On the subgenera of the fungus genus Zoophthora Batko 1964 (Entomophthoraceae)

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The genus Zoophthora Batko (1964 a) is a relatively extensive widely differentiated taxonomic group. At present this genus is composed of the species described up to 1964 as belonging to the genera Empusa Cohn, Entomophthora Fresenius non Nowakowski and Entomophthora auct. non Fresenius sensu Nowakowski (Batko 1964 b). There are in all about 35 species the type species Zoophthora radicans (Brefeld) Batko (1964 a) included. Moreover two new species of Zoophthora have been recently described: Z. vomitoriae Rozsypal (1966) and Z. phalloides Batko (1966).

The intrageneric differentiation of the Zoophthora species is, in spite of the distinct relationships between them, quite pronounced. All the species have characteristic uninucleate conidia with a double membrane and ramified conidiophores, and they exhibit the ability of fixing the host's body on the substrate by means of rhizoids. The primary conidia of Z. radicans, and related species, however, differ from those of Z. aphidis and related fungi by their shape and the tendency of its variation as well as by the plasma structure and nucleus shape. The same may be said of the rhizoids which in some species are thread like, unbranched and gathered in bundles, and in others massive, frequently ramified, ending in a large „foot” often of complex structure. Also the structure of the pseudocystides in various Zoophthora species is varied: in some they are distended and have shapes specific to the given species, in others they are thin and their structure is nonspecific or else they are absent.

The last distinctive trait of the Zoophthora species is the structure of secondary conidia. In most species they are of the same shape and type (according to L a k o n’s classification, 1919) as the primary ones, but in Z. radicans, Z. phalloides and Z. occidentalis anadhesispores (lemonshaped dry conidia) formed on capillary secondary conidiophores have been found. The ability of forming anadhesispores indicates a relationships of this group of Zoophthora species to the genus Triplo-
sporium (Thaxter) Batko (1964 a) and to some species of the genus Conidiobolus Brefeld (1884) mostly described by Drechsler and not quoted here.

All the above named traits specific to the particular groups of Zoophthora species are distinctly correlated. For instance the formation of anadhesive spores is typical of species with thread-like rhizoids aggregated in pseudorhizomorphs, and enlarged pseudocystides of complex structure occur always with single thick rhizoids, however deproved of a distinctly shaped „foot”. After separating on this basis the genus Zoophthora into four subgenera, the author established that three of them consist of species parasitizing on members of the four basic groups of insects being hosts of entomophthoraceous fungi: Homoptera, Coleoptera, Diptera and Lepidoptera. On insects of each of the enumerated orders so far at least one species of each of three basic subgenera of Zoophthora was found. This seems to suggest that the subgenera proposed are in a large extent „natural” and objectively correspond to the existing groups of species formed by way of adaptation to parasitism on insects from three related ancestral species. This has convinced the author of the usefullness of distinguishing several subgenera within the genus Zoophthora. In this connection the following names and diagnoses are proposed:

Zoophthora subg. Zoophthora
(Figs 1—3)


Primary conidia elongated: cylindrical, oval or fusiform, with homogenous hyaline plasma generally without large vacuoles or robust granules; nucleus elongated frequently visible in unstained spores, stains much more intensively with cotton blue in lactophenol than plasma, according to Lakon’s (1919) classification the conidia belong to the typus papillata or turbinata. Secondary conidia similar to primary ones or anadhesispores. Pseudocystides thin, not thicker than conidiophores or absent. Rhizoids thin, threadlike, unbrached, not widened at ends, aggregated in pseudorhizomorphs.
Figs 1—10. Morphology of *Zoophthora* spp. 1, 2 — conidia of subgenus *Zoophthora* members; 3 — cluster of rhizoids of *Zoophthora* subg. *Zoophthora* sp.; 4, 5 — conidiophore and pseudocystystide of subgenus *Erynia* member; 6 — conidium of *Zoophthora* subg. *Pandora* sp., dorsal view; 7 — as 6, lateral view; 8—9 — foots of *Pandora* sp. rhizoids; 10 — conidiophore and conidium of *Zoophthora* (*Furia*) *virescens* (all figurs semidiagrammatic, fig. 10 redrawed from Thaxter, 1888 and simplified).
Type of subgenus: Zoophthora (Zoophthora) radicans (Brefeld) Batko (1964 a).


Zoophthora subg. Erynia (Nowakowski) subg. nov.
(Figs 4 and 5)


Conidia primaria ad typos papillata pertinenta, plasmate vacuolis abundanter predita. Pseudocystidia conidiophoris multipliceter maceriora, saepe supra strata conidialia prominentia et modo valde Complexe formata. Rhizoidea quoad maceritatem pseudocystidiis similia vel recedentia, saepissime sine pede distincto.


Primary conidia of papillata type with highly vacuolated plasma. Pseudocystides many times thicker than conidiophores, frequently standing out high above the sporiferous layer and of complex structure. Rhizoids as thick as pseudocystides or thinner, generally without distinct foot.

Type of subgenus: Zoophthora (Erynia) ovispora (Nowakowski) Batko (1964 c).


Zoophthora subg. Pandora subg. nov.
(Figs 6—9)

Conidia cylindrica, ovulata, adverse ovulata, pyriformia, rarius — fusiformia, in classificatione Lakonii (1919) ad typos subpapillata, rarius


Conidia oval, ovoid, obovoid, pyriform, less frequently fusiform, according to Lakon’s classification (1919) of subpapillata type, less frequently papillata or sporangiata, often with weakly outlined bilateral symmetry: on one side (abdominal) slightly flattened, on opposite (dorsal) side more convex, on the third (lateral) side somewhat curved towards the abdominal side and slightly asymmetrical, papilla nearer abdominal side: plasma highly vacuolated, foamy or granulated, sometimes contains large highly refractive crystals near base of conidium; nucleus spherical or slightly depressed, frequently closer to abdominal surface of conidium, sometimes slightly irregular, stains only a little more intensively with cotton blue than the plasma. Pseudocystidia thin, not thicker than conidiophores or absent. Rhizoids single, thick or thin, ending in broad scutellar or irregular foot, sometimes irregularly branched. The ends of the ramifications have the form of bunches of short processes.

Type of subgenus: Zoophthora (Pandora) aphidis (Hoffman in Fre senius) Batko (1964 c).

To the subgenus Pandora I assign, beside Z. aphidis, the following species: Z. brahminae (Bose et Mehta) Batko, Z. calliphorae (Giard) Batko, Z. dipterigena (Thaxter) Batko, Z. echinospora (Thaxter) Batko, Z. exitalis (Hall et Dunn) Batko, Z. gloeospora (Vuillemin) Batko (Batko 1964 c), Z. vomitoriae Rozsypal (1966), and two others for which I suggest new combinations:

Zoophthora subg. Furia subg. nov.

Conidia maxima ex parte in classificatione Lakoni (1919) ad typum epapillata pertinentia. Conidiophori irregulariter ramosi, singulairum ramorum partes apicales a conidiophoris transversis septis disjunctae et modo ampullari tumidae. Pseudocystidia desunt.


Conidia mostly of the epapillata type according to Lakoni's (1919) classification. Conidiophores irregularly ramified, apical parts of the particular branchings separated from conidiophore by septa and bottlewise distended. Pseudocystides absent.

Type of subgenus: Zoophthora (Furia) virescens (Thaxter) Batko, (1964 c).

Etymology: furia (lat.) fury; name given to stress the destructive effect of the epizootia of this type species of the subgenus in populations of Lepidoptera caterpillars.

Monotypic subgenus, to the author's knowledge so far no other species of Zoophthora have been described which might be qualified to the subgenus Furia.

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O podrodzajach rodzaju Zoophthora Batko 1964 (Entomophthoraceae)

Streszczenie