

## TAXONOMIC STATUS OF SEVERAL SIBLING SPECIES – PARASITES IN MAN AND IN OTHER VERTEBRATES

F. Tenora

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### Abstract

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The taxonomic status of several related species pairs of sibling species character is discussed. They are the following pairs:

- 1) *Ascaris lumbricoides* L., 1758; *A. suum* Goeze, 1782;
- 2) *Rodentolepis nana* (Siebold, 1852); *R. fraterna* (Stiles, 1906);
- 3) *Hymenolepis flavopunctata* (Weinland, 1858); *H. diminuta* (Rudolphi, 1819).

*Homo*, free living and domestic Vertebrata, parasites, *Ascaris suum*, *A. lumbricoides*, *Rodentolepis nana*, *R. fraterna*, *Hymenolepis flavopunctata*, *H. diminuta*

During the 18th and first of all during the 19th century, a number of parasitic worm species, parasitizing man, were described. Subsequently, mostly during the same centuries, several new parasitic species – parasites free living or domestic vertebrates were described of no significantly valuable morphological characters, by which they could be differentiated from the species described previously in man. This situation led several authors to the opinion that in such cases, an interchange between man and free living or domestic vertebrates occurs. The references and literature below indicate that there is no uniform opinion on these problems. Several authors assign to such parasitic worms a wide specificity, others assign to them a strict specificity (mostly limited to one host species). The study submitted provides a set of opinions on 6 parasitic worms (see their names within the Abstract), and it states their taxonomic appurtenance on the present status.

### MATERIAL AND METHOD

The material and method were published in the following studies: BAER, J.; TENORA, F. (1970); BARUŠ, V. et al. (1975); MURAI, É., TENORA, F. (1975); POVOLNÝ, D., TENORA, F.

(1966); RYŠAVÝ, B. et al. (1976); TENORA, F. (1963a, b, 1965, 2002); TENORA, F., BARUŠ, V. (1955); TENORA, F., KULLMANN, E. (1970); TENORA, F., MURAI, É. (1970, 1972); TENORA, F., STANĚK, M. (1994); TENORA, F., TOMÁNEK, J. (1963); TENORA, F. et al. (1994, 1998, 2004a, b, c).

### RESULTS AND DISCUSSION

The selected species discussed belong to 2 families: Ascarididae and Hymenolepididae.

#### 1. Ascarididae

*Ascaris lumbricoides* (parasite in man); *A. suum* (parasite in mammals of the family Suidae).

The recent study Loreille and Bouchet (2003) stated, similarly as formerly Ansel and Thibaud (1973): “Generally, the adults of *Ascaris suum* and *A. lumbricoides* can be identified according to morphological and biochemical criteria”. But a more recent communication by Tenora et al. (2004c) excludes the statement that morphological characters can be used for differentiation between *A. suum* and *A. lumbricoides*. By far more reliable method for distinguishing *A. suum* and *A. lumbricoides* is variation in the ribosomal and

mitochondrial DNA (Anderson, 1995; Anderson and Janicke, 1997; Anderson et al., 1995; Le et al., 2000; Peng et al., 1998, 2004; Zhu et al., 1999). However also at using the DNA method Anderson's (1995) comment has to be respected: „Although no diagnostic markers have been found which distinguish between individual worms of human or pig origin, the two host-associated worm populations are distinguished by very different frequencies of mitochondrial haplotypes and alleles at a variety of nuclear loci (Anderson et al., 1993), Anderson, 1994“.

The trated facts that the species *A. suum* (parasite in pigs), also parasitizes man, are not always documented credibly and they are different. For example, to the specialist public, known are not hitherto unsuccessful experiments, when Prof. Lýsek (Medicine Faculty in Olomouc, Czech republic) did not succeed to infect himself with ascarid eggs of the genus *Ascaris* from pigs not even repeatedly (personal communication by Ass. Prof. Chalupský, 2000, Charles University, Prague, Czech republic). On the contrary, the study Anderson and Janicke (1997) reports that it was succeeded experimentally to infect several volunteers with invasive eggs of ascarids from the genus *Ascaris* from pigs. The latter results support the opinion by Anderson et al. (1995) that „A small fraction of the parasite population, cycling normally in pigs, may contain rare alleles (perhaps for genes encoding surface molecules or allergens) which allow them to become established in humans. On the other hand, data are absent that could document that possible is (even only experimentally) the infection of pigs by the genus *Ascaris* eggs from man.

The above results sooner support the idea that in the case of *A. lumbricoides* and *A. suum* two species bonae of sibling species character are concerned. They document that infection of man by the species *A. suum* is entirely extraordinary. The latter statement is documented by the results by Anderson, (1995) from Northern America: „The molecular data incriminate pigs as the source of infection in the N. American cases“. Similar communications can be documented from Afganistan, where more than 86 % of the human population is infected by the species *A. lumbricoides* (Povolný a Tenora, 1966; Ryšavý et al., 1976).

## 2. Hymenolepididae

*Rodentolepis nana* (parasite in man): *R. fraterna* (parasite in mammals of the order Rodentia).

More than 100 years, specialists are engaged in the problem, whether in the case of *Rodentolepis nana* and *R. fraterna*, two or one species are concerned. Often one also meets with the statement that several tapeworm species from the family Hymenolepididae have as their definitive hosts both man and rodents

(Coombs and Crompton, 1991, and others). This opinion reflects the hypothesis published by Joyeux and Baer (1929) that „... most of rarer species of tapeworms occurring in man are probably parasites of other mammals, especially of Rodentia“. Especially in the species highly related, of course, there are no complex objective bases, which would either support or argue against the above hypothesis.

The difficulty of how to document convincingly the problem suggested above consists in the controverse taxonomic and long-term discussed approach to *R. nana* and *R. fraterna*. The species *R. nana* was described as a parasite of man under the name *Taenia nana* Siebold, 1852 and by Stiles (1906) (in lit.) arranged into the genus *Hymenolepis* Weinland, 1858. Later on, the species *T. nana* was transferred into a number of the genera (see the review in Tenora, 2004).

The species *R. fraterna* was described originally as a parasite of rodents under the name *Hymenolepis fraterna* Stiles, 1906, and later on, similarly as *R. nana*, it was transferred into various genera of the family Hymenolepididae. At the present, accepted is commonly the arrangement of the species *T. nana* and *H. fraterna* in the genus *Rodentolepis* Spassky, 1954 (see Vaucher, 1994). The situation was greatly complicated in the past by Spassky (1954), who establishing the genus *Rodentolepis* nov. gen. and its type species *R. straminea* (Goeze, 1782), transferred among its synonyms not only *Hymenolepis nana*, but also *Hymenolepis fraterna*. This opinion was trated with different modifications up to 1970, when Baer and Tenora (1970) proved that *H. nana* and *H. fraterna* do not belong among synonyms of *R. straminea*. Since that time (except for several authors e.g. Ryzhikov et al., 1978), one meets more frequently with previously traded and later ad adopted opinion that *R. nana* and *R. fraterna* are bona species (Skrjabin and Matevosjan, 1948; Baer in Baer and Tenora, 1970; Hunkeler, 1974; Tenora, 2002; Tenora et al., 2004a, b; Macnish et al., 2002; and others).

The development of the species *R. fraterna* is realized through interhosts (Arthropoda), but also without an interhost and also with an interhost; under European conditions, the first case is more frequent. Experiments by Macnish et al. (2002) proved a failure to infect laboratory rodent hosts with human isolates of *Rodentolepis nana*. Known are no data on the possibility of to infect experimentally man with the species *R. fraterna*, but the infection with some other species of the genus *Rodentolepis* is not excluded (Macnish et al., 2003). *R. fraterna* populations parasitize both free living rodents and rodents in captivity; *Rodentolepis nana* populations parasitize most often among children collectives (schools, nurseries), uncommonly also in individuals. Biological and ecological

data favorize sooner bona species both in the case of *R. nana* and *R. fraterna*. For the exact determination of both species, indispensable are examinations using DNA that have been absent hitherto (Mariaux, 1998).

*Hymenolepis diminuta* (parasite in mammals of the order Rodentia): *H. flavopunctata* (parasite in man)

In contrast to *R. nana*, the species *Taenia diminuta* described from rats has changed its generic status only once, namely into *Hymenolepis* Weinland, 1858. On the structure of the species constituting the genus *Hymenolepis*, there is no uniform opinion López-Neyra, 1942a, b; Spassky, 1954; Yamaguti, 1959; Mas-Coma et al., 1980; Burt, 1980; Schmit, 1986, and others. So far species are concerned, one can agree with Spassky (1954) that *H. megaloon* Linstow, 1901 (see Spassky, 1954; Tenora and Murai, 1972; Tenora and Baruš, 1972) and *H. ognevi* Skrjabin, 1924 (see Spassky, 1954) are valid species in the genus *Hymenolepis*. On the other hand by the establishment of the genus *Arostrilepis* Mas-Coma et Tenora, 1997, the species *H. horrida* and its related species have to be excluded from the genus *Hymenolepis* (Mas-Coma and Tenora, 1997; Kontrimavichus and Smirnova, 1991; Tenora et al., 1994; Asakawa et al., 2002). So far hosts are concerned, mammals of the family Gliridae (Tenora, 1965) and rodents from the genus *Apodemus* (Montgomery et al., 1987; Ishih et al., 2003; Tenora, 2004; Tenora et al., 1994; Tenora and Staněk, 1994), have to be excluded from their list. With a great probability, mammals of the orders Carnivora and Insectivora are not hosts of the parasite *H. diminuta* (cf. The review by Burt, 1980). As well the erroneously drawn scolex of the species *H. diminuta* in the publications by Skrjabin and Matevosjan (1948) and Spassky (1954) has to be removed – rostrum is absent.

The problem, indicating that the species *H. diminuta* is a parasite of man (Edelman et al., 1965 and review in Burt, 1980) deserves a wholly species chapter.

Burt (1980), who reports the findings of *H. diminuta* in most details, also states that the species *H. diminuta* has 28 synonyms and 100 host species (prevailing rodents, and including man). The same author writes moreover that: „Records of *H. diminuta* from humans are scattered widely in the literature ...“, and further: „Although over 200 cases of human infection have been reported (Turner, 1975)“. Tenora (2002) and Tenora et al. (2004a,b) excluded the species *Hymenolepis flavopunctata* (Weiland, 1858), the parasite of man, from synonyms of the species *H. diminuta*. In such way, they have approached to the opinion by Skrjabin and Matevosjan (1948), who report the species *H. diminuta* only as the parasite of rodents.

They have also approached to the communication by Mas-Coma et al. (1980), who draw attention to that under the name *H. diminuta* a complex of more species is reported in the literature, Tenora (2002), and Tenora et al. (2004a,b) did not adopt with their opinion the ancient idea by Blanchard (1891) or Grassi and Rovelli (in lit.) (traded generally up to nowadays) that the species *H. flavopunctata* is a synonym of *H. diminuta*. As well, the opinion was doubted that tapeworms of the genus *Hymenolepis* which possess unarmed scolex and parasitize rodents and man, belong to single species, namely to *H. diminuta* (see below). Below, we also report reasons which either negate or confirm the idea that the species *H. flavopunctata* is bona species.

- A) Support of the opinion that the species *H. flavopunctata* is a synonym of the species *H. diminuta*
  - 1) Related morphological and anatomical characteristics (Burt, 1980; López-Neyra, 1942, and others)
  - 2) Experimentally possible is the infection of rodents by tapeworms *H. diminuta* from man (Burt, 1980)
  - 3) The hypothesis by Joyeux and Baer (1929) that „... most of the rarer species of tapeworms occurring in man are probably parasites of other mammals, especially of Rodentia ...“
- B) Support of the opinion that the species *H. flavopunctata* is not synonym of the species *H. diminuta*
  - 1) Taxonomic category of sibling species for the species given (Tenora et al., 2004a)
  - 2) Experimental verification is absent from the literature on parasitization by the tapeworm *H. diminuta* from rodent in man
  - 3) The species *H. diminuta* was distinguished into other species parasitizing rodents, e.g. *H. hibernia* Montgomery, J., Montgomery, I., Dunn, T. S., 1987; *H. pseudodiminuta* Tenora, Asakawa, Kamiya, 1994; and *Hymenolepis* sp. Nickisch-Roseneck, Lucius, Loos-Frank, 1999. The first two species were verified at the level of species bona using the biological, physiological and experimental methods (Montgomery et al., 1987; Ishih et al., 2003). *Hymenolepis* sp. was defined using DNA (Nickisch-Roseneck et al., 1999).
  - 4) Differences in distribution prevalence. The species *H. diminuta* is a frequent commonly known parasite of rodents in Europe, and as the parasite of man, it is reported 2 times, namely according to the findings of eggs (Burt, 1980); it is absent in the review of parasites in man by Joyeux and Baer (1936) and by Skrjabin and Matevosjan (1948). The species *H. flavopun-*

*ctata* (in the literature under the name *H. diminuta*) parasitizes man, first of all in advancing countries; there *H. diminuta* has much more lower prevalence in rodents (Burt, 1980).

Concluding we state that to confirm or argue against the idea that the species *H. flavopunctata* is

not a synonym of the species *H. diminuta*, is possible to do only on a new material of tapeworms from man, and by comparison with the species *H. diminuta* from rodents at the level of DNA (Nickisch-Roseneck et al., 1999).

## SOUHRN

Taxonomický status několika sibling species – parazitů člověka a jiných obratlovců

Práce podporuje taxonomickou kategorii sibling species pro několik druhů a čeledí Ascarididae a Hymenolepididae, parazitujících u člověka a jiných obratlovců. Jsou jimi dvojice druhů:

1. *Ascaris lumbricoides* L., 1758, cizopasník člověka: *A. suum* Goeze, 1782, cizopasník prasatovitých,
2. *Rodentolepis nana* (Siebold, 1852), cizopasník člověka: *R. fraterna* (Stiles, 1906), cizopasník hlodavců,
3. *Hymenolepis flavopunctata* (Weinland, 1858), cizopasník člověka: *H. diminuta* (Rudolphi, 1819), cizopasník hlodavců.

člověk, domácí a volně žijící obratlovci, parazité, sibling species

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#### Address

Prof. RNDr. František Tenora, DrSc., Ústav zoologie, rybářství, hydrobiologie a včelařství, Mendelova zemědělská a lesnická univerzita v Brně, 613 00 Brno, Česká republika