

*Aristolochia huanjiangensis* Yan Liu & L. Wu: Zhu. ZXX17010 (CSH), (a) MK619024, (b) MK619165, (c) MK619096, (d) MK618941;

*Aristolochia hyperxantha* X.X. Zhu & J.S. Ma: Zhu. ZXX1408001 (CSH), (a) MK619058, (b) MK619194, (c) MK619128, (d) MK618971; Zhu, Ding & Yu. ZH099 (CSH), (c) MK619078, (d) -;



*Aristolochia impudica* J.F. Ortega: C. Granados 486 (MEXU, DR), (a) JX485531\*, (b) JX485471\*;  
*Aristolochia involuta* X.X. Zhu, Z.X. Ma & J.S. Ma: Zhu. ZXX17003 (CSH), (a) MK619020, (b) MK619163, (c) MK619094, (d) MK618938;  
*Aristolochia kaempferi* Willd.: Wang. WY01 (CSH), (a) MK619031, (b) MK619170, (c) MK619103, (d) MK618946; Wang. WY05 (CSH), (c) -, (d) MK618948;  
*Aristolochia kalebii* Beutelisp.: Samain *et al.* 2009-276 (MEXU, DR), (a) JX485534\*, (b) JX485474\*;  
*Aristolochia kunmingensis* C.Y. Cheng & J.S. Ma: Wang. WZH019 (CSH), (a) MK619054, (b) MK619190, (c) MK619126, (d) MK618968;  
*Aristolochia kwangsiensis* W.Y. Chun & F.C. Liang: Zhu & Hua. ZH013 (CSH), (a) MK618976, (b) MK619132, (c) MK619062, (d) MK618900;  
*Aristolochia liukuensis* Hatusima: Zhu. ZXX17102 (CSH), (a) MK619040, (b) MK619176, (c) MK619111, (d) MK618955;  
*Aristolochia macrophylla* Lam.: Ma. E2028 (CSH), (a) MK618991, (b) MK619145, (c) MK619073, (d) MK618912;  
*Aristolochia manshuriensis* Komarov.: Ma. MJS201608 (CSH), (a) MK619010, (b) MK619156; Wang. WY06 (CSH), E2269, (a) MK619033, (b) MK619172, (c) MK619105, (d) MK618949;  
*Aristolochia melanocephala* X.X. Zhu & J.S. Ma: Zhu. ZXX17046 (CSH), (a) MK619028, (b) MK619167, (c) MK619100, (d) MK618943;  
*Aristolochia meionantha* (Hand.-Mazz.) X.X. Zhu & J.S. Ma: Zhu & Hua. ZH086 (CSH), (a) MK618995, (b) MK619149, (c) MK619076, (d) MK618916;  
*Aristolochia mollis* Dunn.: Chen. GBJ02612 (CSH), (a) MK619013, (b) MK619159, (c) MK619087, (d) MK618931;  
*Aristolochia mollissima* Hance: Wang. WZH020 (CSH), (a) MK619055, (b) MK619191, (c) MK619127, (d) MK618969;  
*Aristolochia moupinensis* Franch.: Zhu & Hua. ZH046 (CSH), (a) MK618984, (b) MK619141, (c) -, (d) MK618907;  
*Aristolochia mulunensis* Y.S. Huang & Yan Liu: Huang & Peng. ML1425, (a) MK619023, (b) MK619164;  
*Aristolochia neolongifolia* J.L. Wu & Z.L. Yang: Zhu & Hua. ZH045 (CSH), (a) MK618983, (b) MK619140, (c) MK619068, (d) MK618906; Zhu & Hua. ZH077 (CSH), (a) MK618993, (b) MK619147, (c) -, (d) MK618914;  
*Aristolochia obliqua* S.M. Hwang: Wang. WZH012 (CSH), (a) MK619052, (b) MK619188, (c) MK619123, (d) MK618967;  
*Aristolochia panamensis* Standl.: Jiang. E2262 (CSH), (a) MK619029, (b) MK619168, (c) MK619101, (d) MK618944;  
*Aristolochia petelotii* O.C. Schmidt: Deng & Ma. DM6763 (CSH), (a) MK619056, (b) MK619192; Sun. ZXX18017 (CSH), (c) MK619115, (d) MK618959;  
*Aristolochia pilosistyla* X.X. Zhu & J.S. Ma: Zhu. ZXX17014 (CSH), (a) MK619025, (b) MK619166, (c) MK619097, (d) MK618942;  
*Aristolochia pseudocaulialata* X.X. Zhu, J.N. Liu & J.S. Ma: Zhu. ZXX16047 (CSH), (a) MK619015, (b) -, (c) MK619089, MK618933;  
*Aristolochia pseudohowii* *sp. nov.* ined.: Zhu & Hua. ZH015 (CSH), (a) MK618977, (b) MK619133, (c) MK619063, (d) MK618901;  
*Aristolochia pseudotriformis* *sp. nov.* ined.: Zhu. ZXX18074 (CSH), (a) MK619045, (b) MK619182, (c) MK619117, (d) MK618961;  
*Aristolochia pseudofulvicoma* *sp. nov.* ined.: Zhu & Wang. ZXX18076 (CSH), (a) MK619046, (b) MK619183, (c) MK619118, (d) MK618962;  
*Aristolochia reflexa* *sp. nov.* ined.: Zhu. ZXX17018 (CSH), (a) MK619043, (b) MK619181, (c) MK619114, (d) MK618958;  
*Aristolochia saccata* Wall.: Asa (TI), (c) AB353527\*, (d) -;  
*Aristolochia salvadorensis* Standl.: Zhu. ZXX17096 (CSH), (a) MK619034, (b) MK619173;  
*Aristolochia sanyaensis* *sp. nov.* ined.: Zhu & Li. ZXX17105 (CSH), (a) MK619041, (b) MK619177; Zhu & Li. ZXX17106 (CSH), (a) MK619042, (b) MK619178, (c) MK619112, (d) MK618956;  
*Aristolochia shimadae* Hayata.: Hu. ZH102 (CSH), (a) MK618973, (b) MK619130, (c) MK619060, (d) MK618897;  
*Aristolochia tanzawana* (Kigawa) Watanabe-Toma & Ohi-Toma: Wang. WY03 (CSH), (a) MK619032, (b) MK619171, (c) MK619104, (d) MK618947;  
*Aristolochia tomentosa* Sims.: 75/Taschkent 699 (DR), (a) JX485529\*, (b) JX485469\*; Sugawara *et al.* SETS77



(T1), (c) AB206938\*, (d) -; Ma. E2191 (CSH), (a) MK619011, (b) MK619157;  
*Aristolochia transsecta* (Chatterjee) C.Y. Wu ex S.M. Hwang: Wang. WZH015 (CSH), (a) MK619053, (b) MK619189, (c) MK619125, (d) -;  
*Aristolochia tricaudata* Lem.: Zhu. ZXX17097 (CSH), (a) MK619035, (b) MK619174, (c) MK619106, (d) MK618950;  
*Aristolochia utrififormis* S.M. Hwang: Deng & Liu. DM6824 (CSH), (a) MK619001, (b) MK619151, (c) -, (d) MK618922; Deng & Liu. DM6825 (CSH), (a) MK619002, (b) MK619152, (c) MK619083, (d) MK618923;  
*Aristolochia veracruzana* J.F. Ortega: Samain *et al.* 2009-295 (MEXU, DR), (a) JX485535\*, (b) JX485475\*;  
*Aristolochia versicolor* S.M. Hwang: Huang & Lin. CZ1474, (a) MK619021, (b) -, (c) MK619095, (d) MK618939;  
*Aristolochia wardiana* J.S. Ma: Ma. MJS97343 (CSH), (a) -, (b) MK619179, (c) MK619113, (d) MK618957;  
*Aristolochia weixiensis* X.X. Zhu & J.S. Ma: Zhu & Hua. ZH084 (CSH), (a) MK618994, (b) MK619148, (c) MK619075, (d) MK618915;  
*Aristolochia westlandii* Hemsl.: Wang. E1070 (CSH), (a) MK618978, (b) MK619134; Ma. E2027 (CSH), (a) MK618990, (b) MK619144, (c) MK619072, (d) MK618911;  
*Aristolochia xuanlienensis* N.T.T. Huong, B.H. Quang & J.S. Ma: Do. HN-NY430, (a) MK618988, (b) MK619143, (c) MK619070, (d) MK618910;  
*Aristolochia yangii* *sp. nov.* ined.: Zhu & Hua. ZH028 (CSH), (a) MK618980, (b) MK619135, (c) MK619065, (d) MK618903;  
**Endodeca**  
*Aristolochia serpentaria* L.: Neinhuis 112 (DR), (a) JX485527\*, (b) JX485467\*; (c) -, (d) -;  
**Aristolochia L. subgenus *Aristolochia***  
*Aristolochia albida* Duch.: Liu. ZH107, (a) MK618997, (b) -, (c) MK619079, (d) MK618918;  
*Aristolochia austrochinensis* C.Y. Cheng & J.S. Ma: Zhu. ZXX17025 (CSH), (a) MK619026, (b) -, (c) MK619098, (d) -;  
*Aristolochia chlamydophylla* C.Y. Wu ex S.M. Hwang: Zhu. ZXX16050 (CSH), (a) MK619016, (b) -, (c) MK619090, (d) MK618934;  
*Aristolochia contorta* Bunge.: Xie. 15-JF-10 (CSH), (a) MK618989, (b) -, (c) MK619071, (d) -;  
*Aristolochia debilis* Siebold & Zuccarini.: Wang. WZH023 (CSH), (a) MK619059, (b) -, (c) MK619129, (d) MK618972;  
*Aristolochia delavayi* Franchet.: Ma. MA0005 (CSH), (a) MK619004, (b) -, (c) -, (d) MK618925;  
*Aristolochia fimbriata* Cham.: Zhu & Liao. ZH124 (CSH), (a) MK619000, (b) -, (c) MK619082, (d) MK618921;  
*Aristolochia fujianensis* S.M. Hwang: Zhu. ZXX17036 (CSH), (a) MK619027, (b) -, (c) MK619099, (d) -;  
*Aristolochia gentilis* Franchet.: Ma. MA0006 (CSH), (a) MK619005, (b) -, (c) -, (d) MK618926;  
*Aristolochia gigantea* Mart.: Zhu. ZXX17099 (CSH), (a) MK619037, (b) -, (c) MK619108, (d) MK618952;  
*Aristolochia grandiflora* Sw.: Zhu. ZXX17101 (CSH), (a) MK619039, (b) -, (c) MK619110, (d) MK618954;  
*Aristolochia impressinervis* C.F. Liang: Huang & Lin. CZ1545, (a) MK619022, (b) -, (c) -, (d) MK618940;  
*Aristolochia odora* Steud.: Zhu. ZXX17100 (CSH), (a) MK619038, (b) -, (c) MK619109, (d) MK618953;  
*Aristolochia ringens* Vahl.: Zhu & Liao. ZH121 (CSH), (a) MK618999, (b) -, (c) MK619081, (d) MK618920;  
*Aristolochia tagala* Chamisso.: Wang. E1071 (CSH), (a) MK618979, (b) -, (c) MK619064, (d) MK618902;  
*Aristolochia trilobata* L.: Wang. E2149 (CSH), (a) MK619008, (b) -, (c) -, (d) MK618929;  
*Aristolochia tuberosa* C.F. Liang & S.M. Hwang: Zhu & Hua. ZH053 (CSH), (a) MK618985, (b) -, (c) -, (d) MK618908;  
*Aristolochia tubiflora* Dunn.: Zhu & Hua. ZH096 (CSH), (a) MK618996, (b) -, (c) MK619077, (d) MK618917;  
*Aristolochia zhongdianensis* J.S. Ma: Ma. MA0004 (CSH), (a) MK619003, (b) -, (c) MK619084, (d) MK618924;  
*Aristolochia zollingeriana* Miquel.: Zhu & Hua. ZH011 (CSH), (a) MK618975, (b) -, (c) MK619061, (d) MK618899;  
**Aristolochia L. subgenus *Pararistolochia***  
*Aristolochia promissa* Mast.: Neinhuis, 118 (DR, BONN), (a) JX485525\*, (b) JX485465\*; (c) AB206947\*; (d) -;  
**Aristolochiaceae, subfamily *Asaroideae***  
*Asarum caudigerellum* C.Y. Cheng & C.S. Yang: Zhu & Hua. ZH057 (CSH), (a) MK618986, (b) MK619137;  
*Asarum yakusimense* Masam.: Murata *et al.* s.n. (TI), (c) AB206949\*, (d) -;  
*Saruma henryi* Oliv.: Lu. E2322 (CSH), (a) MK619047, (b) MK619136; Murata *et al.* SETS36 (TI), (c) AF190104\*, (d) -.