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RUSSULA MEDULLATA (RUSSULALES, BASIDIOMYCOTA): A NEW SPECIES IN THE MYCOBIOTA OF POLAND*

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Abstract. The first Polish locality of *Russula medullata* Romagn. was found in the Gorce Mts (West Carpathians) in August 2007. The basidiocarps grew on fresh meadow close to a thicket with *Populus tremula*, *Betula pendula* and *Salix caprea*, on clayey soil. The basidiocarps of the specimens we found were characterized by a slightly viscid pileus, shining when dry, slightly sulcate at edge, and rather pale color: lilac, flesh-pink, pinkish brown and grey-olive in the center, and greenish grey at margin; mature lamellae ochre, spore print dark ochre, taste mild. The distinctive microscopic features of *R. medullata* are well defined dermatocystidia, terminal hyphae of the pileipellis which are formed on chains of short, inflated cells, and spores with isolated warts. The paper summarizes information on the ecology, distribution and status of the species in Europe, as well as the structural characteristics of the ectomycorrhiza of *R. medullata* with poplar. The features distinguishing *R. medullata* from similar species are given.

Key words: fungi, Gorce Mts, Poland, *Russula*, Western Carpathians

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INTRODUCTION

The first description of *Russula medullata* was published in 1962 by Romagnesi, who redescribed it several years later (Romagnesi 1997) as the first description was not validly published. Since then the species has been recorded in many European countries, but in some regions it is regarded as rare.

Here we describe basidiomata found in the Gorce Mts (Western Carpathians, S Poland) and summarize information on the ecology, distribution and status of the species in Europe, as well as the structural characteristics of its ectomycorrhiza with poplar. We also give the features that distinguish *R. medullata* from similar species.

MATERIAL AND METHODS

The basidiomata were collected in August 2007 in the Gorce Mts (West Carpathians, S Poland) and identified according to the keys and descriptions published by Romagnesi (1967, 1997), Bresinsky (1985) and Sarnari (1998).

Our description of morphological characters of basidiomata are based on fresh and dried specimens. Micromorphological features were examined in fresh and in dry fragments of tissues dehydrated in water, under a Nikon Eclipse E80i light microscope with Nomarski interference contrast, using a 100× objective. Pileipellis and lamella fragments were mounted in sulphovanilin to examine for the presence of latex in hymenial cystidia and dermatocystidia. Elements of the hymnenium and pileipellis were also observed and measured from preparations mounted in 2% KOH. Spores were examined in Melzer's reagent and were taken from the spore print for measurements. Values are based on 30–50 measurements, and are presented as minimum, maximum and extreme values (in parentheses), along with the means. The spore length/width ratio (Q) was also calculated. Specimens are deposited in the fungal collection of the Herbarium of the Institute of Botany, Jagiellonian University in Kraków (KRA).

DESCRIPTION OF BASIDIOCARPS

Russula medullata Romagn.

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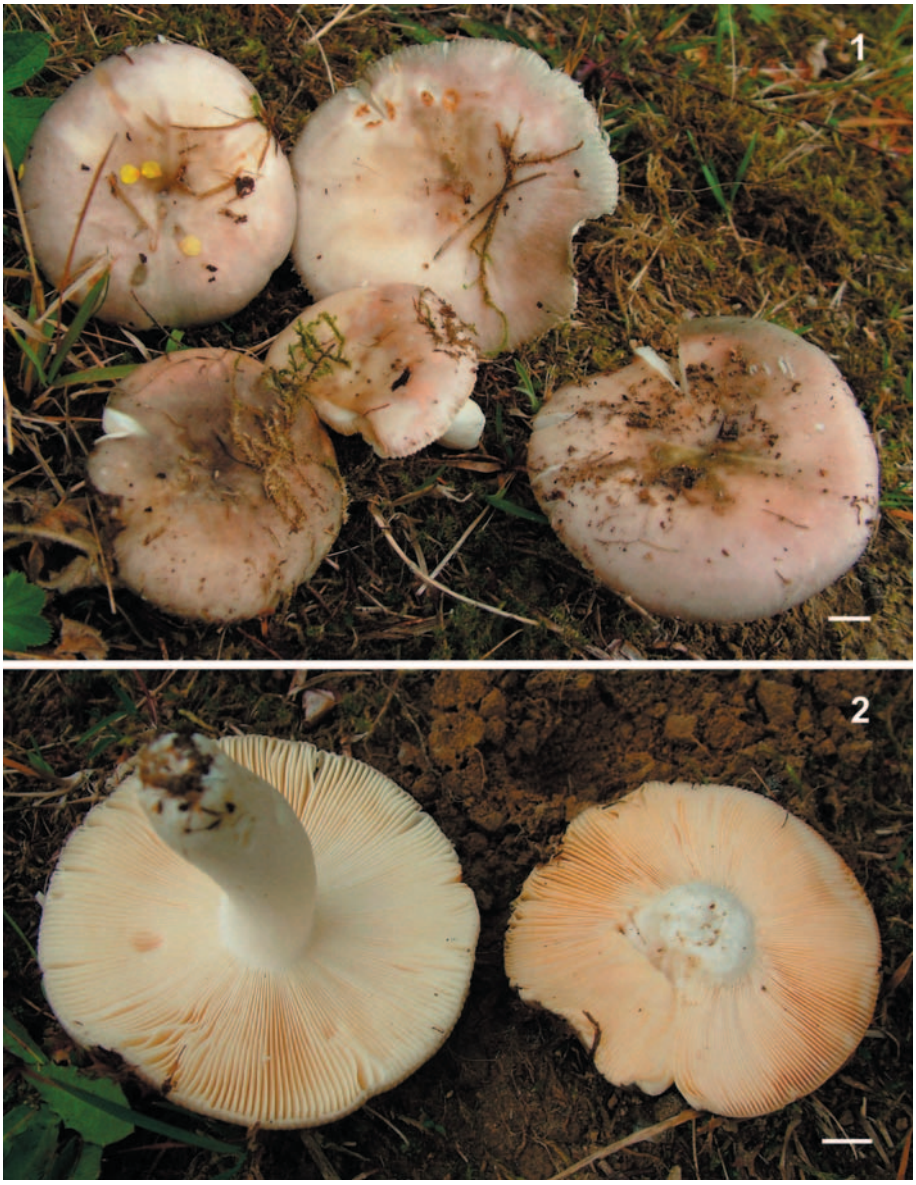
Pileus (Fig. 1) up to 100 mm in diameter, soon expanding, with central depression, margin smooth

* This paper is dedicated to Professor Tomasz Majewski on the occasion of his 70th birthday.

in young, striate (slightly sulcate) in older specimens, surface moderately viscid, shining when fresh and in dry condition, with some debris and plant particles attached, color lilac, flesh-pink, pinkish brown, pinkish grey, in some specimens greenish-grey to olive-grey in center, faded to cream or ochraceous in places, greenish grey at margin, pileipellis in dry specimens olive-grey, brownish grey to ochraceous grey with a slight pinkish hue. Stipe up to 80 mm long and 25 mm in diameter, cylindrical to slightly clavate and rounded at base, white, sometimes with ochraceous tint. Lamellae (Fig. 2) whitish in young basidiomata, becoming ochraceous with age, adnate. Context white when fresh, ochraceous when dry, pale orange-pink with $FeSO_4$, taste mild, smell absent. Spore print III c (acc. to color scale of Romagnesi 1967). Basidia (Fig. 3) distinctly clavate, 37–48(–50) × (8–)9–11 µm, mean 44.1 × 10.4 µm, sterile elements (basidioles) (Fig. 3) slightly clavate, rarely cylindrical, (25–)27–32(–36) × 7–10 µm, mean 30.0 × 8.2 µm. Pleurocystidia (Fig. 4) fairly frequent, cigar-shaped, with apical appendices, mucronate or tapered at apex, 52–75(–90) × 8–11(–13) µm, mean 70.5 × 10.9 µm, content dark grey in sulphovanilin. Cheilocystidia similar to pleurocystidia. Spores (Fig. 5) 6–8 × (4–)5–6 µm, mean 7.2 × 5.4 µm, broadly ellipsoid, Q = 1.08–1.5(–1.75), mean 1.33, covered mostly with isolated, round, rarely elongated or fused warts not exceeding 0.5 µm in height, ornamentation of the hilar side of spores usually less prominent than that of the opposite side, suprahilar plaque weakly amyloid. Pileipellis with generative hyphae and pileocystidia, without primordial hyphae and setae. Pileocystidia (Fig. 6) with content black in sulphovanilin, cylindrical to slightly spindle-shaped, (24–)30–75(–80) × 5–9(–10) µm, mean 50 × 7.7 µm, capitate, with apical appendix or rounded apex, similar in all parts of the pileipellis, but cystidia with appendices less frequent at pileus margin. Generative hyphae (Fig. 7) frequently septate, branched, cylindrical or with slightly to moderately swollen hyphal segments, constricted at septa, terminal elements mostly cylindrical, less frequently swollen and narrowing at apices, (21–)25–65(–76) µm long and 4–7(–9) µm in diameter, mean 45.6 × 5.1 µm.

SPECIMENS EXAMINED: POLAND. WESTERN CARPATHIANS, Gorce Mts, Ochotnica Górna village, Duże Jaszcze valley, right slope with eastern exposition, alt. 840 m a.s.l., on mown fresh meadow close to thicket with *Populus tremula* L., *Betula pendula* Roth. and *Salix caprea* L., on clayey soil over flysch bedrock with enhanced content of calcium, 30 Aug. 2007, *leg. M. Kozak & P. Mleczko* (KRA F-2007-2, KRA F-2007-3), *ca* 20 basidiocarps at two sites *ca* 200 m apart.

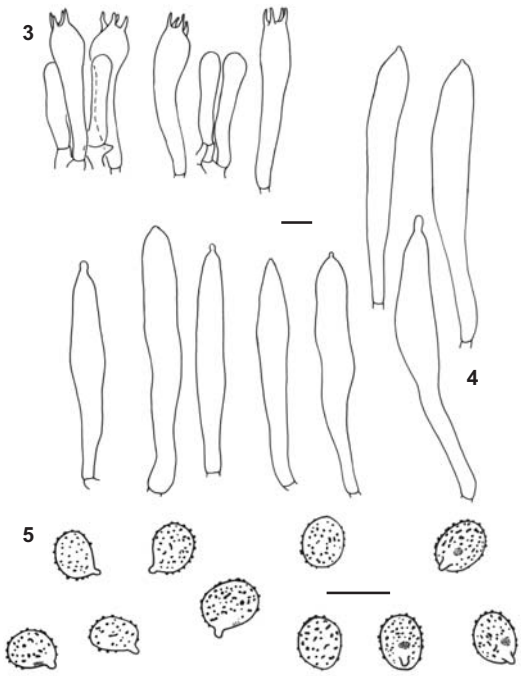
AFFINITIES. *Russula medullata* is classified in the subgenus *Heterophyllidia* Romagnesi *emend*. Sarnari, section *Heterophyllae* Fries, subsection *Griseinae* J. Schaeffer (Sarnari 1998). Like many species of the subsection, *R. medullata* is characterized by a moderate (pale orange pink) reaction of the context to $FeSO_4$, well defined dermatocystidia, and terminal hyphae of the pileipellis which are formed in chains of inflated cells. It can be distinguished from other European species of the subsection *Griseinae* by its characteristic combination of features: spores with rather isolated warts and an ochraceous spore print, that is rather exceptional in this subsection (Sarnari 1998). Apart from those features, *R. medullata* also shows loose, spongy context of the core part of the stipe, a slightly viscid pileipellis, shiny when dry, slightly sulcate pileus edge and the ochraceous color of mature lamellae. The color of the pileus is variable in this species, with different combinations of green, grey, olive and brown but also lilac, violet to pinkish and ochraceous to cream shades, similarly to some other *Russula* species such as *R. anatina* Romagn., *R. aeruginea* Fr., *R. cyanoxantha* (Schaeff.) Fr., *R. grisea* (Batsch) Fr., *R. ionochlora* Romagn., *R. parazurea* Jul. Schäff. and *R. pseudoaeruginea* (Romagn.) Kuyper & Vuure (Romagnesi 1967; Kühner 1975; Einhellinger 1985; Skirgiełło 1991; Sarnari 1998; Kränzlin 2005; Kaufmann 2007; Knudsen *et al*. 2008). All of them, however, have a much paler spore print (white in *R. cyanoxantha* and cream in the others). *Russula cyanoxantha* also differs in having poorly developed pileocystidia and pileipellis hyphae which are not swollen at the base, and by its pale, flexible lamellae. As compared with *R. medullata*, *R. grisea* has



Figs 1 & 2. *Russula medullata* Romagn. from Poland. 1 – basidiocarps of different ages, 2 – lamellae of immature (left) and mature (right) basidiocarp. Scale bars = 1 cm.

a stronger reaction (orange pink) and *R. anatina* a weaker reaction (slowly and weakly pinkish, then greenish) of the context to $FeSO_4$. The spores of *R. aeruginea, R. parazurea* and *R. pseudoaeruginea* differ from those of *R. medullata* in having cristulate to subreticulate ornamentation. The pale tones of the pileipellis of Polish specimens, with lilac, flesh-pink and grey shades, and a weak share of green, make them similar to the specimens of *R. medullata* mentioned by, for example, Kühner (1975) and Kaufmann (2007) from Greenland and Scandinavian mountains, and by Romagnesi (1967, 1997) from France.

The spore print color and spore dimensions

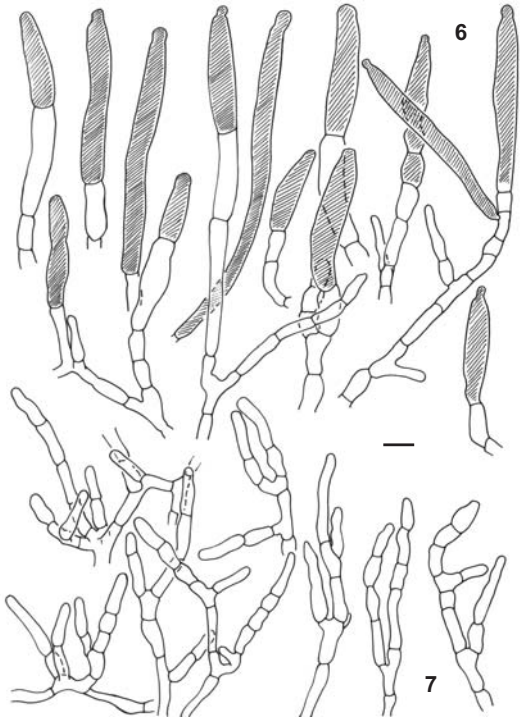


Figs 3–5. Microscopic features of *Russula medullata* Romagn. from Poland. 3 – basidia and sterile elements of the hymenium, 4 – pleurocystidia, 5 – spores. Scale bars = 10 μm.

of Polish specimens are generally in accord with those given in the literature [spore print color IIIa-c according to scale of Romagnesi (1967); spore dimensions (5.7–)6.0–8.5(–9) × (5.0–)5.5–7.0 μm], although the specimens from the Gorce Mts have slightly lower maximum spore length (8 μm) and minimum spore width (5 μm, exceptionally 4 μm) than given by other authors (Romagnesi 1962; Kühner 1975; Einhellinger 1985; Sarnari 1998; Kränzlin 2005; Kaufmann 2007; Knudsen *et al*. 2008).

ECOLOGY. *Russula medullata* occurs often but not exclusively in open, grassy vegetation, mostly on basic to neutral soil, in moist places (Einhellinger 1985; Sarnari 1998; Adamčík *et al*. 2006). It is a mycorrhizal partner of broadleaved trees. In Central Europe it prefers *Populus* and *Betula* (Einhellinger 1985; Jahn & Jahn 1986; Krieglsteiner 2000; Adamčík *et al*. 2006) but has also been mentioned as growing in association with other trees such as *Carpinus*, *Castanea*, *Corylus*, *Fagus* and *Quercus* (Einhellinger 1985; Sarnari 1998; Bon 2000; Krieglsteiner 2000; Kränzlin 2005; Knudsen *et al*. 2008). In the Mediterranean region it was recorded under *Quercus suber* L., and in boreal/arctic and alpine areas close to *Salix* spp. (e.g., *S. herbacea* L.), *Betula nana* L., *Polygonum viviparum* L. and *Dryas octopetala* L. (Kühner 1975; Sarnari 1998; Bon 2000; Knudsen *et al*. 2008).

Specimens from the Gorce Mts were found on mown fresh meadow on a small slope at lower elevation (840 m a.s.l.), close to a thicket with poplar, birch and willow, the trees most often accompanying *Russula medullata* in Central Europe (Einhellinger 1985; Adamčík *et al*. 2006). Although soil pH was not measured it is safe to assume that it is fairly neutral, as the part of the Gorce Mts where the species was recorded is built of flysch bedrock with calcium inclusions, and rich brown soil with neutral pH is common in this region (Sikora & Żytko 1968).



Figs 6 & 7. Microscopic features of *Russula medullata* Romagn. from Poland. 6 – pileocystidia, 7 – generative hyphae of the pileipellis with terminal elements. Scale bars = 10 μm.

ECTOMYCORRHIZA. Ectomycorrhizae of *Russula medullata* with *Populus tremula* were identified and described in detail by Beenken (2001a). Monopodial-pinnate mycorrhizal systems were characterized by light brown color and a short-spiny surface due to the presence of two types of cystidia: (1) thin-walled, with or without an apical appendix, with content brownish in sulphovanilin, and (2) thick-walled, awl-shaped cystidia with swollen bases. Rhizomorphs running along the roots, with ladder-like enlarged inner hyphae, were also found. The presence of two types of cystidia, together with a plectenchymatous mantle and differentiated rhizomorphs, is shared by the ectomycorrhizae of other *Russula* species of the subgenus *Heterophyllidia* described to date (Beenken 2001b, 2004; Agerer & Rambold 2004–2009), and may be regarded as a distinguishing feature for this subgenus.

DISTRIBUTION. *Russula medullata* has a wide distribution in Europe, ranging from the Mediterranean (Italy, Portugal, Spain), through the Balkans (Croatia), Western and Central Europe (Austria, Czech Republic, France, Germany, Netherlands, Romania, Slovakia, Switzerland) up to the Nordic region (Estonia, Finland, Greenland, Norway, Sweden) and Russia (Romagnesi 1967; Marchand 1977; Pázmány & László 1982; Einhellinger 1985, 1994; Jahn & Jahn 1986; Herches 1990; Van Vuure 1992; Courtecuisse & Duhem 1994; Hallingbäck & Aronsson 1998; Sarnari 1998; Tkalčec & Mešić 2003; Kränzlin 2005; Soliño & Castro 2005; Tanase & Pop 2005; Adamčík *et al*. 2006; Kaufmann 2007; Muhutdinov 2007; Knudsen *et al*. 2008; Lamoure *et al*. 2008; Anonymous 2010). Although widespread and regarded as not rare and as even locally common in, for example, subalpine areas of Italy (Sarnari 1998; Pierotti 2007), Nordic boreal-arctic habitats and in France (Romagnesi 1967; Knudsen *et al*. 2008), it is rather rare or very rare in some regions such as Bavaria, Baden-Württemberg, Saarland, Sachsen-Anhalt (Germany), Loire (France), Switzerland, the Netherlands, central Italy or hemiboreal Sweden (Van Vuure 1992; Einhellinger 1994; Hallingbäck & Aronsson 1998; Krieglsteiner 2000; Anonymous 2001; Täglich *et al*. 2004; Kränzlin 2005; Schmitt 2007; Senn-Irlet *et al*. 2007). In Romania it was placed on the red list of threatened macrofungi (Tanase & Pop 2005). In Poland it has never been recorded before, but Skirgiełło (1991) suggested that it may have been overlooked and needed attention. The species should be searched for especially in mountainous and submontane regions of Poland, and its presence in other parts of the country cannot be excluded. It may have been misidentified because of its resemblance to other similar species, especially if a spore print was not available.

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