

CHAPTER 7

Taxonomical Conclusions of the Kickxellales

7.1 TAXONOMICAL CONCLUSIONS

In this chapter, I emend the Kickxellales and propose a new classification system of the order by integrating morphological grouping (chapter 4), observation of septal ultrastructures (chapters 5), and rDNA sequence analyses (chapter 6). The three groups of the Kickxellales based on morphology were supported by the latter two methods. Thus, the Kickxellales were divided into three groups by all the methods employed in the present study. These three groups are mutually distinct from each other, and also independent of any other fungal groups including the Dimargaritales and the Harpellales. Therefore, these groups should be regarded as independent orders each of which consists of a single family.

In conclusion, the Kickxellales *sensu lato* (*s. l.*) should be divided into the following three orders: Kickxellales *sensu stricto* (*s. str.*), Spiromycetales (tentative name), and Ramicandelaberales (tentative name). Historically, Benjamin (1963) and Ogawa et al. (2001) stretched out the range of the Kickxellales when they described *Spiromyces* and *Ramicandelaber*, respectively. By this treatment, the range of the Kickxellales recurs to the original one, and the opinion of O'Donnell et al. (1998) that the *Spiromyces* should be taxonomically separated from the other members of the order is realized.

7.2 DIAGNOSES OF THE ORDERS AND FAMILIES

In the following part, the order Kickxellales and the family Kickxellaceae will be emended, and new orders and families: Spiromycetales (tentative name) and Spiromycetaceae (tentative name), and Ramicandelaberales (tentative name) and Ramicandelaberaceae (tentative name) will be described.

7.2.1 Emendation of the Kickxellales and the Kickxellaceae

Order Kickxellales Kreisel ex R. K. Benj. The whole fungus. The sexual-asexual synthesis, vol. 2. National Museum of Natural Science, National Museums of Canada, and the Kananaskis Foundation, Ottawa. p. 610. 1979.

Family Kickxellaceae Linder, Farlowia 1: 56. 1943.

1. Genus *Kickxella* Coem., Bulletin de la Société Royale de Botanique de Belgique 1: 155. 1862.

2. Genus *Martensella* Coem., Bulletin de l'académie Royale de Botanique Belgique Sér. 2. 15: 540. 1863.
3. Genus *Coemansia* Tiegh. & G. Le Monn., Annales des Sciences Naturelles. Botanique Sér. 5. 17: 392. 1873.
4. Genus *Linderina* Raper & Fennell, American Journal of Botany 39: 81. 1952.
5. Genus *Martensiomycetes* Meyer, Bulletin Trimestriel de la Société Mycologique de France 73: 190. 1957.
6. Genus *Spirodactylon* R. K. Benj., Aliso 4: 408. 1959.
7. Genus *Dipsacomycetes* R. K. Benj., Aliso 5: 15. 1961.
8. Genus *Myconymphaea* Kurihara, Degawa & Tokumasu, Mycological Research 105: 1398. 2001.

Order Kickxellales Kreisel ex R. K. Benj. 1979. emend. Kurihara, Degawa, Ogawa & Tokumasu 2002

Fungi mostly saprobic or weakly parasitic, nonhaustorial. Vegetative body of branched, septate hyphae giving rise to septate, branched or unbranched sporangiophores. Septa with median disciform cavities containing biconvex or biumbonate plugs that are persistent in dilute alkali. Asexual reproduction by unispored sporangia borne on monosporic pseudophialides arising from globoid to elongate, septate or nonseptate sporocladia. Plural pseudophialides formed on a sporocladial cell. Sexual reproduction by zygospores. Zygospores nearly globose, smooth, without surface ornamentation, and containing several to many globules.

*: Emended parts are emphasized with bold type.

Family Kickxellaceae Linder 1943. emend. Benjamin 1959. emend. Kurihara, Degawa, Ogawa & Tokumasu 2002

Vegetative mycelium submerged, consisting of delicate, hyaline, branched, thin-walled, regularly septate hyphae. Sporangiophores white or light-colored, erect or ascending, simple or branched, septate, forming septate or aseptate sporiferous branchlets (sporocladia) bearing deciduous unispored sporangia on small, hyaline, ovoid or elongate-ellipsoid, monosporic, nondeciduous cells (pseudophialides). Plural pseudophialides formed on a sporocladial cell.

Sporangiole wall delicate. Sporangiospores simple, hyaline or yellowish, ovoid, elongate-ellipsoid, or fusoid, enveloped in liquid at maturity or remaining dry. Septa of both the vegetative and fruiting hyphae characteristically with median disciform cavities containing biconvex or biumbonate plugs. Zygosporangia formed the fusion of similar hyphae, thick-walled, hyaline or yellowish, smooth, without surface ornamentation, containing several to many globules.

*: Emended parts are emphasized with bold type.

7.2.2 Description of the Spiromycetales (tentative name) and the Spiromycetaceae (tentative name)

Order Spiromycetales (tentative name)

Family Spiromycetaceae (tentative name)

1. Genus *Spiromyces* R. K. Benj., Aliso 5: 273. 1963.
2. Genus *Mycoemilia* (tentative name)

Spiromycetales (tentative name)

Hyphae vegetativae septatae. Sporophora septata, simplicia vel furcata, recta vel spiralia, sporocladia lateraliter vel in apice ferenti. Sporocladia eseptata, sporas per gemmationem formantia. Sporae globosae vel fusiformes, siccae vel humectatae. Zygosporae globosae, punctulatae, cum muro crasso, globulum continentes.

Vegetative hyphae septate. Sporophores septate, branched or unbranched, straight or spiral, producing sporocladia laterally or apically. Sporocladia aseptate, producing spores by budding. Spores globose to fusiform, wet or dry at maturity. Zygosporangia spherical, punctulate, thick-walled, containing a globule.

Spiromycetaceae (tentative name)

Hyphae vegetativae septatae. Sporophora septata, simplicia vel furcata, recta vel spiralia, sporocladia lateraliter vel in apice ferenti. Sporocladia eseptata, sporas per gemmationem formantia. Sporae globosae vel fusiformes, siccae vel humectatae. Zygosporae globosae, punctulatae, cum muro crasso, globulum continentes.

Vegetative hyphae septate. Sporophores septate, branched or unbranched, straight or spiral, producing sporocladia laterally or apically. Sporocladia aseptate, producing spores by budding. Spores globose to fusiform, wet or dry at maturity. Zygosporangia spherical, punctulate, thick-walled, containing a globule.

7.2.3 Description of the Ramicandelaberales (tentative name) and the Ramicandelaberaceae (tentative name)

Order Ramicandelaberales (tentative name)

Family Ramicandelaberaceae (tentative name)

1. Genus *Ramicandelaber* Ogawa, Hayashi, Degawa & Yaguchi, Mycoscience 42: 193.

Ramicandelaberales (tentative name)

Hyphae vegetativae septatae. Sporophora erecta, septata, rami fertiles ferentia. Rami fertiles sporocladia efferentes. Sporocladia aseptata, pseudophialidem formantia. Pseudophialides sporangiola efferentes. Sporae tenui-fusiformes, humectatae.

Vegetative hyphae septate. Sporophores erect, septate, producing fertile branches. Fertile branches bearing sporocladia. Sporocladia aseptate, producing pseudophialides. Pseudophialide producing a spore. Spores slender fusiform, wet at maturity.

Ramicandelaberaceae (tentative name)

Hyphae vegetativae septatae. Sporophora erecta, septata, cum rhizoideis, ramos fertiles ferentia. Rami fertiles sporocladia efferentes. Sporocladia aseptata, pseudophialidem formantia. Pseudophialides sporas ferentes in collis. Sporae tenui-fusiformes, humectatae.

Vegetative hyphae septate. Sporophores erect, septate, with rhizoids, producing fertile branches. Fertile branches bearing sporocladia. Sporocladia aseptate, producing pseudophialides. Pseudophialide producing a spore on the neck. Spores slender fusiform, wet at maturity.