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Note on the taxonomy of *Frenkelia microti* (Findlay & Middleton, 1934) (Apicomplexa: Sarcocystidae)

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Abstract

Based on biological, morphological and molecular data, species of *Frenkelia* Biocca, 1968 should be reclassified within the genus *Sarcocystis* Poche, 1913. This taxonomic change leads to the secondary homonymy of *S. microti* (Findlay & Middleton, 1934) n. comb. and *S. microti* Dubey, 1983. The recently suggested conspecificity and consequent synonymy of *S. microti* (Findlay & Middleton, 1934) and *S. buteonis* (Henry, 1932) is not really justifiable and thus *S. microti* (Findlay & Middleton, 1934) should be considered a valid species. *S. jaypeedubeyi* nom. nov. is, therefore, proposed as a *nomen novum* for *S. microti* Dubey, 1983 to alleviate the problem of this secondary homonymy.

Introduction

The frenkelias are heteroxenous coccidia (Apicomplexa: Sarcocystidae: Sarcocystinae) circulating between buzzards (*Buteo* spp.) and rodents, as definitive and intermediate hosts respectively (Krampitz & Rommel, 1977; Rommel & Krampitz, 1975; Upton & Mckown, 1992). Both existing species of *Frenkelia* Biocca, 1968 differ in the morphology of their brain cysts and their intermediate host spectrum. Rounded cysts of *F. glareoli* (Erhardová, 1955) are found in the brain of voles of the genus *Clethrionomys* Tilesius, while lobulate *F. microti* (Findlay & Middleton, 1934) cysts infect a wide range of rodents but mainly the field vole *Microtus arvalis* (Pallas) (see Dubey et al., 1989). The life-cycle of *Frenkelia* spp. does not differ from that of related species of *Sarcocystis* Poche, 1913, with birds of prey as final hosts, except that infective cysts in the intermediate host develop in the rodent brain rather than in the muscles. The taxonomy of frenkelias is rather complex and recent attempts to solve the problem have appeared in the literature (Odening, 1997, 1998). The main aim of our contribution is to review some persisting inconsistencies in the taxonomy of these parasites and to offer a taxonomic solution that is fully in accord with recent phylogenetic advances as well as with the rules of zoological nomenclature.

The problem

Toxoplasma microti Findlay & Middleton, 1934 was first found in the brain of the short-tailed field vole *Microtus agrestis* from Wales. Although the name was erected solely on the basis of being found in a new host, lobulate cysts seen in histological sections suggest conspecificity with other isolates found subsequently in the brains of the *Microtus* spp. In 1953, the parasite was found in the meadow vole *Microtus modestus* Baird (currently a subspecies of *M. pennsylvanicus* Ord) in Montana, USA, and referred to as the 'M-organism' (Frenkel, 1953). Only in 1968, was the generic name *Frenkelia* erected by Biocca in

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order to distinguish the species from other heteroxenous coccidia (Biocca, 1968). The second species, *T. glareoli* Erhardová, 1955, was described from the brain smear of a bank vole *Clethrionomys glareolus* in Czechoslovakia and transferred to *Frenkelia* several years later (Erhardová, 1955; Tadros et al., 1972).

The results of analyses of small and large subunit ribosomal ribonucleic acid gene sequences are inconsistent with the division of the Sarcocystinae Poche, 1913 into the genera *Frenkelia* and *Sarcocystis* Poche, 1913 and have cast doubt on the validity of *Frenkelia* (see Mugridge et al., 1999; Votýpka et al., 1998). These results, which analysed the phylogenetic relationships of *Sarcocystis* spp. and *Frenkelia* spp., strongly support the synonymy of these genera.

Historically, several authors have noted the morphological similarity of *Frenkelia* with *Sarcocystis* and have suggested their synonymy (Černá, 1978; Šebek, 1962). Recently, the congeneric status of species of *Frenkelia* and *Sarcocystis* was pointed out in reviews on the biology and systematics of *Sarcocystis* by Odening (1997, 1998). In an attempt to prevent problems causes by the potential homonymy between *F. microti* (Findlay & Middleton, 1934) and *S. microti* Dubey, 1983 (see below), Odening (1998) synonymised *F. microti* (Findlay & Middleton, 1934) with *Isospora buteonis* Henry, 1932. The latter species was originally described from the Nearctic raptors *Buteo borealis* (Gmelin), *B. swainsoni* Bonaparte and *Accipiter cooperi* (Bonaparte), and from an owl *Asio flammeus* (Pontoppidan). The description was based solely on the morphology of oöcysts/sporocysts found in the intestinal contents (Henry, 1932). It is not doubted that *I. buteonis* actually represents a heteroxenous *Sarcocystis*, even though its life-cycle is not known. However, sporogonial stages of *Sarcocystis* spp. are morphologically extremely uniform and, as such, cannot be used for the proper diagnosis of a species (*inter alia* Dubey et al., 1989; Upton et al., 1992). Moreover, in the original description, *I. buteonis* was reported from four different hosts, and it is probable that the taxon itself, as defined by Henry (1932), includes more species of sarcosporidia. Based on these facts, *I. buteonis* should be regarded as a *species inquirenda* and its conspecificity with *F. microti* (Findlay & Middleton, 1934), as suggested by Odening (1997, 1998), is purely speculative. Then, the proposed synonymy of both names is not really justifiable and thus *F. microti* (Findlay & Middleton 1934) should be considered a valid species.

The solution

In view of the above, the reclassification of *Frenkelia microti* and its transfer to *Sarcocystis* leads to the secondary homonymy of *S. microti* (Findlay & Middleton, 1934) n. comb. with *S. microti* Dubey, 1983. The latter species becomes a junior secondary homonym (ICZN, 1999: Art. 53.3, Art. 57.3). According to the ICZN "a junior homonym must be rejected and replaced either by an available and potentially valid synonym or, for a lack of such a name, by a new substitute name" (ICZN, 1999: Art. 60.1.). *S. microti* Dubey, 1983 was described from a Nearctic vole, *Microtus pensylvanicus,* based on the ultrastructure of muscular stages (Dubey, 1983), and, as far as we are aware, there are no available synonyms. Thus, the following taxonomic solution for the above-mentioned homonymy is proposed in accord with the rules of the zoological nomenclature. *Sarcocystis jaypeedubeyi* nom. nov. is proposed as a replacement name for *S. microti* Dubey, 1983, which is pre-occupied by, and thus a secondary homonym of, *S. microti* (Findlay & Middleton, 1934) n. comb. The speciesis named for Dr J.P. Dubey, who first recognised and described this taxon.

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