

## New records of dung inhabiting *Coprinus* species in Ukraine II. Section *Coprinus*

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In this part of the article on dung inhabiting *Coprinus* species in Ukraine data on new records of fimicolous representatives of the section *Coprinus* in Ukraine are reported. As a result of the study 9 taxa belonging to the subsections *Lanatuli* J.E. Lange, *Narcotici* Uljé et Noordel. and *Nivei* Citérin were found. *Coprinus cordisporus* Gibbs, *C. foetidellus* P.D. Orton, *C. pseudoniveus* Bender et Uljé, *C. pseudoradiatus* Kühner et Joss. ex Watling and *C. utrifer* (Joss.) Watling were collected for the first time in Ukraine. One new variety (*C. pachyspermus* var. *tetrasporus*) is described. For each taxon a description and drawings are provided.

**Key words:** Basidiomycetes, fimicolous mushrooms, *Agaricales*, *Coprinaceae*, *Coprinus*, *Lanatuli*, *Narcotici*, *Nivei*.

Prydiuk M. P. (2011): Nové nálezy koprofilních druhů rodu *Coprinus* na Ukrajině II. Sekce *Coprinus*. – Czech Mycol. 63(1): 13–32.

Článek obsahuje údaje o nových nálezech koprofilních druhů rodu *Coprinus*, sekce *Coprinus* na Ukrajině. Bylo nalezeno 9 taxonů patřících do podsekcí *Lanatuli* J.E. Lange, *Narcotici* Uljé et Noordel. a *Nivei* Citérin. *Coprinus cordisporus* Gibbs, *C. foetidellus* P.D. Orton, *C. pseudoniveus* Bender et Uljé, *C. pseudoradiatus* Kühner et Joss. ex Watling a *C. utrifer* (Joss.) Watling byly na Ukrajině nalezeny poprvé. Je popsána jedna nová varieta (*C. pachyspermus* var. *tetrasporus*). Každý druh je popsán a vyobrazen.

### INTRODUCTION

This paper continues the topic started in the previous one (Prydiuk 2010), in which 8 representatives of fimicolous *Coprinus* species belonging to the section *Pseudocoprinus* (Kühner) P.D. Orton et Watling recorded in Ukraine were reported. In this article I present information on 9 representatives of the section *Coprinus* collected during our investigations. Five species (*Coprinus cordisporus* Gibbs, *C. foetidellus* P.D. Orton, *C. pseudoniveus* Bender et Uljé, *C. pseudoradiatus* Kühner et Joss. ex Watling and *C. utrifer* (Joss.) Watling) were collected in Ukraine for the first time. For *C. ephemeroides* (DC.: Fr.) Fr.,

*C. niveus* (Pers.: Fr.) Fr. and *C. radiatus* (Bolton: Fr.) Gray new localities were registered. One new variety (*C. pachyspermus* var. *tetrasporus*) is described. All the taxa are presented in details below.

#### MATERIALS AND METHODS

This paper is based on a study of both collections made by the author and selected specimens kept in the Herbarium of the M. G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, Kiev, Ukraine (KW). Many *Coprinus* specimens were collected in the field, but a considerable part of them was grown in moist-chambers from earlier gathered samples of dung. The classical method (Richardson 2001) was used with minor changes: the dung samples were placed into transparent plastic cups covered by somewhat larger ones and incubated on several layers of moist filter paper under natural light at room temperature (18–20 °C) during several weeks. The specimens obtained in the moist-chambers are marked with an asterisk (\*).

Microscopic structures were observed in dried material. Microscopic sections of lamellae were made at about half of the pileus radius and examined in 3% KOH. The spores were studied in water.

Spore sizes are based on at least 20 spore measurements per basidiocarp from one habitat. For basidia and cystidia the means of the smallest and the largest ones per basidiocarp are based on 10 measurements in each case.

All the collections are deposited in the Herbarium of the M.G. Kholodny Institute of Botany (KW).

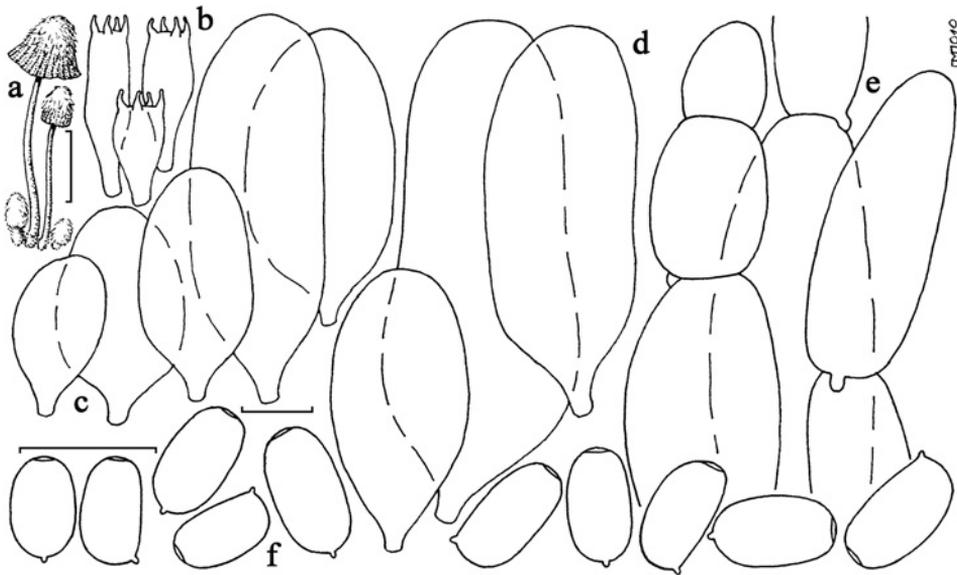
In the descriptions the following abbreviations are used: av. B = average width of the spores in frontal view; av. L = average length of the spores; L = number of lamellae reaching stipe; l = number of short lamellae (not reaching stipe) between two long ones; Q = length divided by width; av. Q = average Q.

#### RESULTS AND DISCUSSION

##### **Subsection *Lanatulii* J.E. Lange**

***Coprinus pseudoradiatus* Kühner et Joss. ex Watling, Notes R. Bot. Gdn. Edinb., 35: 154, 1976. Fig. 1**

*Coprinus pseudoradiatus* Kühner et Joss., Bull. Soc. Mycol. Fr., 60: 26, 1944 (invalid). – *Coprinopsis pseudoradiata* (Watling) Redhead, Vilgalys et Moncalvo, Taxon, 50: 230, 2001.



**Fig. 1.** *Coprinus pseudoradiatus* (KW 25484): **a** – basidiocarps, **b** – basidia, **c** – cheilocystidia, **d** – pleurocystidia, **e** – veil elements, **f** – spores. Bars = 1 cm for basidiocarps and 10 µm for microstructures.

Pileus 3–5 × 3–4 mm when still closed, ovoid, ellipsoid, cylindrical-ellipsoid, then campanulate, obtuse conical to convex, finally applanate with revolute margin, up to 10 mm in diam. when expanded, slightly ribbed, pale grey-brown to grey-brown, somewhat darker at centre, covered with silvery-whitish to pale silvery-grey veil, soon radially splitting up into appressed or somewhat recurved hairy-fibrillose flocks, often finally disappearing. Lamellae narrowly adnate to free, L = 16–20, l = 0–1, at first white, then greyish, finally blackish. Stipe 10–30 × 0.3–1.0 mm, hyaline-whitish, slightly tapering towards apex, base clavate, up to 1 mm broad, minutely hairy-flocculose, particularly at base, then nearly glabrous. Flesh very thin, whitish. Taste and smell indistinct. Spore print black.

Spores 7.0–9.5 × 4.5–5.5 µm, Q = 1.5–2.0, av. L = 8.7±0.66 µm, av. B = 4.9±0.31 µm, av. Q = 1.76±0.12; ellipsoid to subcylindrical, with rounded base and apex, germ pore central, up to 1.5 µm wide, dark brown to almost black. Basidia 14–29 × 7.0–8.5 µm, 4-spored, surrounded by 3–6 pseudoparaphyses. Cheilocystidia 14–45 × 11–20 µm, subglobose, broadly-ellipsoid or ellipsoid, sometimes subcylindrical. Pleurocystidia 29–73 × 13–21 µm, ellipsoid, elongate-ellipsoid, ellipsoid-cylindrical, or utriform. Veil made up of elongate, cylindrical or fusiform, sausage-like elements, 14–120 × 8–24 µm, usually constricted at septa, terminal cells subcylindrical or subglobose. Clamp-connections present.

**Habitat and distribution.** Solitary or in small groups on dung of herbivorous animals, in forests, meadows and pastures. Known from Europe and North America (Cacialli et al. 1999, Uljé & Noordeloos 1999, Urbonas 1999, Doveri 2004, Uljé 2005, Vesterholt 2008). Its distribution in Ukraine is still insufficiently known; it seems to be rather rare or overlooked.

**Notes.** Macroscopically *Coprinus pseudoradiatus* is fairly similar to *C. radiatus* (though has somewhat smaller basidiocarps) but differs by its very small spores (Uljé & Noordeloos 1999, Uljé 2005). The specimen collected by us corresponds rather well to Uljé's description of this species (Uljé & Noordeloos 1999, Uljé 2005) as well as to the data of Kühner and Romagnesi (1953), though many authors quote a notably smaller spore size for this species: 7.5–8.5 × 4.5–5.5 µm (Orton & Watling 1979, Dissing & Lundquist 1992); 7–9 × 4.0–5.5 µm (Moser 1983); (7.1)7.6–8.0(8.5) × 4.2–4.7 µm (Doveri 2004).

**Specimens examined.** Ukraine: Rivne Region, Dubrovytsia District, about 2 km west of the village of Krupove, on horse dung, 51°33'31.34" N, 26°26'39.47" E, 16 July 2003, leg. M.P. Prydiuk (KW 25484); about 2 km north-west of the village of Krupove, on horse dung, 51°34'12.39" N, 26°27'2.16" E, 18 June 2004, leg. M.P. Prydiuk (KW 29846). Sumy Region, Seredyna-Buda District, Desnians'ko-Starohuts'kyj National Nature Park, about 1 km north of the village of Stara Huta, on horse dung, 52°19'18.73" N, 33°47'43.33" E, 16 August 2003, leg. M.P. Prydiuk (KW 25485).

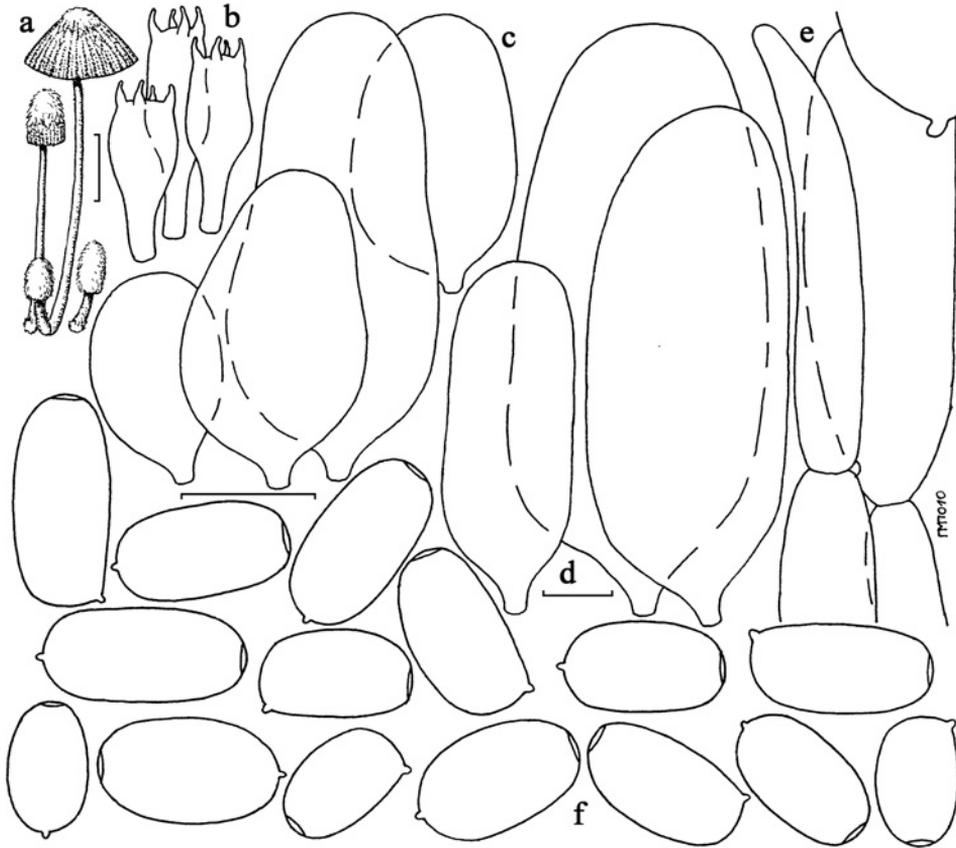
***Coprinus radiatus* (Bolton: Fr.) Gray, Nat. Arr. Br. Pl., 1: 635, 1821.**

**Fig. 2**

*Agaricus radiatus* Bolton, Hist. Fung. Halifax, 1: 39, 1788. – *Agaricus radiatus* Bolton: Fr., Syst. mycol., 1: 313, 1821. – *Coprinopsis radiata* (Bolton: Fr.) Redhead, Vilgalys et Moncalvo, Taxon, 50: 230, 2001. – *Coprinus fimetarius* L. ex Fr., Epicrisis: 245, 1838.

Pileus up to 8 × 6 mm when still closed, ovoid, ellipsoid, cylindrical-ellipsoid, then campanulate, obtuse conical, finally applanate with revolute margin, up to 16 mm in diam. when expanded, slightly ribbed, grey-brown, paler towards margins, covered with silvery-whitish to pale silvery-grey veil, soon radially splitting up into appressed or somewhat recurved hairy-fibrillose flocks, finally often disappearing. Lamellae narrowly adnate to free, L = 18–35, l = 1–3, at first white, then greyish, finally blackish. Stipe 15–60 × 0.5–1.5 mm, hyaline-whitish, slightly tapering towards apex, base clavate, up to 2.5 mm broad, minutely hairy-flocculose particularly in lower half and at base, finally practically glabrous. Flesh very thin, whitish. Taste and smell indistinct. Spore print black.

Spores 9.0–15.5 × 6.0–8.5 µm, Q = 1.40–2.21, av. L = 11.9±1.42 µm, av. B = 7.0±0.55 µm, av. Q = 1.7±0.15; ovoid, ellipsoid, elongate-ellipsoid to cylindrical-ellipsoid, with rounded base and apex, germ pore central, up to 1.8 µm wide, dark brown to almost black. Basidia 17–41 × 7.5–11.0 µm, 4-spored, surrounded by 4–6 pseudoparaphyses. Cheilocystidia 27–80 × 20–38 µm, broadly-ellipsoid, ellipsoid, broadly-utriform, utriform and subutriform. Pleurocystidia 50–90 × 19–38 µm, ellipsoid, elongate-ellipsoid, subcylindrical, or elongate-utriform. Veil made up of elon-



**Fig. 2.** *Coprinus radiatus* (KW 35940): **a** – basidiocarps, **b** – basidia, **c** – cheilocystidia, **d** – pleurocystidia, **e** – veil elements, **f** – spores. Bars = 1 cm for basidiocarps and 10 µm for microstructures.

gate, cylindrical and sausage-like elements,  $30\text{--}190 \times 8\text{--}41 \mu\text{m}$ , usually constricted at septa, terminal cells subcylindrical or subfusiform. Clamp-connections present.

**Habitat and distribution.** Solitary or in small groups on dung of herbivorous animals, in forests, gardens, meadows and pastures. Known from Europe, North America and South America (Cacialli et al. 1999, Uljé & Noordeloos 1999, Richardson 2001, Doveri 2004, Uljé 2005, Vesterholt 2008). In Ukraine it was earlier found in these regions: Kharkiv (Milovtsova 1937), Kiev (Gizhytska 1929), Poltava (Ganzha 1960a, 1960b, 1960c, 1960d), Ternopil (Bobyak 1907); apparently rather common.

**Notes.** The species can be recognised by its rather large, narrow, sub-cylindrical spores as well as by its small basidiocarps. *Coprinus macrocephalus*

has spores of similar length but wider (8–10  $\mu\text{m}$ ) and more ellipsoid (Uljé & Noordeloos 1999, Uljé 2005), although Doveri (2004) quoted narrower spores for this species: (13.3)13.7–15.2  $\times$  (7.4)7.6–8.5  $\mu\text{m}$ . Moreover, *C. macrocephalus* has clearly larger basidiocarps (up to 40 mm in diameter) than *C. radiatus* (Uljé & Noordeloos 1999, Doveri 2004, Uljé 2005). It must be mentioned that our collections of *C. radiatus* possess spores differing in size rather strongly: from 9.0–12.0  $\times$  6.0–7.0  $\mu\text{m}$  (KW 29854) to 12.0–15.5  $\times$  6.5–8.0  $\mu\text{m}$  (KW 36940) with several intermediate variants. The spore size of collection KW 36940 is fairly close to Uljé's data (Uljé & Noordeloos 1999, Uljé 2005), while some other ones possess spore sizes more similar to the measurements given by other authors, for example, Kühner and Romagnesi (1953): 11–14  $\times$  6–7  $\mu\text{m}$ ; Moser (1983): 11.0–12.5  $\times$  6.5–7.5  $\mu\text{m}$ ; Orton & Watling (1979): 11–14  $\times$  6–7  $\mu\text{m}$ ; Dissing & Lundquist (1992): 12–14  $\times$  6.5–7.5  $\mu\text{m}$ ; Urbonas (1999): 9.0–13.0(14.0)  $\times$  6.0–7.5  $\mu\text{m}$ . Taking into account these differences in spore-size of *C. radiatus* reported by various European mycologists and the rather great variability of spore-measurements in our collections of this species, one may suppose that *C. radiatus* probably represents a complex of morphologically closely related taxa. Undoubtedly, this interesting problem deserves a special study in the future.

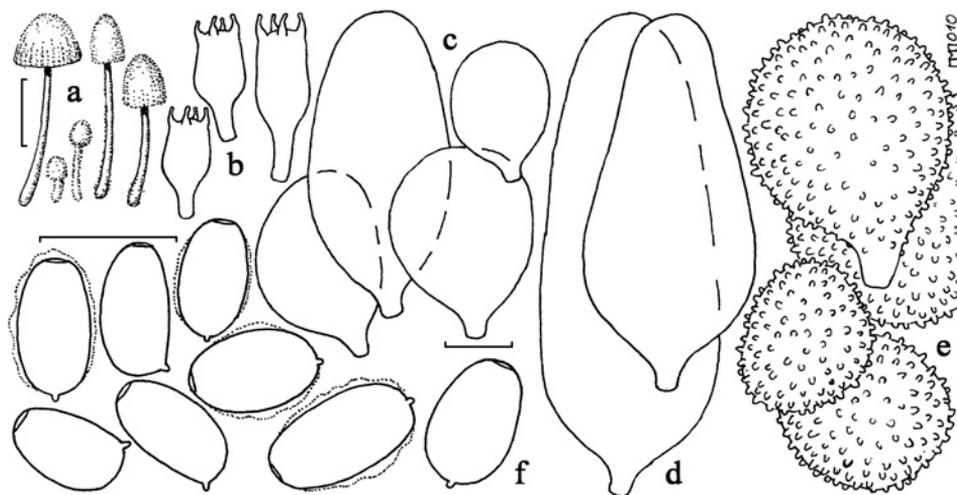
Specimens examined. Ukraine: Rivne Region, Dubrovytsia District, about 4 km north of the village of Litvytsia, on horse dung, 51°36'26.91" N, 26°21'23.215" E, 23 June 2004, leg. M.P. Prydiuk (KW 29854); about 4 km north-east of the village of Litvytsia, on wild boar dung, 51°35'49.20" N, 26°23'36.54" E, 24 July 2006, leg. M.P. Prydiuk (KW 36916)\*; Dubno District, about 1 km east of the village of Martynivka, on horse dung, 50°13'21.68" N, 25°50'21.85" E, 11 August 2009, leg. M.P. Prydiuk (KW 36940)\*. Sumy Region, Korop District, Mezynskyj National Nature Park, village of Vyshen'ky, on horse dung, 51°39'0.52" N, 33°04'46.57" E, 17 August 2004, leg. M.P. Prydiuk (KW 29856). Ternopil Region, Kremenets District, near the village of Stizhok, on horse dung, 50°11'26.42" N, 25°51'28.33" E, 11 August 2009, leg. M.P. Prydiuk (KW 36917)\*. Kharkiv Region, Zmiyiv District, Gomilshanski Lisy National Nature Park, on elk dung, 49°38'17.33" N, 36°19'58.83" E, 2 December 2009, leg. O. Prylutskyj (KW 36918).

### Subsection *Narcotici* Uljé et Noordel.

*Coprinus foetidellus* P.D. Orton, Notes R. Bot. Gdn. Edinb., 31: 139, 1971. Fig. 3.

Pileus at first up to 6  $\times$  4 mm, subglobose, ovoid to broadly-ellipsoid, then campanulate to convex, finally applanate, up to 8 mm in diam., slightly ribbed, covered by pale grey or grey powdery-floccose veil. Lamellae free, crowded, L = 15–20, l = 0–1, at first white then black. Stipe 10–40  $\times$  0.3–0.5 mm, cylindrical with somewhat clavate base, hyaline-whitish. Flesh thin, whitish. Taste not observed, smell strong, narcotic. Spore print black.

Spores 7.2–10.8  $\times$  4.0–6.5  $\mu\text{m}$ , Q = 1.48–2.0, av. L = 9.0  $\pm$  0.91  $\mu\text{m}$ , av. B = 5.3  $\pm$  0.62  $\mu\text{m}$ , av. Q = 1.7  $\pm$  0.11; ovoid to ellipsoid, with rounded base and apex, germ pore central, up to 1.3  $\mu\text{m}$  wide, dark red-brown, myxosporium sparse, up to 1  $\mu\text{m}$  wide, often undetectable. Basidia 15–24  $\times$  6–8  $\mu\text{m}$ , 4-spored, surrounded by 3–5



**Fig. 3.** *Coprinus foetidellus* (KW 29860): **a** – basidiocarps, **b** – basidia, **c** – cheilocystidia, **d** – pleurocystidia, **e** – veil elements, **f** – spores. Bars = 1 cm for basidiocarps and 10  $\mu$ m for microstructures.

pseudoparaphyses. Cheilocystidia 21–45  $\times$  15–22  $\mu$ m, subglobose, ovoid, ellipsoid to utriform. Pleurocystidia 36–72  $\times$  13–27  $\mu$ m, oblong to utriform. Veil consisting of ellipsoid and globose, warty, up to 45  $\mu$ m wide cells. Clamp-connections not observed.

**Habitat and distribution.** Solitary on dung of herbivorous animals and compost heaps, in meadows and pastures. Known from Europe (Cacialli et al. 1999, Uljé 2005, Vesterholt 2008). Its distribution in Ukraine is still insufficiently known.

**Notes.** *Coprinus foetidellus* is recognisable by its absence of sclerotia, small basidiocarps and strong unpleasant smell. A similar species is *C. tuberosus* usually growing from sclerotia and having much larger basidiocarps (Uljé 2005). The spores of our specimens were somewhat narrower than Uljé (2005) indicated (7.5–11.0  $\times$  4.5–7.0  $\mu$ m) and closer to the data of some other authors: 9.0–11.0  $\times$  (5.0)5.5–6.0  $\mu$ m (Orton & Watling 1979); 9.0–11.0  $\times$  5.5–6.0  $\mu$ m (Vesterholt 2008).

**Specimens examined.** Ukraine: Rivne Region, Dubrovytsia District, village of Krupove, on compost heaps, 51°33'54.85" N, 26°29'10.15" E, 25 June 2004, leg. M.P. Prydiuk (KW 29860). Ternopil Region, Kremenets District, near the village of Stizhok, on cow dung, 50°11'26.16" N, 25°51'24.10" E, 11 August 2009, leg. M.P. Prydiuk (KW 36932)\*.

**Subsection *Nivei* Citérin*****Coprinus cordisporus*** Gibbs, Naturalist, 614: 100, 1908.

Fig. 4

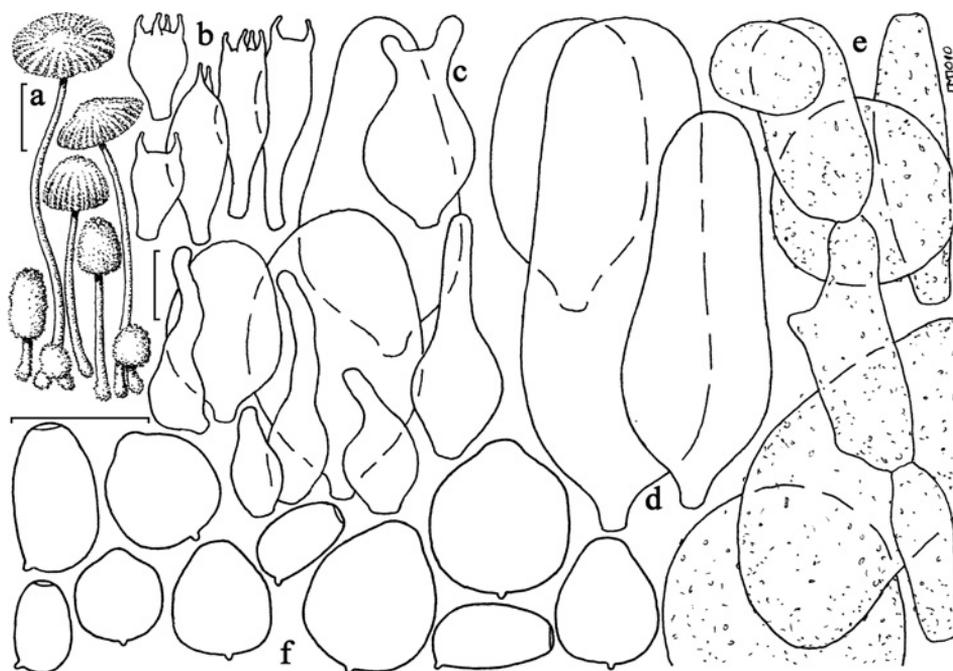
*Coprinus patouillardii* subsp. *isabellinus* Locq., Bull. Soc. Mycol. Fr., 63: 83, 1947. – *Coprinus patouillardii* sensu Cacialli et al., Schede Micol., 1: 213, 1995.

Pileus at first up to  $9 \times 4$  mm, globose, subglobose, ovoid, ellipsoid, elongate-ellipsoid, then campanulate to convex-campanulate, finally applanate, up to 15 mm in diam., ribbed, completely covered by whitish or pale pinkish brown powdery veil, veil at centre somewhat warty-floccose, at margins hairy-floccose. Lamellae free, rather crowded,  $L=16-20$ ,  $l=0-3$ , at first whitish then greyish to black. Stipe  $15-40 \times 0.3-1.0$  mm, cylindrical with clavate, up to 2.0 mm broad base, white, hyaline, minutely floccose by veil remnants, particularly at base. Flesh thin, whitish. Taste and smell indistinct. Spore print black.

Spores  $6.5-11.5 \times 6.0-10.5 \times 4.0-6.0$   $\mu\text{m}$ ,  $Q = 1.0-1.38$ , av.  $L = 8.3 \pm 1.05$   $\mu\text{m}$ , av.  $B = 7.5 \pm 0.94$   $\mu\text{m}$ , av.  $Q = 1.11 \pm 0.07$ ; flattened, rounded pentagonal, rectangular ellipsoid with conical apical papilla and rounded to convex base in frontal view, ellipsoid in lateral view, germ pore central,  $1.3-1.5$   $\mu\text{m}$  wide, dark red-brown. Basidia  $12-22 \times 6.0-9.5$   $\mu\text{m}$ , 4-spored (2-spored in collection KW 36776), surrounded by 4–6 pseudoparaphyses. Cheilocystidia of two types: a)  $24-48 \times 17-24$   $\mu\text{m}$ , subglobose, ovoid, ellipsoid to widely utriform; b)  $16-33 \times 7.5-17.0 \times 2.5-4.5$   $\mu\text{m}$ , lageniform, sometimes branched. Pleurocystidia  $35-58 \times 15-23$   $\mu\text{m}$ , ovoid, utriform, ellipsoid to subcylindrical, or elongate-utriform. Veil consisting of globose, subglobose, ellipsoid and ellipsoid-fusiform, smooth to slightly granular, up to 55  $\mu\text{m}$  wide elements. Clamp-connections absent.

**Habitat and distribution.** Solitary or in small groups on dung of herbivorous animals, in forests, meadows and pastures. Known from Europe, North America and South America (Uljé & Noordeloos 1993; Cacialli et al. 1999, Richardson 2001). In Ukraine apparently fairly common.

**Notes.** *Coprinus cordisporus* differs from similar species (*C. cardiasporus* Bender, *C. ephemeroides* (DC.: Fr.) Fr., *C. patouillardii* Quél.) in the presence of lageniform cheilocystidia. Moreover, *C. patouillardii* doesn't occur on dung, *C. ephemeroides*, which, according to Uljé (2005) may sometimes also possess sparse lageniform cheilocystidia, has a small ring, and *C. cardiasporus* has differently shaped spores (heart-shaped and much narrower:  $5.0-6.5$   $\mu\text{m}$ ) (Uljé & Noordeloos 1993, Uljé 2005). The spores of our collections rather strongly vary in size: specimens with 4-spored basidia had an average spore length from 7.3  $\mu\text{m}$  (KW 36929) to 8.7  $\mu\text{m}$  (KW 36775) while one with 2-spored basidia (KW 36776) showed an average spore-length 10.5  $\mu\text{m}$ , but due to presence of lageniform cheilocystidia all the collections were undoubtedly *C. cordisporus*. Although our 2-spored collection possessed larger spores, Uljé indicated about an equal spore-



**Fig. 4.** *Coprinus cordisporus* (KW 36776): **a** – basidiocarps, **b** – basidia (4-spored ones from KW 25461), **c** – cheilocystidia, **d** – pleurocystidia, **e** – veil elements, **f** – spores. Bars = 1 cm for basidiocarps and 10  $\mu$ m for microstructures.

size for 2- and 4-spored specimens of this species (Uljé & Noordeloos 1993, Uljé 2005). Besides, Miller et al. (1982) reported for 4-spored collection of *C. cordisporus* from Alaska a spore-size of (7.0)9.0–11.0(12.0)  $\times$  8.0–10.0  $\times$  5.5–7.0  $\mu$ m, which is rather close to the spore-size of our 2-spored collection.

**Specimens examined.** Ukraine: Rivne Region, Dubrovitsya District, near the village of Krupove, on horse dung, 51°34'4.30" N, 26°28'18.17" E, 15 July 2003, leg. M.P. Prydiuk (KW 25460); about 1.5 km west of the village of Krupove, on horse dung, 51°33'37.78" N, 26°26'31.94" E, 26 July 2006, leg. M.P. Prydiuk (KW 36775)\*; Dubno District, about 1 km east of the village of Martynivka, on horse dung, 50°13'20.49" N, 25°50'2.78" E, 11 August 2009, leg. M.P. Prydiuk (KW 36929)\*. Sumy Region, Seredyna-Buda District, Desnians'ko-Starohuts'kyj National Nature Park, about 1 km north of the village of Stara Huta, on horse dung, 52°19'21.46" N, 33°47'43.38" E, 15 August 2003, leg. M.P. Prydiuk (KW 25461). Chernihiv Region, Korop District, Mezyns'kyj National Nature Park, about 2 km north of the village of Sverdlovka, on cow dung, 51°48'40.62" N, 33°04'23.08" E, 26 May 2009, leg. M.P. Prydiuk (KW 36926)\*; northern margin of the village of Ryhli, on cow dung, 51°41'13.94" N, 32°52'39.37" E, 28 May 2009, leg. M.P. Prydiuk (KW 36927)\*. Ternopil Region, Kremenets District, about 1 km north-east of the village of Stizhok, on horse dung, 50°11'37.08" N, 25°51'1.09" E, 11 August 2009, leg. M.P. Prydiuk (KW 36928)\*. Odesa Region, Kiliya District, Dunaiski Plavni Biosphere Reserve, about 2 km north of the town of Vylkove, on cow dung, 45°25'38.72" N, 29°33'55.43" E, 23 October 2009, leg. M.P. Prydiuk (KW 36776).

***Coprinus ephemeroïdes* (DC.: Fr.) Fr., Epicrisis: 250, 1838.**

Fig. 5

*Agaricus ephemeroïdes* DC. in DC. et Lam., Fl. franç., Ed. 3, 2: 145, 1805. – *Agaricus ephemeroïdes* DC.: Fr., Syst. mycol., 1: 313, 1821. – *Agaricus hendersonii* Berk. in Hooker, Engl. Fl., 5: 122, 1836. – *Coprinus hendersonii* (Berk.) Fr., Epicrisis: 250, 1838. – *Coprinus bulbillosus* Pat., Tab. anal. Fung., 2: 60, 1889.

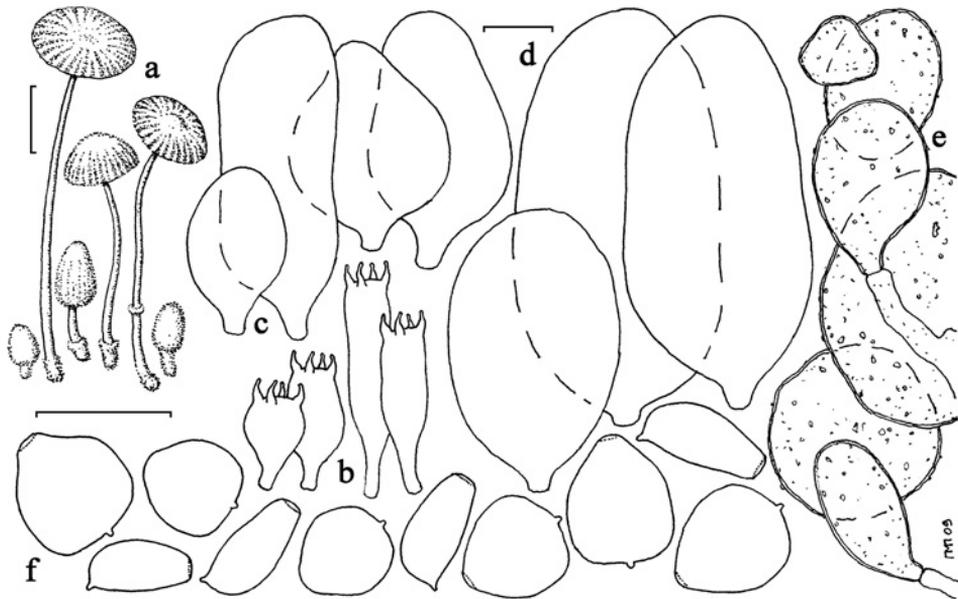
Pileus at first up to 5 × 3 mm, globose, subglobose, ovoid, ellipsoid, elongate-ellipsoid, then campanulate to convex, finally applanate, up to 15 mm in diam., ribbed, completely covered by whitish or pale pinkish brown powdery veil, veil at centre somewhat warty-floccose, at margins hairy-floccose. Lamellae free, rather crowded, L = 15–25, l = 0–3, at first whitish then grayish to black. Stipe 20–40 × 0.3–1.0 mm, cylindrical with clavate base up to 2.0 mm broad, white, hyaline, minutely floccose by veil-remnants, particularly at base where the veil-remnants form an erect floccose volva later turning into a floccose ring in the lower part of the stipe. Flesh thin, whitish. Taste and smell indistinct. Spore print black.

Spores 6.5–9.5 × 6.5–8.5 × 4.5–5.0 µm, Q = 1.0–1.29, av. L = 8.5 ± 0.56 µm, av. B = 7.5 ± 0.49 µm, av. Q = 1.12 ± 0.06; flattened, rounded pentagonal, rectangular ellipsoid, with apical papilla and rounded to convex base in frontal view, ellipsoid in lateral view, germ pore central, 1.3–1.5 µm wide, dark red-brown. Basidia 12–25 × 6–9 µm, 4-spored, surrounded by 4–7 pseudoparaphyses. Cheilocystidia 18–48 × 14–31 µm, subglobose, ovoid, ellipsoid to utriform. Pleurocystidia 29–55 × 17–33 µm, ovoid, utriform, ellipsoid, or elongate-ellipsoid. Veil consisting of globose, subglobose and ellipsoid, up to 50 µm wide, smooth or slightly granular elements. Clamp-connections absent.

Habitat and distribution. Solitary or in small groups on dung of herbivorous animals, in forests, meadows and pastures. Known from Europe, Asia and North America (Uljé & Noordeloos 1993, Caciali et al. 1999, Urbonas 1999). In Ukraine it was earlier found in Ternopil Region (Bobyak 1907); its distribution is apparently insufficiently known.

Notes. *Coprinus ephemeroïdes* is very similar to *C. cordisporus* and *C. patouillardii* differing mainly by their presence of a small ring in the lower part of the stem. Moreover, *C. patouillardii* does not grow on dung, and *C. cordisporus* possesses numerous lageniform cheilocystidia, although Uljé noted sparse lageniform ones also in some collections of *C. ephemeroïdes* (Uljé & Noordeloos 1993, Uljé 2005). Even though the spores of our collections are slightly larger than some authors indicated (Kühner & Romagnesi 1953, Uljé & Noordeloos 1993, Doveri 2004, Uljé 2005, Vesterholt 2008), on the whole their features correspond rather well to Uljé's data (Uljé & Noordeloos 1993, Uljé 2005).

Specimens examined. Ukraine: Rivne Region, Dubrovitsya District, about 0.5 km north of the village of Zalishany, on horse dung, 51°33'24.21" N, 26°24'57.07" E, 10 July 2000, leg. M.P. Prydiuk (KW 25492); near the village of Krupove, on horse dung, 51°34'15.13" N, 26°29'29.26" E, 15 July 2003, leg. M.P. Prydiuk (KW 25464); on horse dung, 51°34'3.45" N, 26°28'2.88" E, 16 July 2003, leg. M.P. Prydiuk (KW 25465).



**Fig. 5.** *Coprinus ephemeroideus* (KW 25492): **a** – basidiocarps, **b** – basidia, **c** – cheilocystidia, **d** – pleurocystidia, **e** – veil elements, **f** – spores. Bars = 1 cm for basidiocarps and 10 µm for microstructures.

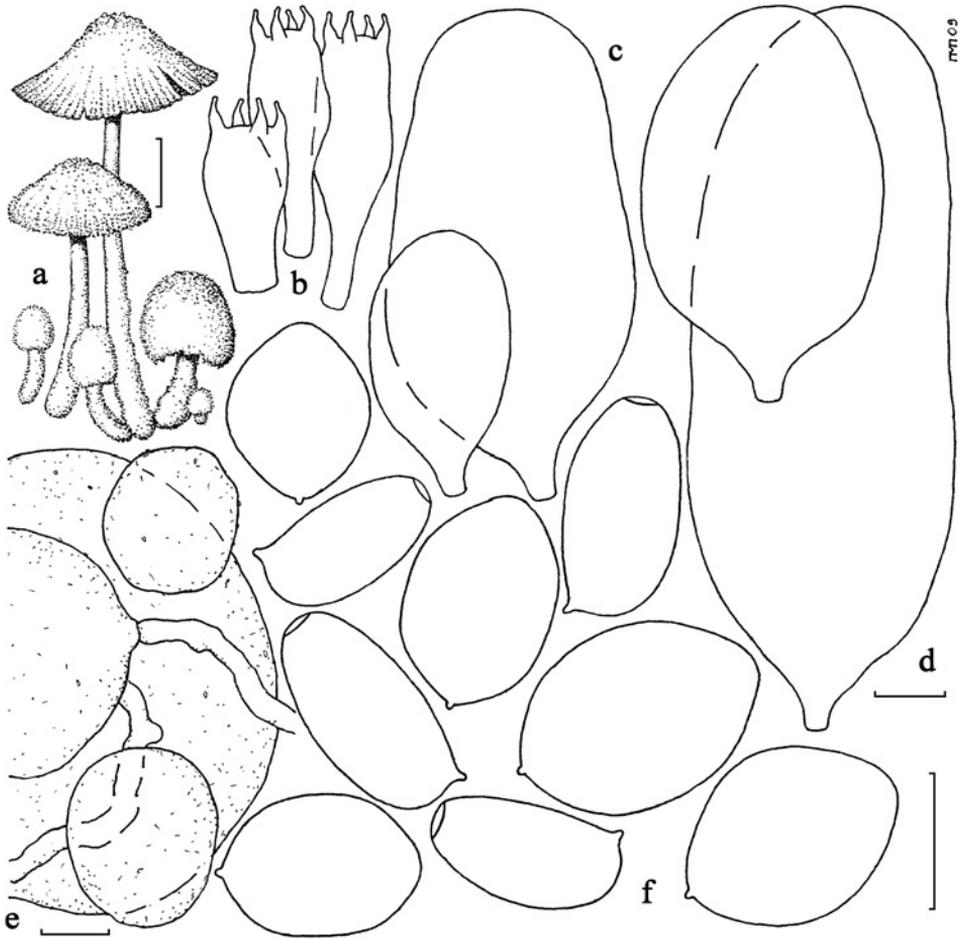
***Coprinus niveus* (Pers.: Fr.) Fr., Epicrisis: 246, 1838.**

**Fig. 6, 10A**

*Agaricus niveus* Pers., Syn. meth. Fung.: 400, 1801. – *Agaricus niveus* Pers.: Fr., Syst. mycol., 1: 311, 1821. – *Coprinopsis nivea* (Pers.: Fr.) Redhead, Vilgalys et Moncalvo, Taxon, 50: 229, 2001. – *Coprinus latisporus* P.D. Orton, Notes R. Bot. Gdn. Edinb., 32: 140, 1972.

Pileus at first 10–20 × 6–13 mm, subglobose, ovoid, ellipsoid to cylindrical-ellipsoid, then obtusely conical to convex, finally applanate with revolute margins, up to 30 mm in diam., ribbed, completely covered by white powdery veil, at margins somewhat hairy-floccose. Lamellae free, crowded, L = 25–40, l = 1–5, at first white, then gray, finally black. Stipe 10–70 × 2–4 mm, slightly tapering upwards, with clavate base up to 5–6 mm broad, white, floccose by veil remnants. Taste and smell indistinct. Spore print black.

Spores 12.0–18.5 × 9.5–13.5 × 7.5–8.5 µm, Q = 1.11–1.57, av. L = 15.1 ± 1.5 µm, av. B = 11.3 ± 0.8 µm, av. Q = 1.34 ± 0.11; flattened, widely-ellipsoid with apical papilla, limoniform to rounded-hexagonal with rounded base and apical papilla in frontal view, ellipsoid in lateral view, germ pore central or slightly eccentric, up to 1.8 µm wide, dark red-brown to almost black. Basidia 24–36 × 10–12 µm, 4-spored, surrounded by 5–7 pseudoparaphyses. Cheilocystidia 31–77 × 15–43 µm, ellipsoid,



**Fig. 6.** *Coprinus niveus* (KW 25480): **a** – basidiocarps, **b** – basidia, **c** – cheilocystidia, **d** – pleurocystidia, **e** – veil elements, **f** – spores. Bars = 1 cm for basidiocarps and 10 µm for microstructures.

broadly utriform to subcylindrical. Pleurocystidia 52–130 × 24–55 µm, similar to cheilocystidia. Veil consisting of subglobose cells up to 80 µm wide. Clamp-connections present.

**Habitat and distribution.** Solitary or subfasciculate on dung of herbivorous animals, in forests, steppes, meadows and pastures. Cosmopolitan (Uljé & Noordeloos 1993, Cacialli et al. 1999, Uljé 2005, Vesterholt 2008). In Ukraine it was earlier found in the Crimea (Sarkina 2001, 2004), Donetsk (Zerova 1959, Wasser & Soldatova 1977), Kherson (Wasser & Soldatova 1977), Luhansk (Wasser &

Soldatova 1977), Poltava (Ganzha 1960a, Besedina 1998), and Ternopil (Batyrova 1989) Regions; apparently common.

**Notes.** This species is distinguishable by its very large, flattened, limoniform spores, 4-spored basidia and rather large snow-white basidiocarps (Uljé & Noordeloos 1993, Doveri 2004, Uljé 2005).

**Specimens examined.** Ukraine: Kyiv Region, municipality of Irpin, near the settlement of Vorzel, on horse dung, 50°33'19.75" N, 30°09'47.53" E, 25 August 1965, leg. G.L. Rozhenko (KW 29915); Donetsk Region, Volodars'ke District, Ukrainian Steppe Nature Reserve, Kamyani Mogyly department, on cow dung, 47°18'47.20" N, 37°04'10.31" E, 08 June 1970, leg. S.P. Wasser (KW 4618); AR Crimea, municipality of Yalta, Yalta forest-mountain Nature Reserve, Livadia forest area, on horse dung, 44°28'42.66" N, 34°03'31.95" E, 24 September 2003, leg. M.P. Prydiuk (KW 25480); Chernihiv Region, Korop District, Mezyn's'kyj National Nature Park, about 4 km north-west of the village of Buzhanka, on horse dung, 51°40'52.18" N, 33°04'11.31" E, 18 August 2004, leg. M.P. Prydiuk (KW 36933)\*; Luhans'k Region, Lutugino District, about 1 km west of the village of Rozkishne, on cow dung, 48°29'26.11" N, 39°14'4.26" E, 21 September 2004, leg. M.P. Prydiuk (KW 29842).

***Coprinus pachyspermus* P.D. Orton var. *tetrasporus* Prydiuk, var. nov.**

Fig. 7, 10B

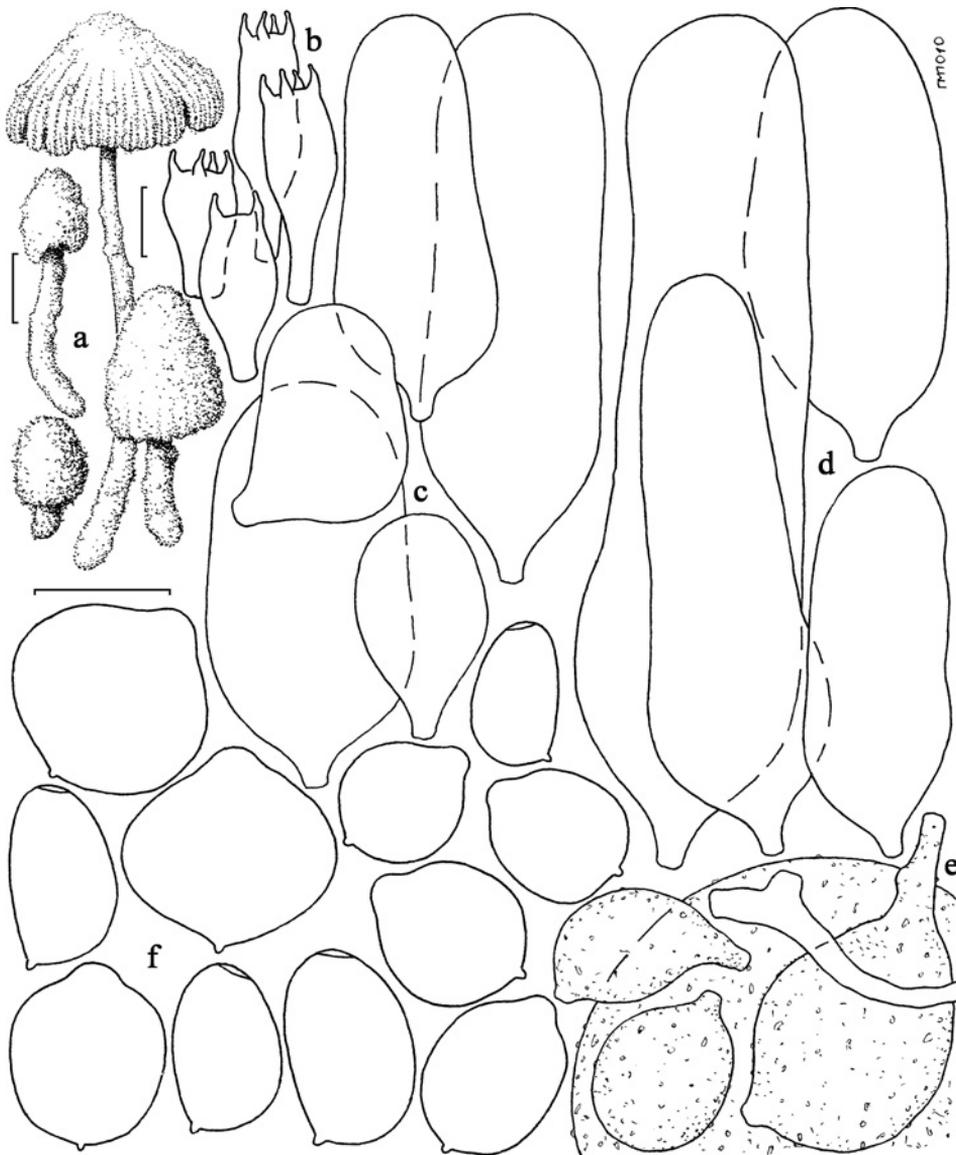
(MycoBank MB519044)

**Diagnosis latina.** A varietate typica differtur basidiis tetrasporiis et pileis roseoligriseis, roseolicremeis.

**Holotypus.** Ukraina, Odessa regio, Kiliya Districtus, pagus Lisky, 25-X-2009, KW 36809.

Pileus at first 10–23 × 8–17 mm, ovoid, ellipsoid to ellipsoid-campanulate, then obtusely conical to convex, finally applanate with revolute margin, up to 33 mm in diam., slightly ribbed, completely covered by pinkish-creamy, pinkish-grey or creamy-white powdery, towards margins more hairy-floccose veil. Lamellae free, crowded, L = 25–40, l = 1–5, at first whitish then gray to black. Stipe 25–80 × 1.5–4.0 mm, slightly attenuated upwards, with clavate base up to 5 mm broad, white, flocculose by veil remnants. Flesh thin, white. Taste mild, smell indistinct. Spore print black.

Spores 10.0–16.0 × 9.0–15.5 × 6.5–8.5 μm, Q = 0.93–1.39, av. L = 12.9 ± 1.59 μm, av. B = 11.4 ± 1.85 μm, av. Q = 1.14 ± 0.11; flattened, subglobose with apical papilla to widely-ellipsoid with apical papilla, widely-limoniform, sometimes rounded-hexagonal, with convex base and apical papilla in front view, ellipsoid in lateral view, germ pore eccentric, up to 1.8 μm wide, dark red-brown to almost black. Basidia 18–31 × 9.5–12.0 μm, 4-spored, also many 2-spored occur, surrounded by 4–6 pseudoparaphyses. Cheilocystidia 32–84 × 19–31 μm, ellipsoid, broadly utriform, utriform to subcylindrical. Pleurocystidia 55–127 × 17–33 μm, ellipsoid, cylindrical-ellipsoid, or utriform to subcylindric. Veil consisting mainly of subglobose cells up to 75 μm wide, but also some pyriform, ellipsoid and hyphal elements occur. Clamp-connections present.



**Fig. 7.** *Coprinus pachyspermus* var. *tetrasporus* (KW 36809): **a** – basidiocarps, **b** – basidia, **c** – cheilocystidia, **d** – pleurocystidia, **e** – veil elements, **f** – spores. Bars = 1 cm for basidiocarps and 10  $\mu$ m for microstructures.

**Habitat and distribution.** Solitary and subfasciculate on cow dung, in pastures. Apparently very rare. *Coprinus pachyspermus* var. *pachyspermus* known from Europe (Orton 1972, Uljé & Noordeloos 1993, Uljé 2005), was also re-

ported from Ukraine by Besedina (1998). However, careful examination of this collection (KW 8805) revealed that it actually belonged to *C. niveus*.

**Notes.** The features of *Coprinus pachyspermus* var. *tetrasporus* rather well fit those of the typical variety (Orton 1972) except for the presence of 4-spored basidia (although many 2-spored ones also occur) and its pinkish grey, pinkish creamy to pinkish white pileus: the typical one has a grey or creamy grey pileus (Orton 1972, Uljé & Noordeloos 1993, Uljé 2005). The colour of basidiocarps of *C. pachyspermus* var. *tetrasporus* is rather similar to that of *C. pseudoniveus*, but the latter one differs by smaller and relatively narrower spores with a central germ pore. Although our specimens of *C. pseudoniveus* have slightly larger spores ( $9.5\text{--}13.5 \times 8.0\text{--}11.5 \times 6.0\text{--}8.0 \mu\text{m}$ ) than other authors (Uljé & Noordeloos 1993, Uljé 2005, Vesterholt 2008) indicate, they are much smaller than those of *C. pachyspermus* var. *tetrasporus*. *C. niveus* possesses larger and relatively narrower (more ellipsoid in frontal view) spores and snow-white basidiocarps (without pinkish grey hue). Besides, the spores of *C. pachyspermus* var. *tetrasporus* are comparatively wider than those of both *C. niveus* and *C. pseudoniveus* (Fig. 10): their  $Q = 0.93\text{--}1.39$  (the width of some spores in this collection even exceeds their length), av.  $Q = 1.14$ , while spores in our collections of *C. niveus* have  $Q = 1.11\text{--}1.57$ , av.  $Q = 1.34$ , and spores in our specimens of *C. pseudoniveus* have  $Q = 1.04\text{--}1.50$ , av.  $Q = 1.25$ .

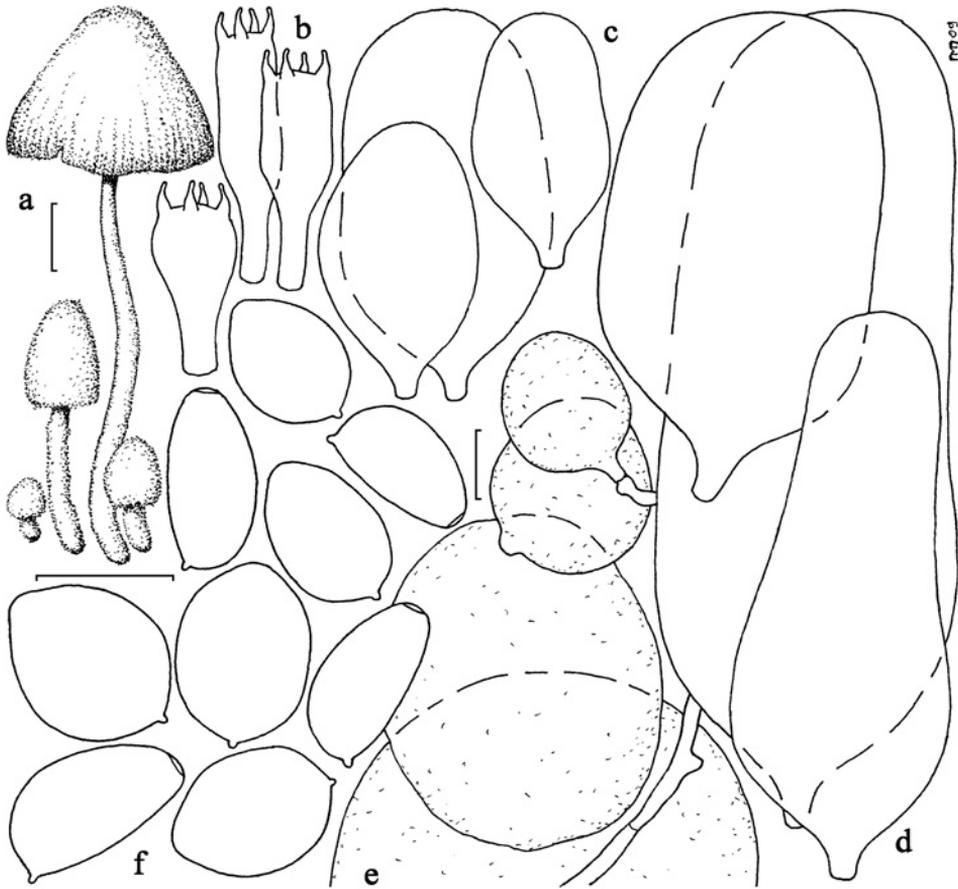
**Specimen examined.** Ukraine: Odesa Region, Kiliya District, Dunaiski Plavni Biosphere Reserve, about 1 km east of the village of Lisky, on cow dung,  $50^{\circ}34'45.01''$  N,  $30^{\circ}49'27.37''$  E, 25 October 2009, leg. M.P. Prydiuk (KW 36809, holotype).

***Coprinus pseudoniveus*** Bender et Uljé in Uljé et Noordeloos, *Persoonia*, 15: 270, 1993. Fig. 8, 10C

*Coprinopsis pseudonivea* (Bender et Uljé) Redhead, Vilgalys et Moncalvo, *Taxon*, 50: 230, 2001.

Pileus at first  $5\text{--}15 \times 4\text{--}10$  mm, subglobose, ovoid, ellipsoid or ellipsoid-cylindrical, then obtusely conical to convex, finally appanate with revolute margin, up to 30 mm in diam., ribbed, completely covered by powdery veil with a pale pinkish brown to white colour and pinkish grey hue, which is more hairy-floccose towards margins. Lamellae free, crowded,  $L = 20\text{--}40$ ,  $l = 1\text{--}3$ , at first whitish, then grey, finally black. Stipe  $30\text{--}80 \times 2\text{--}3$  mm, slightly attenuated upwards, with clavate up to 4 mm broad base, white, flocculose by veil remnants. Flesh thin, white. Taste mild, smell not recorded. Spore print black.

Spores  $9.5\text{--}13.5 \times 8.0\text{--}11.5 \times 6.0\text{--}8.0 \mu\text{m}$ ,  $Q = 1.04\text{--}1.50$ , av.  $L = 11.9 \pm 0.91 \mu\text{m}$ , av.  $B = 9.6 \pm 0.73 \mu\text{m}$ , av.  $Q = 1.25 \pm 0.09$ ; flattened, widely-ellipsoid with apical papilla, widely limoniform or rounded-hexagonal, with rounded base and apical papilla in frontal view, ellipsoid in lateral view, germ pore central, up to  $1.5 \mu\text{m}$  wide, dark red-brown to almost black. Basidia  $17\text{--}34 \times 8.5\text{--}12.0 \mu\text{m}$ , 4-spored, surrounded by



**Fig. 8.** *Coprinus pseudoniveus* (KW 25481): **a** – basidiocarps, **b** – basidia, **c** – cheilocystidia, **d** – pleurocystidia, **e** – veil elements, **f** – spores. Bars = 1 cm for basidiocarps and 10  $\mu\text{m}$  for microstructures.

4–6 pseudoparaphyses. Cheilocystidia 20–84  $\times$  10–20  $\mu\text{m}$ , ellipsoid, utriform to subcylindrical. Pleurocystidia 60–144  $\times$  25–38  $\mu\text{m}$ , ellipsoid, cylindrical-ellipsoid, utriform, or subcylindric. Veil consisting of mainly subglobose cells up to 72  $\mu\text{m}$  wide. Clamp-connections not observed.

**Habitat and distribution.** Solitary or in small groups on dung of cow and horse, in meadows and pastures. Known from Europe (Cacialli et al. 1999, Uljé & Noordeloos 1993, Doveri 2004, Uljé 2005, Vesterholt 2008). Its distribution in Ukraine is still insufficiently known, but it is apparently rather common.

**Notes.** *Coprinus pseudoniveus* differs from *C. niveus* and *C. pachyspermus* by its much smaller spores. The spores of *C. cothurnatus* are relatively narrower (6.5–8.5  $\mu\text{m}$ ), more hexagonal and this species has no pleurocystidia (Uljé 2005).

Our specimens have slightly longer and relatively narrower spores, than many other authors indicate for *C. pseudoniveus*: 9.0–12.5 × 7.5–11.5 μm (Uljé & Noordeloos 1993, Uljé 2005, Vesterholt 2008); (9.5)10.0–12.3(12.8) × (8.5)9.0–10.0(10.4) μm (Doveri 2004). Neither the yeast-like smell of basidiocarps (Uljé & Noordeloos 1993, Uljé 2005) was observed in our specimens, but Doveri (2004) did not indicate any smell in his collections of this species. Thus, on the whole the features of our *C. pseudoniveus* collections fit this species description fairly well.

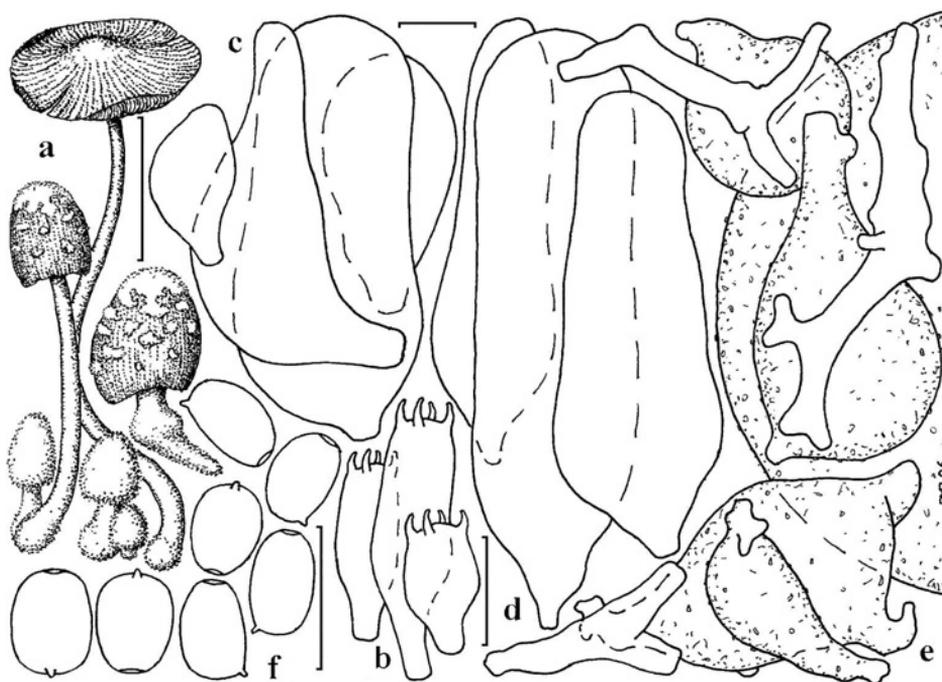
Specimens examined. Ukraine: Kyiv Region, Brovary District, near the village of Skybyn, on unidentified dung, 50°34'47.41" N, 30°49'33.17" E, 01 November 1964, leg. M.Y. Zerova (KW 29899); Obukhiv District, near the village of Tatsenky, on cow dung, 50°09'49.52" N, 30°39'57.12" E, 11 September 2002, leg. M.P. Prydiuk (KW 25481); near the village of Vytachiv, on cow dung, 50°06'2.41" N, 30°52'8.23" E, 18 September 2002, leg. M.P. Prydiuk (KW 25482). Poltava Region, Poltava District, near the village of Zavorsklo, on cow dung, 49°27'11.98" N, 34°38'36.01" E, 27 October 2003, leg. M.P. Prydiuk (KW 25483). Rivne Region, Zdolbuniv District, near the village of Bushcha, on cow dung, 50°14'11.27" N, 25°50'25.08" E, 14 August 2009, leg. M.P. Prydiuk (KW 36937)\*; on horse dung, 50°14'11.25" N, 25°50'25.1" E, 14 August 2009, leg. M.P. Prydiuk (KW 36938)\*. Odesa Region, Kiliya District, Dunaiski Plavni Biosphere Reserve, about 1 km east of the village of Lisky, on cow dung, 45°28'57.39" N, 29°28'24.15" E, 25 October 2009, leg. M.P. Prydiuk (KW 36839)\*.

***Coprinus utrifer* (Joss.) Watling, Notes R. Bot. Gdn. Edinb., 31: 362, 1972. Fig. 9**

*Coprinus utrifer* Joss., Bull. Soc. Mycol. Fr., 64: 27, 1948. – *Coprinopsis utrifer* (Watling) Redhead, Vilgalys et Moncalvo, Taxon, 50: 232, 2001.

Pileus at first 4–9 × 2.0–7.5 mm, ovoid, ellipsoid to ellipsoid-campanulate, then obtusely campanulate to convex, finally applanate with recurved margins, up to 15 mm in diam., slightly ribbed, grey-brown, covered by white felty, towards margins felty-fibrillose, veil later splitting into hairy-fibrillose flocks, finally disappearing. Lamellae free, crowded, L = 35–45, l = 1–5, at first whitish then blackish-brown to black. Stipe 10–60 × 1.0–1.5 mm, cylindrical, slightly tapering upwards, with clavate base up to 3.5 mm broad, hyaline-whitish, minutely hairy by veil remnants, particularly in its lower part. Flesh thin, whitish. Taste and smell indistinct. Spore print black.

Spores (6.0)6.5–7.5 × (4.5)5.0–5.5(6.0) × 4.5–5.0 μm, Q = 1.17–1.52, av. L = 7.0 ± 0.31 μm, av. B = 5.2 ± 0.34 μm, av. Q = 1.34 ± 0.06; widely-ellipsoid to somewhat rectangular-ellipsoid with rounded basis and apex in frontal view, ellipsoid in lateral view, germ pore central, up to 1.5 μm wide, dark red-brown. Basidia 12–24 × 6–8 μm, 4-spored, surrounded by 3–5 pseudoparaphyses. Cheilocystidia 22–62 × 11–25 μm, subglobose, ovoid, ellipsoid, up to subcylindrical or utriform. Pleurocystidia 58–84 × 17–24 μm, widely utriform, ellipsoid to subcylindrical and elongate-utriform. Veil consisting of two kinds of elements: a) 29–82 × 12–82 μm, pyriform, fusoid-ellipsoid, ellipsoid and subglobose; b) branched and diverticulate hyphal elements up to 5–14 μm wide. Clamp-connections present.

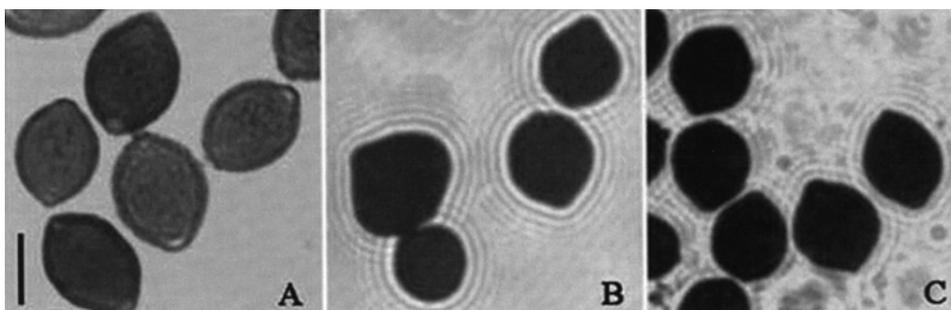


**Fig. 9.** *Coprinus utrifer* (KW 30592): **a** – basidiocarps, **b** – basidia, **c** – cheilocystidia, **d** – pleurocystidia, **e** – veil elements, **f** – spores. Bars = 1 cm for basidiocarps and 10  $\mu$ m for microstructures.

**Habitat and distribution.** Solitary or in small groups on dung of herbivorous animals, in meadows, pastures and steppes. Known from Europe (Orton & Watling 1979, Cacialli et al. 1999, Urbonas 1999, Doveri 2004, Uljé 2005, Vesterholt 2008). Its distribution in Ukraine is insufficiently known yet.

**Notes.** This species can be easily identified due to its rather small rectangular-ellipsoid spores and veil consisting of two types of elements. The presence of branched elements in its veil makes this species similar to representatives of the subsection *Alachuanii* Singer, but Uljé (Uljé & Noordeloos 1993) placed *Coprinus utrifer* into the subsection *Nivei* because of the predominance of subglobose veil elements in this taxon. This point of view was confirmed by molecular data (Hopple & Vilgalys 1999, Moncalvo et al. 2002).

The spores of our specimen were slightly broader than Uljé and Noordeloos (1993) indicated:  $6.0\text{--}7.7 \times 4.2\text{--}5.0 \times 4.1\text{--}4.5 \mu\text{m}$ ; and noticeably smaller than some other authors mentioned:  $7.5\text{--}9.0 \times 4.5\text{--}5.0 \mu\text{m}$  (Moser 1983);  $7.5\text{--}9.0 \times 4.5\text{--}5.5 \mu\text{m}$  (Orton et Watling 1979);  $7\text{--}9 \times 4.5\text{--}5.5 \mu\text{m}$  (Urbonas 1999). However, they correspond more or less to the data of some other authors:  $6.5\text{--}7.5 \times 4.5\text{--}5.0(5.5) \mu\text{m}$  (Doveri, 2004);  $6.5\text{--}7.5 \times 4.0\text{--}5.0 \times 4.0\text{--}4.5 \mu\text{m}$  (Vesterholt 2008). Kühner and Romagnesi (1953)



**Fig. 10.** Spores of some *Coprinus* species under a light-microscope: **A** – *Coprinus niveus* (KW 4618), **B** – *Coprinus pachyspermus* var. *tetrasporus* (KW 36809), **C** – *Coprinus pseudoniveus* (KW 36938). Bar = 10  $\mu$ m.

mentioned even larger spores for the species:  $7.8\text{--}8.8 \times 4.6\text{--}5.3(5.5)$   $\mu$ m. It must be mentioned that Uljé and Noordeloos (1993) noticed many differences in the size of microstructures of *C. utrifer* as given by various authors.

Specimen examined. Ukraine: Luhans'k Region, Sverdlovs'k District, Luhans'k Nature reserve, Provalskij Step department, area called Grushivs'ka, on cow dung,  $48^{\circ}08'59.37''$  N,  $39^{\circ}53'42.90''$  E, 18 September 2005, leg. M.P. Prydiuk (KW 30592)\*.

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