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Molecular phylogenetic and morphological analyses of the traditional tribe Coriandreae (Umbelliferae-Apioideae)

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Abstract

All eight genera (*Coriandrum, Bifora, Fuernrohria, Schrenkia, Schtschurowskia, Kosopoljanskia, Lipskya* and *Sclerotiaria*) of the tribe Coriandreae (Umbelliferae), delimited on the basis of morphological characters, were studied using molecular systematic methods to check the monophyly of the tribe. Plastid *psb*A-*trn*H data contained very little information and were incongruent with nrDNA data. The nrDNA analyses clearly showed that the tribe Coriandreae consists of three separate groups, differing in their sequences of ITS and ETS of nuclear ribosomal DNA. Only *Bifora* appears to be closely related to *Coriandrum*, whereas *Fuernrohria* falls into tribe Careae, and the five remaining taxa, endemic or subendemic to Middle Asia, form a separate clade, informally named the "*Schrenkia* clade". The species of *Kosopoljanskia* do not form a monophyletic clade, being scattered in molecular trees among the *Schrenkia* species. *Kosopoljanskia* and *Schrenkia* are regarded as congeneric. One new species is described and two new nomenclatural combinations are proposed.

Key words: Nuclear markers, taxonomy, molecular phylogeny, new species, *Schrenkia*, Coriandreae

Introduction

The rather small tribe Coriandreae W.D.J. Koch was recognized in the first tribal classification of the family (Koch, 1824). Initially, Coriandreae numbered two genera, *Coriandrum* L. (1753: 256) and *Bifora* Hoffm. (1816: 191). Drude (1897–98) enlarged the tribe to include two additional genera, *Fuernrohria* K. Koch (1842: 356) and *Schrenkia* Regel & Schmalh. (1877: 606). Koso-Poljansky (1916a) recognized three genera in Coriandrinae (*Coriandrum*, *Anidrum* [nom. illeg.] and *Schtschurowskia* Regel & Schmalh. (1882: 40) and regarded *Fuernrohria* as a closely related genus (Koso-Poljansky, 1916b). He recognized two subgenera in *Coriandrum*, namely *Fuernrohria* and (Eu) *Coriandrum*, and two subgenera in *Anidrum*, namely *Schrenkia* and *Bifora*. Independently, Hiroe (1979) also attributed *Schrenkia* to *Bifora*, probably based on the didymous fruit form. Korovin (1923, 1962) described two new genera, *Kosopoljanskia* Korovin (1925: 19) and *Sclerotiaria* Korovin (1962: 243), and Nevski (1937) an additional new genus, *Lipskya* Nevski (1937: 271). All three are from mountainous regions of Middle Asia (Tian-Schan and Pamiro-Alaj).

In order to provide a complete critical revision of the tribe Coriandreae, the following opinions which are now seemingly rather obsolete, may be noted. For instance, *Schrenkia vaginata* was described in *Cachrys* L. (1753: 246) (Ledebour, 1829), and *S. golickeana* in *Daucus* L. (1753: 242) (Regel & Schmalhausen, 1878). Bentham (1867) put *Coriandrum* and *Bifora* into Caucalideae, and included *Schrenkia* in *Hippomarathrum* or, at least, treated it as the closest relative. Boissier (1872) and Koso-Poljansky (1914) attributed *Fuernrohria* to Smyrnieae, and Baillon (1879) regarded *Coriandrum* as part of Careae. Hiroe (1979) placed *Schrenkia papillaris* and *Lipskya insignis* in *Hippomarathrum.*

The systematics of *Schrenkia*, the largest genus of the tribe, appears to be problematic in several respects. The description of some species (*S. involucrata*, *S. papillaris*, *S. golickeana* and *S. pungens*), during the early stages of making an inventory of the Middle Asian flora, has been criticized by Lipsky (1904) for the incorrect identification of several specimens. In his "Revisio monographica" of *Schrenkia* (pp. 158–169), he changed the nomenclature of some species, proposed new names and noted some interspecific transitional forms. Later Koso-Poljansky (1920) attempted

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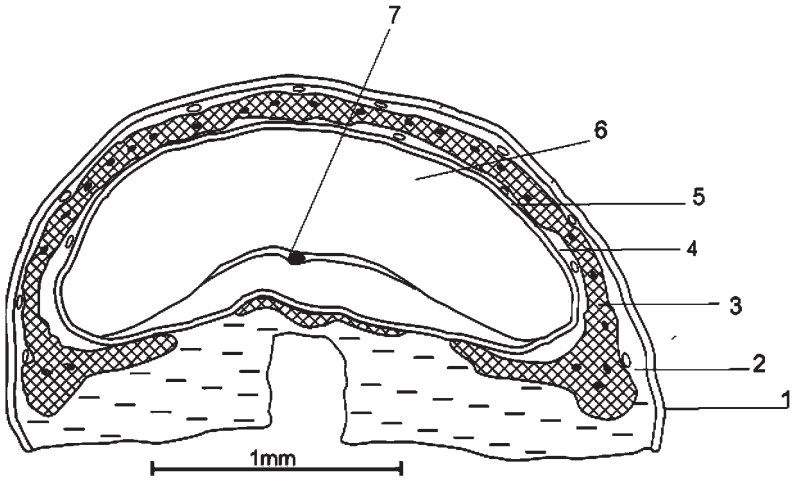

FIGURE 9. Schematic transverse sections of mericarp of *Schrenkia alaica* Pimenov (Pimenov *et al.* 503, MW), drawn from Pimenov, Vasilieva et Lavrova 503.1 = exocarp; 2 = outer layer of mesocarp; 3 = middle (sclerenchymatous) layer of mesocarp; 4 = inner layer of mesocarp; 5 = endocarp; 6 = endosperm; 7 = vascular bundle of funicle; scale bar = 1mm.

Conclusions

Monophyly does not exist in yet another tribe of the Umbelliferae. It seems clear that the tribe Coriandreae should be treated in a considerably narrower sense (with two genera—*Coriandrum* and *Bifora*). This paradoxically agrees with Koch's first Umbelliferae classification of 1824. *Fuernrohria* should probably be placed in the compound group ("supertribe") Apieae, partly corresponding to the molecular tribe Careae. The Middle Asian clade of genera closely related to *Schrenkia*, which share many morphological characters, merits separation as an independent "*Schrenkia* clade". One new species is described and two new nomenclatural combinations are proposed.

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http://dx.doi.org/10.1002/fedr.19210170827

Appendix

Species names and GenBank accession numbers of DNA sequences used in this study. Voucher data is given for accessions for which DNA sequences were newly obtained, using the following format: Taxon name, country, area, *collector(s)* and *collector number*, herbarium acronym, nr, GenBank accession numbers.
**,* New sequences generated for this study.

Aciphylla congesta Cheeseman, EU886819; ***Aegokeras caespitosa*** (Sm.) Rat. Turkey, Uludak, *Pimenov & Kljuykov 370* (MW), *JF807579, *JF807559, *JF807527, *F807605; ***Aegopodium kashmiricum*** (R.R. Stewart ex Dunn) Pimenov, AF077872; ***Aegopodium podagraria*** L., Russia, Moscow, MSU, Bot. Gard., *Zaharova*, s.n., JF807569, JF807549, JF807503, EU445714; ***Ammi majus*** L., U78386, U78446; ***Angelica sylvestris*** L., HQ256681; ***Angelica tatianae*** Bordz., AF008610, AF009089; ***Anisosciadium isosciadium*** Bornm., EU169244; ***Anisotome aromatica*** Hook. f., U78360, U78420; ***Apium graveolens*** L., FJ986043; ***Arafoe aromatica*** Pimenov & Lavrova, AF077874; ***Aulacospermum anomalum*** (Ledeb.) Ledeb., AF008641, AF009120; (1) ***Bifora radians*** M. Bieb., Frankreich, Dep. Alpes-de-Haute-Provence, *Nydegger 30610* (MW), *JF807570, *JF807550, *JF807505, *JF807589; ***Bifora radians*** M. Bieb., U78408, U78468; ***Bifora testiculata*** (L.) Spreng., Turkey, Gaziantep, Kızılhisar dere, *Davis 28034* (ANK), *JF807571, *JF807551, *JF807506, *JF807590; ***Bilacunaria microcarpa*** (M. Bieb.) Pimenov & V.N. Tikhom., Iran, prov. Tehran, Alborz Mts., *Pimenov et al. 86* (MW), AY941265, AY941293, *JF807507, *JF807591; ***Bunium bulbocastanum*** L., HE602464; ***Bunium latilobum*** Korovin, Tadzhikistan, E. slope Kojki-Tau ridge, *Pimenov et al. 656* (MW), DQ435224, DQ435263, *JF807508, *EU445736; ***Cachrys cristata*** DC., Turkey, Burdur, Salda lake, *Pimenov & Kljuykov 64* (MW), JF807572, JF807552, JF807509, JF807592; ***Cachrys libanotis*** L., Portugal, Erag, *Pimenov 489* (MW), JF807573, JF807553, JF807510, JF807593; (1) ***Carum carvi*** L., Russia, Moscow, MSU, Bot. Gard., *Zaharova*, s.n., AF077878, JF807511, DQ457171; ***Carum carvi*** L., U78377, U78437; ***Caucalis platycarpos*** L., U78364, U78424; ***Cicuta virosa*** L., AY524766; (1) ***Coriandrum sativum*** L., Israel, Lower Galilee, Alonim, *Grizi &*