

New or interesting species of *Ascobolus* and *Saccobolus* in the USSR

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SUMMARY

In the study of coprophilous Discomycetes 17 interesting species from the genera *Ascobolus* and *Saccobolus* have been found on samples of dung of different animals, on soil and on plant remains. Two of them – *Ascobolus ursinus* Prokhorov, sp. nov. and *Saccobolus minimoides*, Prokhorov sp. nov. are described as new. Other species of these genera are rare or seldom collected ones. The most northern locality *A. scatigenus* has been detected in natural conditions.

Introduction

The species composition of coprophilous Discomycetes on the territory of the USSR has been poorly investigated until recent times. When a detailed study of this ecological group of fungi was started a few years ago by the first author only 15 most common species were known. They were, in general, fungi with relatively big or bright-coloured fruit bodies, well noticeable in field conditions. As a result of an analysis of extensive material originating from different regions of the USSR 96 coprophilous species belonging to 15 genera of Pezizales have been identified [6, 7, 8, 9, 10]. Among them are some interesting species so far found only occasionally. Also a species of *Ascobolus* growing on bear dung and a species of *Saccobolus* on squirrel dung collected in the Primorsk Region (the Far East) have certain peculiarities distinguishing them from the hitherto known species. They are here described as new taxa.

Materials and methods

The ascocarps of the majority of the species described in this paper were obtained by the first author using the method of

incubation of samples of dung of different animals in moisture chambers under laboratory conditions. Some interesting species, however, have been collected fruiting under natural conditions by the second author and his collaborators and have been studied in the Herbarium of the Institute of Zoology and Botany of the Estonian Academy of Sciences (TAA). In the paper drawings of the first author have been presented.

Discussion

Intensive screening of abundant material collected in various regions of the USSR has allowed us to reveal species of coprophilous Discomycetes, which in literature have been reported only from few localities. The distribution area of many species is shown to be essentially wider northward and eastward.

Most coprophilous Discomycetes of which the distribution has been sufficiently investigated have evidently no regional limits connected with climate and flora. Therefore they may be regarded as a group of fungi of multiregional distribution. In connection with this there arises the problem of the so-called "rare" species. No doubt it is determined first and foremost by the state of investigation of coprotrophs in different regions of the world. Studies of this interesting ecological fungal group are carried out in

relatively few countries by a small number of mycologists. Much depends on the methods of investigation. According to our experience by collecting their fruit bodies in nature the detection of not more than 5 per cent of the whole number of species known in the group is guaranteed. The method of incubation in moist chambers is undoubtedly more effective, nevertheless, it does not give a comprehensive idea of the species composition. Observations show that the appearance of apothecia of Discomycetes on different fragments of dung collected from one animal are very unequal. It often happens that the fruit bodies (or even one single apothecium) develop only on one out of 7–10 fragments of dung of roe, elk, hare and other animals. The role of chance is even more conspicuous when the samples from different animals of the same species are collected in different regions. This peculiarity is undoubtedly due to the dispersal of spores and the casualness according to which the spores pass the digestive tract of animals. The laws of spore dispersal are not yet clear. However, thorough investigations of extensive material in moisture chambers give us the possibility of more complete detection of coprophilous species. This has been confirmed by the present study.

Systematic Part

Ascobolus aglaosporus Heimerl

Jber. k. k. Ober-Realschule Bezirke Sechshaus Wien 15: 14 (1889).

Apothecia 0.3 mm in diameter, pulvinate, sessile, scattered, whitish with violaceous tint, with smooth ectal surface. Ectal excipulum of textura angularis. Asci clavate-cylindrical, (100–) 135–141 × 20.4–23.5 μm . Ascospores broadly ellipsoid, violaceous, minutely echinulate or tuberculate, 15.8–16.7 × 9.3–9.9 μm . Paraphyses cylindrical, hyaline, apically swollen up to 5.0–5.6 μm in diameter. (Fig. 1, b).

Distribution in the USSR: the Tadjik SSR, the Hissar Mountains, valley of the Varzob River, 3100 m a.s.l., on ibex dung, 17. 06. 1982, coll. B. Kullman (TAA); the Primorsk Region, the Lazo Nature Reserve, Popov Island, on horse dung, 20. 08. 1987, coll. V. Gromin.

This species has been found in Austria, Bulgaria (as *A. candidus*), Great Britain, Canada and the USA on the dung of cow, goat, deer and American bison.

Ascobolus amoenus Oud.

Hedwigia 21: 165 (1852).

Apothecia hemispherical to ovoid, 0.4–0.8 mm in diameter, 0.6–0.8 mm high, superficial, scattered, reddish-brown, externally covered by loosely interwoven whitish hyphae, sometimes forming subicular basal mat. Ectal excipulum of textura angularis. Asci clavate-cylindrical, 454–482(–514) × 49–61 μm , penetrating the excipulum, turning blue in Melzer's reagent. Ascospores uniseriate, broadly ellipsoid, (30.5–)(33.3–44.4(–47.8) × 28.6–30.5

μm , minutely warted or with irregularly located big globules of pigment. Paraphyses filiform, septate, hyaline, apically swollen up to 3.3–5.0 μm in diameter, imbedded in lemon-yellow mucus. (Fig. 1, a).

Distribution in the USSR: the Turkmen SSR, the Krasnovodsk Region, the Nebit-Dag Mountains, Bol. Balkhan, on donkey dung, 16. 06. 1985; on sheep dung, 17. 06. 1985, coll. K. Golovkin.

A. amoenus has been found in North and South America (Canada, USA, Argentina, Peru, Venezuela) and Europe (the Netherlands, France). This is the first record of the species in the Irano-Turanic floristic region.

Ascobolus behnitzensis Kirschst.

Verh. bot. Ver. Brandenburg 48: 47 (1907).

Apothecia discoid, saucer-shaped, 0.9–1.5 mm in diameter, sessile on tapering base, dark brown. Ectal excipulum of textura angularis. Asci cylindrical, clavate, 190–18.2 μm , amyloid. Ascospores ellipsoid, (18.6–)19.9–22.4 × 9.9–11.6 μm , ornamented with small warts or ridges anastomosing into angular reticulum with elongated cells. Paraphyses filiform, septate, apically swollen up to 3.5–3.8 μm , embedded in lemon-yellow mucus, paraphyse tips agglutinated with dark brown amorphous substance. (Fig. 1, c).

Distribution in the USSR: the Tuva ASSR, Kyzyl, on the ground in flood-forest in the valley of the river Kaa-Hem, 18. 07. 1972 and 26. 07. 1972, coll. B. Kullman (TAA).

A. behnitzensis has been found so far only in a few European countries – Germany (Region Brandenburg), Great Britain, Italy, Norway, Czechoslovakia. This is the first find of the species in Asia.

Ascobolus boudieri Quel.

Ench. Fung. 293 (1886).

Apothecia hemispherical, short-cylindrical, 0.3–0.6 mm in diameter, scattered, superficial, yellowish-brown. Ectal excipulum of textura angularis. Asci penetrating the excipulum, clavate-cylindrical, 166–188 × 22–25 μm , amyloid. Ascospores elongated-ellipsoid, 22.1–24.1 × 12.2–12.8 μm , violaceous, minutely warted. Paraphyses filiform, hyaline, septate, 1.9–2.4 μm thick, embedded in yellowish-green mucus. (Fig. 1, d).

Distribution in the USSR: the Sverdlovsk Region, the Beloyarsk District, on horse dung, 27. 07. 1987, coll. M. Rochev; the Chelyabinsk Region, the Krasnoarmeisk District, Bordokalmak, on sheep dung, 17. 07. 1987, coll. I. Mozhina.

This species has been known earlier only in Europe (Great Britain, Belgium, the Netherlands, France, Czechoslovakia) and now it was found for the first time in Asia in the Ural Mountains.

Ascobolus cainii Brumm.

Persoonia, Suppl. 1: 126 (1967).

Apothecia discoid, saucer-shaped, 0.2–0.25 mm in diameter, sessile on tapering base, whitish. Ectal excipulum of

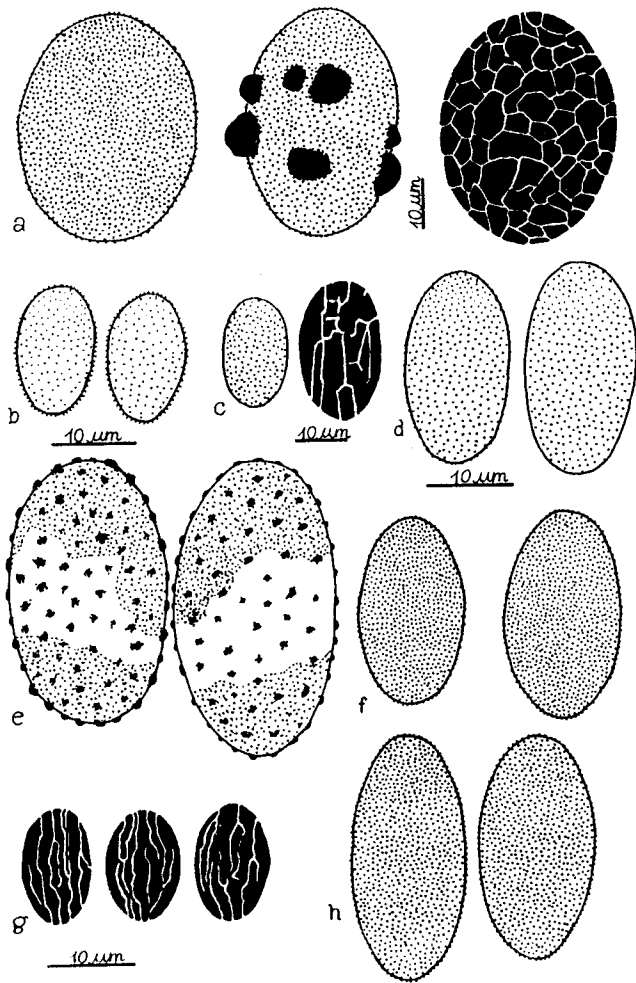


Fig. 1. The spores of *Ascobolus* species: a - *A. amoenus*; b - *A. aglaosporus*; c - *A. behnitziensis*; d - *A. boudieri*; e - *A. deglup-tus*; f - *A. hawaiiensis*; g - *A. minutus*; h - *A. scatigenus*.

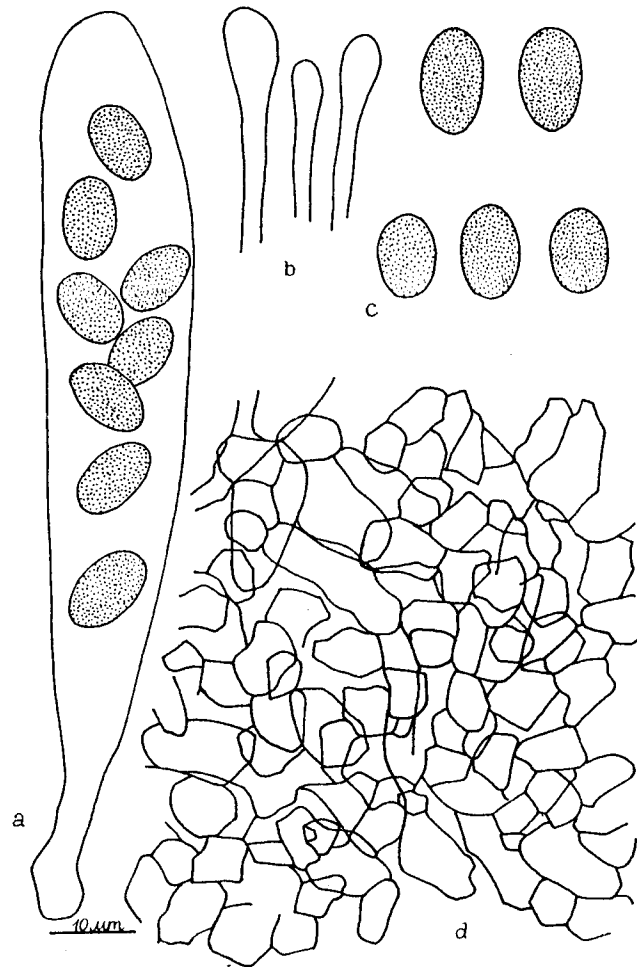


Fig. 2. *Ascobolus cainii*: a - an ascus with spores; b - paraphyses; c - spores; d - part of the ectal excipulum.

textura angularis. Asci clavate-cylindrical, (44.0-)-53.3-62.8 × 9.6-12.0 μm, amyloid. Ascospores ellipsoid, 9.6-10.6 × 4.5-4.8 μm, light violaceous, minutely warted. Paraphyses filiform, septate, 2.5 μm thick, apically swollen up to 4.5-5.0 μm. (Fig. 2).

Distribution in the USSR: the Ukrainian SSR, the Cherkassk Region, the Kanev District, on roe dung, 19. 07. 1987, coll. V. Tikhonenko.

A. cainii has been described on the basis of the material collected on Aug. 26, 1935 in Canada (2) and there have been no other data on this species up to now. Thus, this is the second find of *A. cainii*.

***Ascobolus carletonii* Boud.**

Trans. Brit. mycol. Soc. 4: 62 (1913).

Apothecia at first spherical, closed, then hemispherical with flat hymenial disc and feebly marked margin, 0.3-0.5 mm, smooth, whitish to pale yellowish-green, light brownish in the upper part with groups of angular yellow-gree-

nish cells, at base covered with flexuous septate hyaline hyphae 3.5-5.1 μm in diameter. Ectal excipulum of textura angularis. Asci cylindrical-clavate, gradually tapering into long stipe, 161-204(-220) × 21.3-25.1 μm. Ascospores ellipsoid, 12.8-13.6 × 7.7 μm, irregularly reticulate. In hymenium asci with bigger hypertrophic spores measuring 18.4-20.1 × 12.5-12.8 μm are found. Paraphyses cylindrical, septa not visible, 4.0-5.3 μm, apically swollen up to 6.4 μm. Hymenial mucus hyaline. (Fig. 3).

Distribution in the USSR: the Chukotka Peninsula, basin of the River Chegitun, on dung of gray goose, 17. 08. 1988, coll. V. Dolgov; the Nenets National Area, Kolguyev Island, on partridge dung, 23. 07. 1988, coll. G. Androsov.

According to Brummelen (2) this species was found only twice, in 1912 and 1966, and both times in Great Britain (Scotland) on the dung of capercaillie and grouse. There are no other data on its occurrence. Obviously the species, as different from many other species of coprotrophic Discomycetes, occupies a limited area of distribution

in the northern region of Holarctic Region and is associated with the dung of birds from the orders Galliformes and Anseriformes. Our specimens differ slightly in gross morphology from the description by Brummelen (2) but we suppose that they, however, represent the same species.

Ascobolus degluptus Brumm.

Persoonia, Suppl. 1: 78–80 (1967).

Apothecia at first spherical, then ovoid, 0.2–0.25 mm in diameter, superficial or slightly immersed, light yellowish-grayish. Ectal excipulum of textura angularis. Asci clavate-cylindrical, $289\text{--}354 \times 41.8\text{--}51.4 \mu\text{m}$, amyloid. Ascospores broadly ellipsoid, $27.3\text{--}28.9 \times 16.1 \mu\text{m}$, ornamented with big or smaller irregular globules of pigment, with wide rupture of the pigment layer in the central part of spore surface. Paraphyses cylindrical, simple, septate, hyaline, apically up to $3.2\text{--}3.7 \mu\text{m}$ in diameter. Hymenial mucus hyaline. (Fig. 1, e).

Distribution in the USSR: the Estonian SSR, Põlva, Mõtskula, on hen dung, 10. 10. 1987, coll. L. Pihlik.

A. degluptus has been known so far only in 5 countries – Denmark, Great Britain, the Netherlands and Poland

(2) and France. In the study by M. D. Paulsen and H. Dissing (5) on the species of the genus *Ascobolus*, a drawing represents *A. degluptus*, however, in the text the description of *A. stictoides* has been given.

Ascobolus hawaiiensis Brumm.

Persoonia, Suppl. 1: 87–88 (1967).

Apothecia barrel-shaped, ovoid or shortly cylindrical, superficial, 0.15–0.8 mm in diameter, pale violaceous, brownish-reddish. Ectal excipulum of textura angularis, often containing amorphous globules of violaceous pigment. Asci elongated-clavate to clavate-cylindrical, $125.0\text{--}241.6 \times 22.5\text{--}33.3 \mu\text{m}$, sometimes with 2–4 abortive spores, diffusely blue in Melzer's reagent. Spores ellipsoid, $(16.7\text{--})19.4\text{--}20.8(-22.2) \times (10.0\text{--})11.1\text{--}12.2 \mu\text{m}$, intensively violaceous, ornamented with rather big (up to $0.8\text{--}1.0 \mu\text{m}$ in diameter) hemispherical warts, covered by hyaline mucilaginous envelope. Paraphyses filiform, septate, $2.5\text{--}3.0 \mu\text{m}$ thick, swollen above up to $6.4 \mu\text{m}$, sometimes with dark violaceous pigment. (Fig. 1, f).

Distribution in the USSR: the Armenian SSR, the Ashtarak District, Sagmosavan, on cow dung, 21. 04. 1984, coll. M. Taslakhchyan; the Azerbaijan SSR, the Lenkoran District, Kyzyl-Agach, on buffalo dung, 27. 01. 1986, coll. Yu. Maleyeva; the Kuba District, Velvele-chai, on dung of cow and sheep, 06. 05. 1985, coll. E. Guseinov; the Uzbek SSR, the Tashkent Region, the Bostanlyk District, the Bol. Chimgan Mountains, 2300 m a.s.l., on sheep dung, 24. 04. 1985, coll. V. Prokhorov; the Kirghiz SSR, the Bol. Kirghiz Mountains, Chon-Kurchak, 2900 m a.s.l., on cow dung, 25. 07. 1980; Turup, on cow dung, 27. 06. 1981, coll. S. Mosolova; the Turkmen SSR, the Ashkhabad Region, the Kaakhin District, Karakhan, on sheep dung, 01. 05. 1985, coll. H. Orazov; the western bank of Lake Baikal, the inlet of Mukhor, on sheep dung, 13. 08. 1988, coll. I. Reshetnikova; the Yakutsk ASSR, near the town of Yakutsk, on horse dung, 12. 11. 1988, coll. Yu. Rykova.

A. hawaiiensis has been reported from the Hawaiian Islands, Japan, Norway, Denmark and Spain. The localities of this species in Yakutia and near Lake Baikal show that the distribution of this species extends far to the North. However, in the USSR *A. hawaiiensis* occurs more often in Central Asia and the Transcaucasus.

Ascobolus minutus Boud.

Bull. Soc. bot. Fr. 34: 48 (1888).

Apothecia hemispherical, barrel-shaped, obconical or widely opened, 0.3–1 mm in diameter, scattered, sometimes in groups, yellowish-greenish, externally covered with clusters of brownish-greenish cells. Ectal excipulum of textura angularis in the basal part of the apothecium and of horizontally orientated narrow elongated cells in the marginal part of the fruit-body. Asci cylindrical-clavate, $109\text{--}141 \times 11.2\text{--}14.4(-19.7) \mu\text{m}$, amyloid. Ascospores broadly ellipsoid, $12.0\text{--}13.6 \times 7.7\text{--}8.0 \mu\text{m}$, violaceous, ornamented with longitudinal anastomosing striae, biserrate. Paraphyses filiform, septate, hyaline, apically

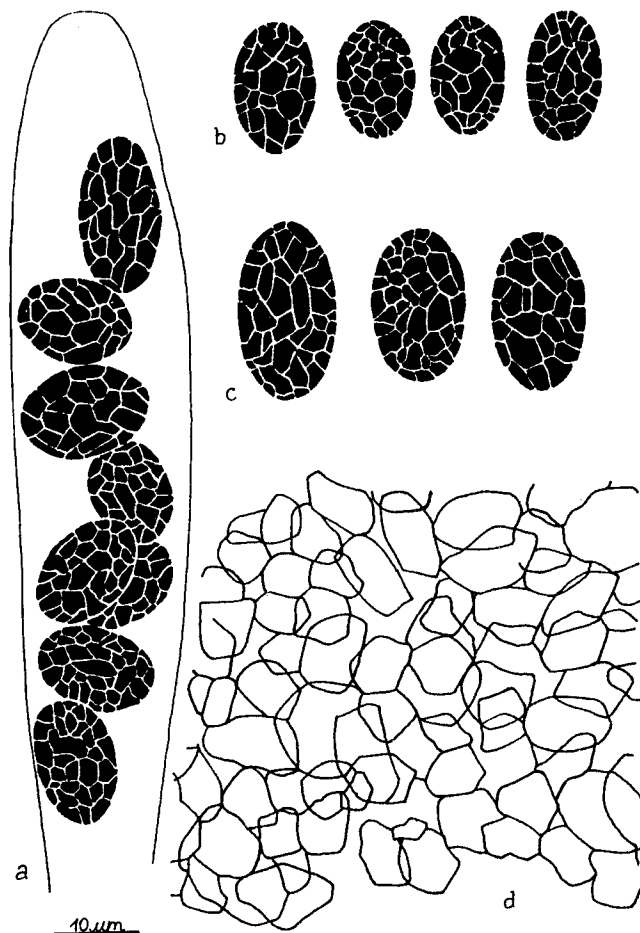


Fig. 3. *Ascobolus carletonii*: a – an ascus with spores; b – normal spores; c – hypertrophied spores; d – part of the ectal excipulum.

slightly swollen up to 3.2–4.5 μm , embedded in lemon-yellow mucus. (Fig. 1, g).

Distribution in the USSR: the Tuva ASSR, the Ulug-Khem District, Ishti-Khem (the Western Tannu-Ola Mountains), on bear dung, 08. 1988, coll. N. Pashenova; the Tyumen Region, the Surgut District, the Great Yugan River, on dung of hare and mouse, 22. 08. 1988; the Yugan Nature Reserve, on dung of hazel grouse and black grouse, 25. 08. 1988; the Perm Region, the Dobryansk District, Khokhlovka and Skobelevka, on dung of cow and goat, 03. 09. 1988, coll. V. Prokhorov.

Up to the present time this species has been known only in Europe (Great Britain, France, Denmark, Czechoslovakia) and the USA but it seems to have a wide Holarctic distribution.

Ascobolus scatigenus (Berk.) Brumm.

Persoonia, Suppl. 1: 159 (1967).

Apothecia widely opened, saucer-shaped, 5–10 mm in diameter, sessile on narrow base, externally granular, olivaceous-brown. Ectal excipulum of textura angularis. Asci narrowly clavate, (141–)149–174 \times 21.6–24.9 μm , amyloid. Ascospores ellipsoid to broadly ellipsoid, 25.5–28.2 \times 11.6–12.0 μm , violaceous, minutely warted, sometimes with 1–2 longitudinal or oblique striae. Paraphyses filiform, septate, 1.8–2.6 μm , embedded in lemon-yellow mucus. (Fig. 1, h).

Distribution in the USSR: the Tadjik SSR, the Hissar Mountains, the Ziddin depression, Kuk-Teppa, 2750 m a.s.l., on dead stems of *Ligularia thomsonii*, 04. 10. 1980, coll. S. Faizova (TAA).

The area of distribution of this species is rather wide (India, Sri Lanka, Vietnam, China, Japan, Pakistan, the Philippines, Indonesia, North-West Borneo, Australia, North Rhodesia, Madagascar, Venezuela, the USA). All the finds, however, originate mainly from the Pantropic region. The cited locality is the most northern one under natural conditions.

Ascobolus ursinus Prokhorov, sp. nov.

Apothecia 0.3–1.1 mm in diametro, pallide luteo-viridula, sessilia, initio globularia, deinde subglobosa, dispersa, disco concavo, marginibus distinctis. Excipulum 225–418 μm crassa, in parte inferiora cellulis globosis, in parte superiori cellulis angularibus horizontaliter versis compositur. Hymenium 210–225 μm et subhymenium 70–97 μm crassum. Asci (151–)157–182 \times 11.2–14.5 μm , octospori, operculati, anguste cylindraco-clavati, parietibus iodo coerulescentibus. Ascospores ellipsoideae, 12.8–13.6 \times 8.2–8.35 μm , violascentes, regulariter verrucosae. Paraphyses filiformes, hyalinae, sparsa septatae, apicibus ad 4.8–6.8 μm incrassatis, in mucilagine citrino immersis. (Fig. 4).

Holotypus: Oriens Extremis, Regio Primorsk, Reservatum Lazo in valle fluvii Kanikheza in fimo Ursi arcti L. 19. 08. 1988, F. M. Bulach lectus, siccus in Herbario Universitatis Moscovensis depositus.

Apothecia scattered, superficial, 0.3–1.1 mm in diame-

ter, at first spherical, closed, then hemispherical with concave disc and differentiated margin, light yellow-green, then yellowish-brownish with concolorous groups of cells on the surface. Ectal excipulum 225–418 μm thick, composed in the lower part of the apothecium of textura globularis, in the upper marginal part of textura angularis, cells angular, horizontally orientated. Hymenium 210–225 μm thick, subhymenium 70–97 μm thick. Asci 8-spored, operculate, cylindrical-clavate, (151–)157–182 \times 11.2–14.4 μm , diffusely blue in Melzer's reagent. Spores ellipsoid, 12.8–13.6 \times 8.2–8.35 μm , violaceous, with fine isolated warts. Paraphyses filiform, hyaline with rare septa, swollen above up to 4.8–6.8 μm , embedded in lemon-yellow mucus. (Fig. 4).

Holotype: on dung of brown bear *Ursus arctos* L., the Primorsk Region, the Lazo Nature Reserve, valley of the River Kanikheza, 19. 08. 1988, coll. Ye. M. Bulakh, in the Herbarium of the Moscow State University.

The fruit bodies appeared on the 21st day of incubation of the sample of dung in a moist chamber. The new taxon

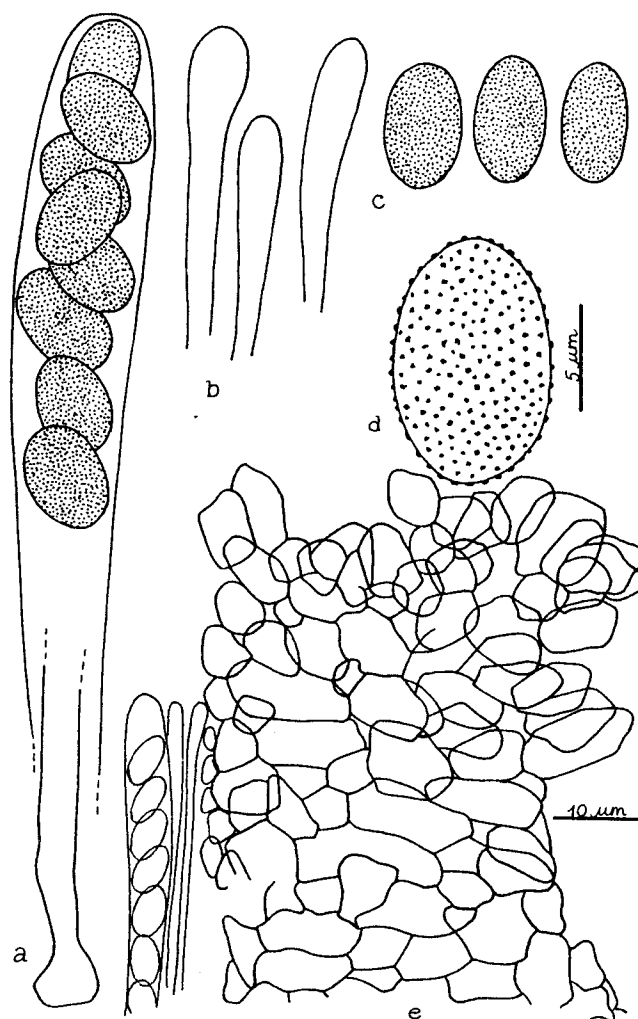


Fig. 4. *Ascobolus ursinus*: a – an ascus with spores; b – paraphyses; c, d – spores at the different magnification; e – the transverse section of the marginal part of an apothecium.

belongs to the section *Ascobolus*. Apothecia developing according to gymnohymenical type. The species differs from the similar species of the sections *Ascobolus* and *Dasyobolus* with warty spore ornamentation in its narrow asci and in ascospore measurements. (*A. camii* has asci $44.0\text{--}56.5(-62.8) \times 9.6\text{--}10.0 \mu\text{m}$ and spores $9.6\text{--}10.6 \times 4.5\text{--}4.8 \mu\text{m}$; *A. boudieri* – asci $220\text{--}260 \times 26\text{--}30 \mu\text{m}$, spores $19.5\text{--}20\text{--}25 \times (10\text{--})11\text{--}13 \mu\text{m}$). From other closely related species it differs in warty spore ornamentation.

Saccobolus caesariatus Renny apud Phill.

Brit. Discom. 297 (1887).

Apothecia short-cylindrical to barrel-shaped, 0.17–0.25 mm in diameter, superficial, sessile, white or pale violaceous, externally with numerous tufts of aggregated conical hyphae, 70–92 μm long and up to 55 μm thick at base. Ectal excipulum of textura angularis, sometimes with amorphous enclosures of violaceous pigment. Asci clavate, apically denser $(92\text{--})103\text{--}186 \times (22.2\text{--})26.4\text{--}36.1(-41.7) \mu\text{m}$, amyloid. Spore clusters dense, aggregated according to type 2, $43.9\text{--}50.0 \times 16.7\text{--}19.4 \mu\text{m}$, with 2 lateral drops of hyaline mucus. Individual spores ellipsoid or slightly asymmetrical, $(17.5\text{--})19.4\text{--}22.2 \times 8.3\text{--}8.4 \mu\text{m}$, dark or gray violaceous, minutely warted. Paraphyses cylindrical, septate, branched, hyaline, 2.8 μm in diameter. (Fig. 5, a).

Distribution in the USSR: the Armenian SSR, the Ashtarak District, Samgosavan, on dung of horse and cow, 21. 04. 1984, coll. M. Taslakhchyan; the Azerbaijan SSR, the Lenkoran District, Kyzyl-Agach, on dung of buffalo and sheep, 25. 01. 1985, coll. A. Abramov; the Uzbek SSR, the Tashkent Region, the Bostanlyk District, the Bol. Chimgan Mountains, 2300 m, on cow dung, 26. 04. 1985, coll. V. Prokhorov; the Kirghiz SSR, the Bol. Kirghiz Mountains, Chon-Kurchak, on cow dung, 30. 06. 1980, coll. S. Mosolova.

The species is very close to *S. depauperatus* and differs from it in the existence of clusters of excipular hyphae and in spore ornamentation. However, *S. depauperatus* can also form in some cases slight or clearly marked hyphal clusters. This can be observed clearly in the incubation of samples in a moist chamber. *S. caesariatus* is often found only in the Transcaucasus and in Central Asia. However, in other countries it is known to be found in more northern regions (Austria, the Netherlands).

Saccobolus dilutellus (Fuckel) Sacc.

Syll. Fung. 8: 526 (1889).

Apothecia pillow-shaped, 0.15–0.35 mm in diameter, whitish-grayish, whitish-blueish, scattered or in small groups, with a few (from 4–6 to 15) ripe asci. Ectal excipulum of textura globulosa-angularis, in the marginal part consisting of loosely interwoven vertically orientated hyphae. Asci clavate, apically truncated or rounded, $67\text{--}103 \times 17.7\text{--}25.0 \mu\text{m}$. Spore clusters compact broadly ellipsoid or subspherical, spores aggregated according to type 4, $19.4\text{--}25.7 \times 16.7\text{--}19.4 \mu\text{m}$. Individual spores ellipsoid, $(12.0\text{--})12.8\text{--}16.6 \times 6.4\text{--}8.3 \mu\text{m}$, violaceous to

dark grayish-violaceous, free spore surface ornamented with minute warts grouped in a compact margin on the line of contact between spores. Paraphyses cylindrical, septate, branched, apically slightly swollen up to 3.6–6.7 μm . (Fig. 5, b).

Disitribution in the USSR: the Moscow Region, the Odintsovo District, the Zvenigorod Biostation of Moscow State University on horse dung, 18. 04. 1984, on dung of wild boar, 15. 07. 1984, on mouse dung, 04. 05. 1987, coll. V. Prokhorov.

S. dilutellus is interesting because of its non-standard arrangement of spore clusters. It has been found in Europe – Austria, Denmark, France, Spain, Czechoslovakia, mainly on dung of birds and rodents as well as of fox and dog. In the USSR the species occurs rather rarely.

Saccobolus globuliferellus Seaver

North Am. Cup-Fungi (Operc.) 95 (1928).

Apothecia scattered, pillow-shaped, about 0.1 mm in diameter, with a few ripe asci, white. Ectal excipulum poorly developed, of textura angularis. Asci broadly clavate, $38.5\text{--}39.0 \times 17.7 \mu\text{m}$. Spore clusters subspherical, aggregated according to type 4, $16.1\text{--}17.8 \times 17.8\text{--}20.1 \mu\text{m}$. Individual spores ellipsoid, ornamented with warts equally distributed on the whole surface, $10.1\text{--}10.4 \times 6.4 \mu\text{m}$. Paraphyses filiform, septate, hyaline, 2.4–3.2 μm in diameter. (Fig. 5, c).

Distribution in the USSR: the Moscow Region, the Odintsovo District, the Zvenigorod Biostation of Moscow State University, on dung of wild boar, 20. 05. 1986, coll. V. Prokhorov; the Byelorussian SSR, the Gomel Region, valley of the Pripyat River, on cow dung, 19. 10. 1988, coll. V. Trukhonovets; the Irkutsk Region, Olkhon Island in Lake Baikal, on partridge dung, 30. 06. 1988, coll. I. Reshetnikova; the Far East, the Primorsk Region, the Lazo Nature Reserve, on bear dung, 16. 09. 1988, coll. Ye. Bulakh.

The species is known in Europe (Denmark, Spain), North and South America (Canada, the USA, Argentina). On the basis of the data on the distribution of *S. dilutellus* and *S. globuliferellus* existing at that time, Brummelen (2) regards them as vicarious species, the former distributed in Europe and the latter in North and South America. The assumed American species has been later detected in Europe (Spain, Denmark) and at present also in the USSR, including its Asian part.

Saccobolus minimoides Prokhorov, sp. nov.

Apothecia 0.1–0.2 mm in diametro, numerosa, frequenter confluentia, initio obconica, deinde pulvinata, aurea vel succinea. Excipulum inferiori receptaculi ex textura angularis compositum. Asci $43.9\text{--}51.7(-53.0) \times 11.7\text{--}12.8(-16.0) \mu\text{m}$, cylindraco-clavati, supra truncati, breviter stipitati, parientibus iodo coerulescentibus. Sporum fasciculi compacti, elongati, $22.5\text{--}24.1 \times 8.0\text{--}9.6 \mu\text{m}$. Ascosporae secundum typum 2 vel raro typum 1 dispositae, ellipsoideae, $7.9\text{--}8.8(-9.64) \times 3.7\text{--}4.3 \mu\text{m}$,

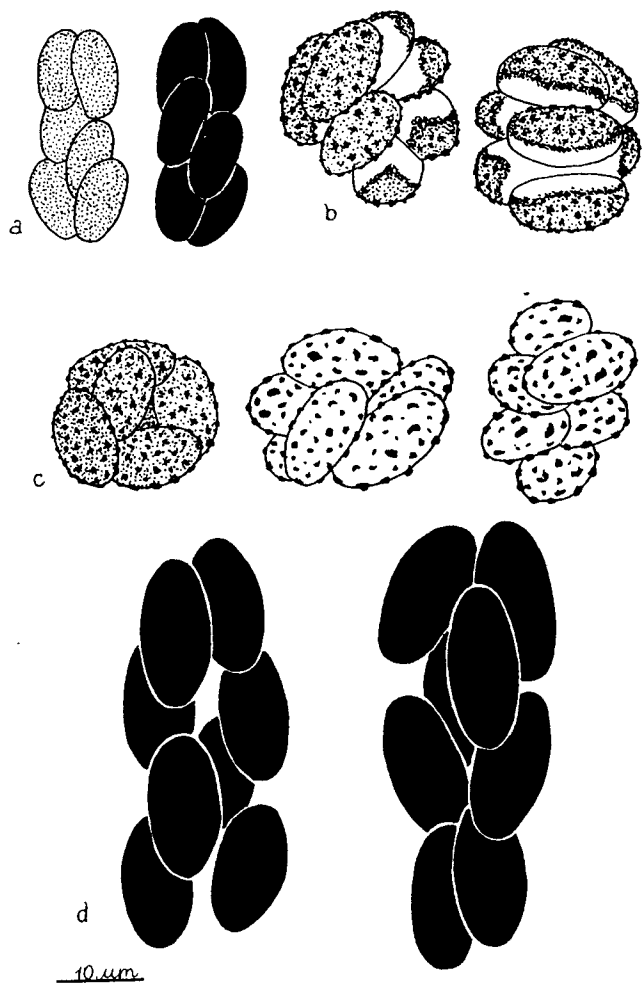


Fig. 5. The spore clusters of *Saccobolus* species: a – *S. caesariatus*; b – *S. dilutellus*; c – *S. globuliferellus*; d – *S. saccoboloides*.

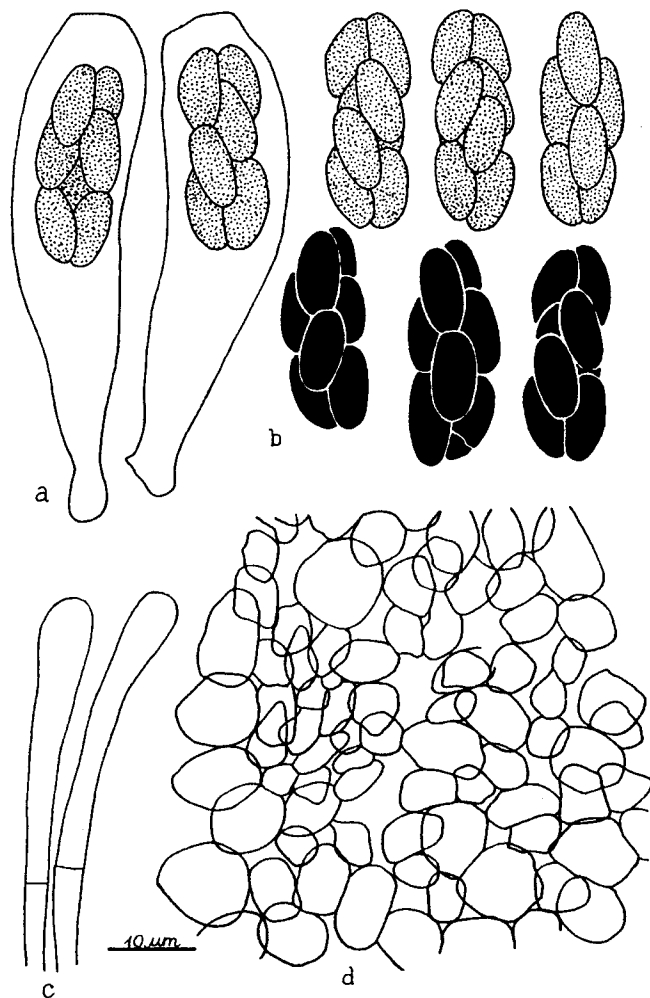


Fig. 6. *Saccobolus minimoides*: a – two asci with spores; b – the spore clusters aggregated according to patterns II and I; c – paraphyses; d – ectal excipulum.

initio pallide violascentes, deinde intense violasceae, tenuiter verrucosae, raro fissura sola transversa ornatae. Paraphyses ramosae, septatae, filiformes, 1.6–2.5 µm in diametro, cellulis superioribus contento laete luteo, apicibus ad 4.0–4.5 µm incrassatis. (Fig. 6).

Holotypus: Oriens Extremis, Reservatum Sichote-Alin, in valle fluvii Bia, in fimo Sciuri vulgaris L., 11. 08. 1987, V. I. Krutova lectus, siccus in Herbario Universitatis Moscovensis depositur.

Apothecia numerous, often anastomosing, 0.1–0.2 mm in diameter, obconical when young, then pulvinate, golden-yellow to amber-yellow. Ectal excipulum of textura angularis, existing only in the lower part of the apothecium. Asci clavate to clavate-cylindrical, truncated above, with short stipe, 43.9–51.7(–53.0) × 11.7–12.8(–16.0) µm, turning blue in Melzer's reagent. Spore clusters compact, firm, aggregated in general according to type 2, sometimes according to type 1, 22.5–24.1 × 8.0–9.6 µm. Individual spores ellipsoid, light violaceous when young,

intensively violaceous when ripe, minutely verrucose, rarely with 1 transversal stria, 7.9–8.8(–9.64) × 3.7–4.3 µm. Paraphyses branched in the upper half, septate, the upper cell with bright yellow content, 1.6–2.5 µm in diameter, apically swollen up to 4.0–4.5 µm. (Fig. 6). Holotype: on the dung of squirrel *Sciurus vulgaris* L., the Primorsk Region, the Sikhote-Alin Nature Reserve, valley of the Bia river, 11. 08. 1987, coll. V. I. Krutova, in the Herbarium of the Moscow State University.

The fruit bodies appeared in a moist chamber on the 19th day of incubation. The species is externally and morphologically close to *S. minimus* Vel., differing from it mainly in smaller size of asci, spore clusters and spores. Taking into account the variability of size according to Brummelen (2) and Minoura and Yamada (4), *S. minimus* has asci 50–62 × 12–16 µm, spore clusters – 27–34 × 9–15 µm and spores – (10.0–)11.5–14.0 × 4.0–6.5(–7.5) µm.

Saccobolus quadrisporus Mass. et Salm.

Ann. Bot. 15: 329 (1901).

Apothecia scattered, pillow-shaped, 0.2–0.25 mm in diameter, yellowish-brown, with a few ripe asci. Ectal excipulum of textura globulosa-angularis. Asci elongated-clavate, 4-spores, $85.3\text{--}141.2 \times 19.3\text{--}31.3 \mu\text{m}$, amyloid. Spore clusters aggregated according to type 5b, $44.9\text{--}50.6 \times 12.0\text{--}19.3 \mu\text{m}$. Spores ellipsoid, $20.1\text{--}22.0 \times 10.4\text{--}11.2 \mu\text{m}$, at first hyaline, then violaceous and brown-blackish, ornamented with unequally distributed big anastomosing globules of pigment. Paraphyses filiform, minutely septate, hyaline, slightly swollen above up to $3.5\text{--}6.4 \mu\text{m}$. (Fig. 7).

Distribution in the USSR: the Nenets National Area, Kolguyev Island, on dung of gray goose, 26. 07. 1988, coll. G. Androsov.

The species is evidently rare, with a limited habitat and connected with animals. It was described for the first time in 1901 in Kew Garden on the fung of *Brantha leucopsis*, then on the Island of Spitzbergen, on the North-East coast of Greenland (3) and in the north of Canada (1). The

study of samples of dung of different birds and other animals has not revealed this species in other regions of the USSR so far.

Saccobolus saccoboloides (Seaver in Dodge et Seaver) Brumm.

Persoonia, Suppl. 1: 168 (1967).

Apothecia occurring in groups, pillow-shaped, 0.2–0.4 mm in diameter, numerous, golden-yellow to amber-yellow. Ectal excipulum of textura angularis. Asci clavate, $(80\text{--})94\text{--}104 \times 19.3\text{--}24.1 \mu\text{m}$, amyloid. Spore clusters aggregated according to type 1 or 2, $33.7\text{--}38.5 \times 11.7\text{--}14.8 \mu\text{m}$, disintegrating early on single spores. Individual spores slightly asymmetrical, ellipsoid, swollen in the centre, $14.4\text{--}16.1 \times 7.1\text{--}7.4 \mu\text{m}$, violaceous, smooth. Paraphyses filiform, septate, with bright yellow or yellow-green content in the upper cells, $2.5\text{--}4.5 \mu\text{m}$ in diameter. (Fig. 5, d).

Distribution in the USSR: the Estonian SSR, the Põlva District, Põlva, on sheep dung, 28. 03. 1986; the Võru District, Vastseliina, on sheep dung, 02. 04. 1986, coll. M. Saar (TAA); the Moldavian SSR, Kishinev, the Zoological Gardens, on elephant dung, 07. 07. 1987, coll. L. Afanasyeva.

S. saccoboloides has been found so far only in 4 countries, mainly in the tropical region (India, Indonesia, New Guinea, Argentina). The new finds essentially widen the known range of distribution of this species.

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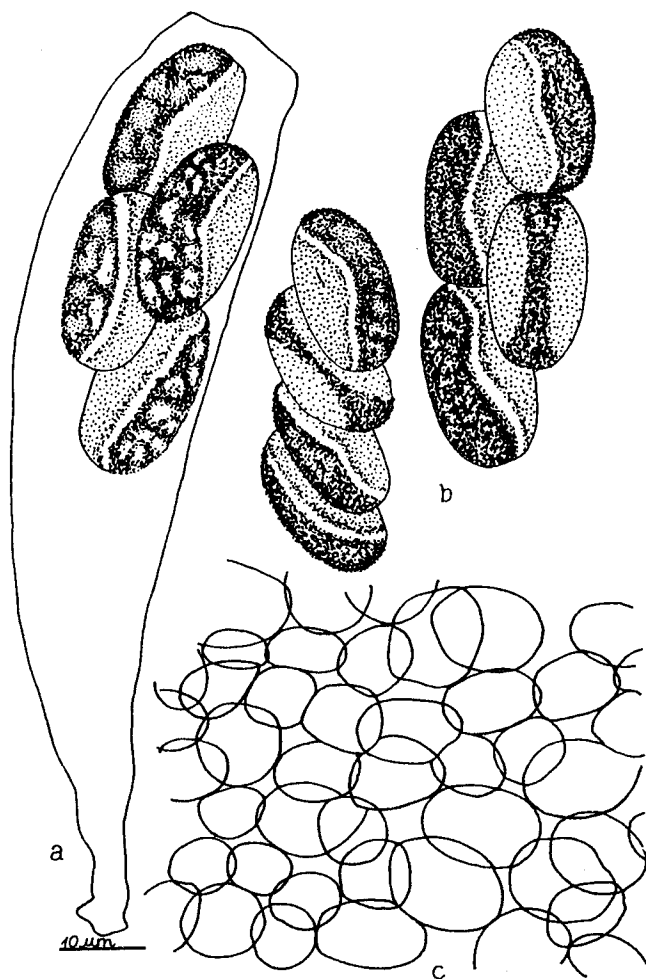


Fig. 7. *Saccobolus quadrisporus*: a – an ascus with spores; b – the spore clusters; c – part of ectal excipulum.

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