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LACTIFLUUS AURANTIORUGOSUS (RUSSULACEAE), A NEW SPECIES FROM SOUTHERN BRAZIL

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Abstract. Sá, M. C. A. & F. Wartchow. 2013. *Lactifluus aurantiorugosus* (Russulaceae), a new species from southern Brazil. *Darwiniana*, nueva serie 1(1): 54-60.

Lactifluus aurantiorugosus is proposed as a new species from southern Brazil. It is characterized by the small-sized basidiomata, pileus orange, glabrous and wrinkled when fresh, distant lamellae, ellipsoid and verrucose basidiospores with warts up to 0.7 μm , interconnected with incomplete reticules, a trichopalisade as pileipellis-structure, and the context of lamella and pileus with abundant sphaerocysts.

Keywords. Agaricomycetes; Neotropic; Russulales; taxonomy.

Resumen. Sá, M. C. A. & F. Wartchow. 2013. *Lactifluus aurantiorugosus* (Russulaceae), una nueva especie del sur de Brasil. *Darwiniana*, nueva serie 1(1): 54-60.

Se propone a *Lactifluus aurantiorugosus* como una nueva especie del sur de Brasil. Se caracteriza por basidiomas de pequeño tamaño, con un píleo de color naranja, glabro y arrugado cuando fresco, laminillas distantes, basidiosporas elipsoides, verrugosas, con verrugas hasta de 0,7 μm , interconectadas con retículos incompletos; pileipellis formada por una estructura en tricopalisada y el contexto de las laminillas y del píleo con abundantes esferocistos.

Palabras clave. Agaricomycetes; Neotrópico; Russulales; taxonomía.

INTRODUCTION

The genus *Lactifluus* (Pers.) Roussel was proposed after a phylogenetic study of *Russula* Pers. and *Lactarius* Pers. by Buyck et al. (2008), who concluded that the genera *Lactarius* and *Russula* were weakly supported, and proposed a new genus, *Multifurca* Buyck & V. Hofstetter, and another group erected later as *Lactifluus* (Buyck et al., 2010). Later, Verbeken et al. (2011, 2012) and Stubbe et al. (2012) proposed new combinations from *Lactarius* to *Lactifluus*, although those combinations did not include any species from Brazil.

Studies in *Lactarius* in southern Brazil are scarce, and the Priest Johannes Rick firstly referred to it from the state of Rio Grande do Sul. Rick (1906, 1907, 1930, 1938) reported or described *Lactarius adustus* Rick, *Lactarius braunii* Rick, *Lactarius distans* Peck, *Lactarius fuliginosus* (Fr.) Fr., *Lactarius helvus* (Fr.) Fr., *Lactarius russula* Rick and *Lactarius steffenii* Rick. Later, Singer (1953) confirmed only *Lactarius braunii* and *Lactarius russula* as accepted species, and then all taxa were summarized in Rick's posthumous work published by Priest Balduino Rambo (Rick, 1961). In recent works, other taxa were reported

from southern Brazil, as *Lactarius argillaceifolius* Hesler & A.H. Sm. var. *argillaceifolius*, *Lactarius deliciosus* (L.) Gray, *Lactarius fragilis* (Burl.) Hesler & A.H. Sm. var. *fragilis*, *Lactarius rufus* (Scop.) Fr., *Lactarius rufus* var. *parvus* Hesler & A.H. Sm. (these from exotic *Pinus* plantations) and *Lactarius venezuelanus* Dennis (Singer et al., 1983; Buyck & de Meijer, 1999; Giachini et al., 2000; de Meijer, 2001, 2006; Sobestiansky, 2005; Karstedt & Stürmer, 2008).

The genus *Lactifluus* was divided into six subgenera according to Verbeken et al. (2011; 2012), Stubbe et al. (2012), and Sá et al. (2013) (Table 1). The section *Aurantiifolii* was not assigned to any subgenus. One hundred twenty new combinations were performed in the genus *Lactifluus* in the last years (Verbeken et al., 2011, 2012; Stubbe et al., 2012; Sá et al., 2013).

The studies of the genus *Lactifluus* in Brazil are very recent and only two species are known for this country: *Lactifluus batistae* Wartchow, J.L. Bezer-

ra & M. Cavalc. from section *Phlebonemi* (Wartchow et al., 2013), and *Lactifluus dunensis* Sá & Wartchow from section *Tomentosi* (Sá et al., 2013), both from northeastern Brazil. We describe here an interesting *Lactifluus* as a new species from the southern Brazilian region of Rio Grande do Sul.

MATERIALS AND METHODS

The proposed new species was collected at the State of Rio Grande do Sul, in an Atlantic Forest fragment, in a location called “Perdida”, municipality of Morrinhos do Sul (29° 21’ 30” S, 49° 58’ 35” W), at about 440 to 480 m elevation. The area contains, among others, members of Euphorbiaceae and Myrtaceae (Jarenkow, 1994) that are putative ectomycorrhizal trees (Smith & Read, 2008).

Melzer’s reagent and KOH 3% were used for microscopic studies. Terminology for microstructures followed Verbeken (1998) and Verbeken &

Table 1. Subgenera and sections of *Lactifluus* (Verbeken et al., 2011, 2012; Stubbe et al., 2012; Sá et al., 2013).

Subgenus	Sections	Distribution
Subg. <i>Edules</i> (Verbeken) Verbeken		endemic to tropical Africa
Subg. <i>Lactariopsis</i> (Henn.) Verbeken	Sect. <i>Lactariopsis</i> Verbeken Sect. <i>Chamaeleontini</i> (Verbeken) Verbeken Sect. <i>Albati</i> (Bataille) Verbeken	Africa, North America, Europe and Asia,
Subg. <i>Russulopsis</i> (Verbeken) Verbeken	Sect. <i>Russulopsidae</i> (Verbeken) Verbeken	endemic to tropical Africa
Subg. <i>Lactifluus</i>	Sect. <i>Rubroviolascetini</i> (Singer) Verbeken	endemic to tropical Africa
	Sect. <i>Polysphaerophori</i> (Singer) Verbeken	Africa and one South American species
	Sect. <i>Pseudogymnocarpi</i> (Verbeken) Verbeken	Africa and one Chinese species
	Sect. <i>Phlebonemi</i> (R. Heim ex Verbeken) Verbeken	Africa, South, North and Central America, Australia, Europe and Asia
	Sect. <i>Tomentosi</i> (McNabb) Verbeken	Africa, South, North and Central America, Australia, Europe and Asia
	Sect. <i>Lactifluus</i>	Asia, American, and European
Subg. <i>Piperati</i> Verbeken	Sect. <i>Piperati</i> (Fr.) Verbeken Sect. <i>Allardii</i> (Hesler & A.H. Sm.) De Crop	Europe, Asia and North America
Subg. <i>Gerardii</i> (A.H. Sm. & Hesler) Stubbe		North America, Asia and Australia
	Sect. <i>Aurantiifolii</i> (Verbeken) Verbeken	Tropical Africa

Walley (2010). Basidiome colors were observed in fresh material, and were coded following Kernerup & Wanscher (1978). For scanning electron microscopy (SEM) studies, sections were removed from dried basidiomata and mounted directly on aluminum stubs using carbon adhesive tabs. The fragments were coated with gold using a sputter coater and examined in Shimadzu SSX-550. Presentation of basidiospore data followed the methodology proposed by Tulloss et al. (1992), and implemented by Wartchow (2012) and Wartchow et al. (2012).

Statistics were based on the measures of 30 basidiospores. Abbreviations included: L(W) = basidiospore lengths (width) average from a single basidiome, Q = length : width ratio range as determined from all measured basidiospores, and Qm = Q value average from all basidiospore measures within a single basidiome.

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RESULTS

Lactifluus aurantiorugosus Sá & Wartchow, **sp. nov.** TYPE: Brazil, Rio Grande do Sul, Morrinhos do Sul, Perdida, 15-V-2009, *F. Wartchow s.n.* (holotype JPB 52376!, Myco-Bank 803541). Figs 1-3.

Lactifluus aurantiorugosus differs from other taxa of section *Tomentosi* in the small size basidiomata, orange and glabrous wrinkled pileus when fresh, distant lamellae, ellipsoid, distinctly verrucose with warts up to 0.7 µm, interconnected with incomplete reticules; pileipellis a trichopalisade, and lamella and pileus trama with abundant sphaerocysts.

Pileus 27-45 mm, plane-convex depressed to deeply depressed, orange (between 68A-68C) sometimes slightly darker (8D8) and margin yellowish (between 4A4-4A5), surface moderately viscid, smooth (shallowly velvety in dried state), radially rugulose-venose; margin entire, incurved in young basidiome and straight and more undulate in older ones; context 4 mm thick at centre, gradually thinning toward the margin; white, unchanging; exuding abundant latex. *Lamellae* short decurrent, pale cream (1A2 or 1B3), distant, up to 2-3 mm broad, tough; edge smooth, concolorous; lamellulae frequent, attenuating in step to subtruncate, with several lengths. *Stipe* 24-35 × 7-10 mm, central (only one basidiome more or less eccentric), more or less cylindrical but sometimes tapering toward the base, slightly tapering near the base, pale cream (1B4) sometimes slightly darkening (between 4C5 and 4C6), smooth; context whitish, solid, unchanging. *Latex* watery white, abundant, unchanging.

Basidiospores (7-)-7.5-10.5 × (4.7-)-6-8 µm (L = 8.9 µm, W = 6.7 µm, Q = (1.19-)-1.22-1.44 (-1.45), Qm = 1.32), broadly ellipsoid to ellipsoid; ornamentation amyloid, finely verrucose with each wart ranging to 0.7 µm high, interconnected by a fine line, but very infrequently forming a complete reticulum; hilar appendix narrowly obtuse to conical. *Basidia* 69-75 × 8.5-10 µm, slender clavate, bearing mainly four sterigmata 6-10 µm long. *Pseudopleurocystidia* common, 4-7 µm wide, non-projecting above the hymenium, with brownish refractive contents, thin-walled, arising deeply from hymenophoral trama. *Lamella edge* with marginal cells 30-45 × 4-6 µm, slender clavate to hyphoid, sometimes sinuous, thin-walled, hyaline, mixed with infrequent basidia. *Pileus context* with abundant sphaerocysts, 24-36 × 20-29 µm, globose to subglobose; hyphae filamentous, 2-4.5 µm; lacticiferous hyphae frequent, 3-8 µm, interwoven, common. *Subhymenium* with short-celled hyphae about 5 µm wide, sometimes more rounded, frequently branching. *Hymenophoral trama* heteromerous, with abundant nearly isodiametric cells 15-26 × 13-25 µm, filamentous hyphae 2-5 µm; lacticiferous hyphae 3-6 µm diam., straight, common. *Pileipellis* trichopalisade, up to 100 µm thick, two layered; elements of suprapellis 20-51 × 4-6 µm, abundant, colorless in KOH 3%, thin-

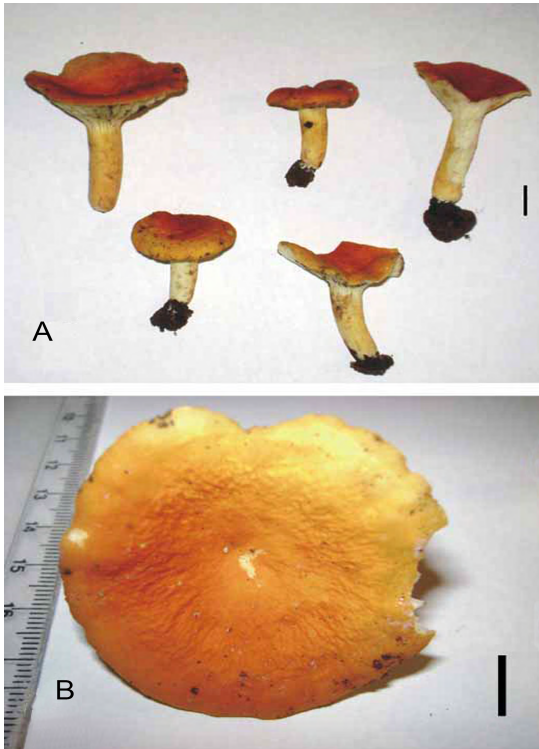


Fig. 1. *Lactifluus aurantiorugosus*. **A**, basidiomes observed in lateral view. **B**, pileus surface. Scale = 10 mm. From holotype. Color version at <http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/520/513>.

walled somewhat thickening up to 0.5 μm , obtuse, subacute to infrequently subcapitate or piriform; subpellis composed of abundant radially oriented hyphae, 2.5–4 μm wide, colorless. *Stipitipellis* with thin-walled and interwoven hyphae; caulocystidia absent. Clamp-connections absent.

Etymology. From latin ‘aurantio’ (= orange) and ‘rugosus’ (= wrinkled), regarding to the orange and wrinkled pileus surface of the species.

Distribution and habitat. Only known from the type locality. Widespread on humus soil near to roots of *Ficus* sp. (Moraceae) in Atlantic Forest of southern Brazil.

Observations. *Lactifluus aurantiorugosus* can be included in *Lactifluus* subgen. *Lactifluus* (Pers.)

Roussel emend Verbeken, sect. *Tomentosi* (McNabb) Verbeken on the basis of its orange pileus with somewhat veined/rugulose surface, ellipsoid basidiospores, very long basidia and scarcity of thick-walled pileipellis elements (Verbeken & Walley, 2010 as *Lactarius*). This species is characterized by the persistently wrinkled and non-cracking orange pileus, the contrasting whitish distant lamellae, proportionally shorter stipe compared to the pileus, basidiospores size (7–)7.5–10.5 \times (4.7–)6–8 μm (L = 8.9 μm , W = 6.7 μm , Q = (1.19–)1.22–1.44(–1.45), Qm = 1.32), non emergent and rather scarce pseudopleurocystidia and narrow pileipellis elements.

The recently described *Lactifluus dunensis* from the State of Rio Grande do Norte, north-eastern Brazil, shares the proportionally shorter stipe. However, it differs from *Lactifluus aurantiorugosus* in several features, i.e. the brownish orange pileus and stipe, light brown lamellae, smaller basidiospores (6.1–)6.6–8.2(–8.7) \times (5.6–)6.1–7.1(–7.7) μm , L = 7.5 μm , W = 6.4 μm , Q = (1.00–)1.10–1.40(–1.50), Qm = 1.20 and the pileipellis, as a palisade (Sá et al., 2013). This species also belongs to sect. *Tomentosi*.

On the basis of the recent taxonomical changes proposed for *Lactifluus* and *Lactarius* (Buyck et al., 2008), we postpone the construction of a key to the Brazilian species of *Lactifluus* until more Brazilian species of *Lactarius* are reviewed to assess their taxonomical position. For the same reason, *Lactifluus aurantiorugosus* is here compared to African and North American *Lactifluus* species.

Among African taxa of this section, at least two species also present orange basidiomes: *Lactifluus pseudovolemus* (R. Heim) Verbeken and *Lactifluus volemoides* (Karhula) Verbeken, but they primarily differ in the tomentose rather than wrinkled pileus (Verbeken & Walley, 2010 as *Lactarius*). It is also interesting to note that Brazilian and African species of *Lactifluus* sect. *Tomentosi* shares mostly emergent pseudopleurocystidia and presence of spherocytes in the hymenophoral trama (Verbeken & Walley, 2010 as *Lactarius*).

Lactifluus xerampelinus (Karhula & Verbeken) Verbeken from Tanzania, Zambia and Zimbabwe shares with *Lactifluus aurantiorugosus* the pi-

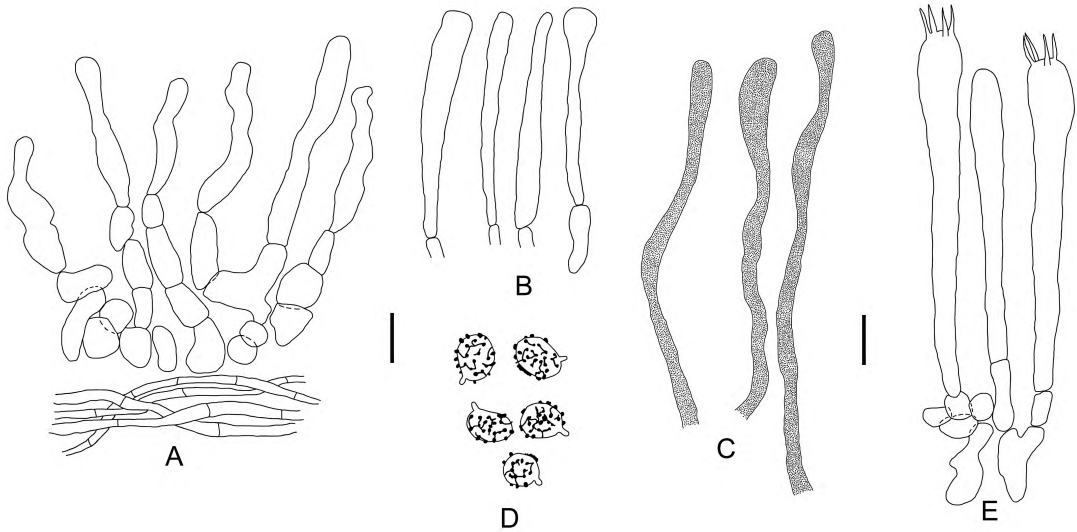


Fig. 2. *Lactifluus aurantiorugosus*. **A**, pileipellis. **B**, marginal cells. **C**, pseudopleurocystidia. **D**, basidiospores. **E**, basidia, basidiole and subhymenium. Scale = 10 µm. From holotype.

leipellis structure, i.e. elongate thin-walled cells forming chains, and basidiospores similar in size ($7.1\text{--}7.5\text{--}10 \times 5\text{--}7 \mu\text{m}$ ($L = 8.1\text{--}8.7 \mu\text{m}$, $W = 5.9\text{--}6 \mu\text{m}$, $Q = 1.29\text{--}1.67$, $Q_m = 1.35\text{--}1.48$). However, this African taxon differs by the larger (up to 120 mm in diam.), cracking, dark reddish brown pileus and the basidiospores with very low (up to $0.2 \mu\text{m}$ high) ornamentations (Verbeken & Walleyn, 2010 as *Lactarius*).

Lactifluus rubiginous (Verbeken) Verbeken, from Tanzania and Zambia, and *Lactifluus kivuensis* (Verbeken) Verbeken from Africa, also has wrinkled and non cracking pileus and somewhat spaced lamellae, but differ primarily in the presence of reddish brown tinges on pileus and the proportionally longer stipe (Verbeken & Walleyn, 2010 as *Lactarius*).

Some taxa from the northern Hemisphere are also considered within this group, according to Verbeken (1998). *Lactarius echinatus* Thiers (not yet combined to *Lactifluus*) has a yellowish pileus with subtomentose to subpruinose surface, nearly concolorous stipe (Thiers, 1957; Hesler &

Smith, 1979); *Lactifluus hygrophoroides* (Berk. & M.A. Curtis) Kuntze has orange-cinnamon, reddish tawny or dull cinnamon pruinose to minutely velvety pileus, concolorous stipe (Hesler & Smith, 1979 as *Lactarius*) and inflated elements in the subpellis (Lalli & Pacioni, 1992 as *Lactarius*); *Lactifluus rugatus* (Kühner & Romagn.) Verbeken (Hesler & Smith, 1979 as *Lactarius*) presents pileipellis also with more inflated elements, with thin-walled elements in terminal cells and larger basidiospores ($7.8\text{--}8.1\text{--}9.5\text{--}9.9 \times (5.6\text{--})5.9\text{--}6.6\text{--}6.8 \mu\text{m}$ (Lalli & Pacioni, 1992) than *Lactifluus aurantiorugosus*.

The North American *Lactarius subvelutinus* Peck (combination in *Lactifluus* is not available) shares the orange pileus and basidiospores somewhat similar in size $7\text{--}9 \times 6.5\text{--}7.5 \mu\text{m}$. However, it differs in the velvety pileus with a cuticle zone, close and narrower lamellae, presence of cheilocystidia and caulocystidia, and shorter basidia $40\text{--}48\text{--}(52) \times (6\text{--})8\text{--}10 \mu\text{m}$. In addition, the cells of pileipellis are distinctly shorter and wider $10\text{--}25 \times 6\text{--}15 \mu\text{m}$ than our new species (Hesler & Smith, 1979).

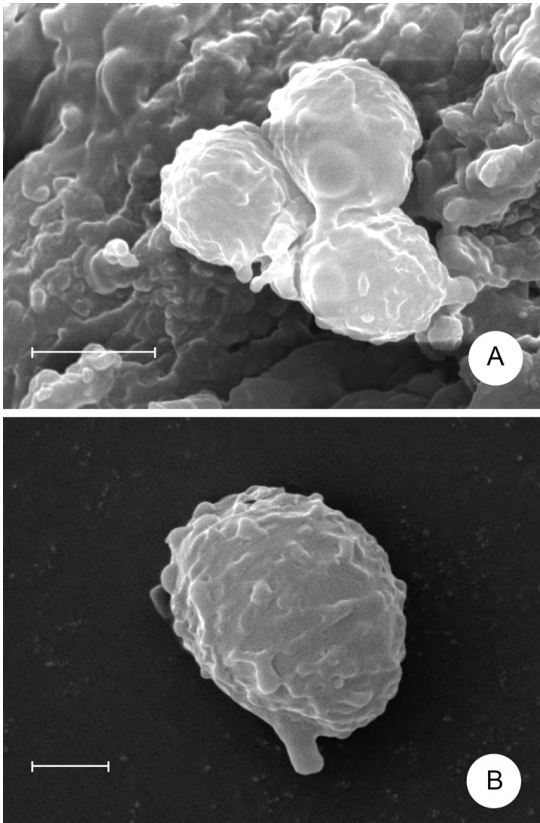


Fig. 3. *Lactifluus aurantiorugosus*. A-B, basidiospores, as seen with scanning electron microscopy (SEM). Scales: A = 5 µm, B = 2 µm. From holotype.

Another recently described species from Bahia (Brazil), *Lactifluus batistae*, is characterized by the lack of true cystidia and the basidiospore ornamentation composed of isolated warts, never forming an incomplete reticulum and the hymenophoral trama mainly composed of narrow hyphae. This taxon is classified in *Lactifluus* sect. *Phlebonemi* (R. Heim ex Verbeken) Verbeken (Verbeken, 1998; Wartchow et al., 2013), and is phenetically distant from *Lactifluus aurantiorugosus* (Verbeken, 1998).

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