

Morganella arenicola, a new species record from North and Northeast Brazil

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Received: 26.07.2013 • Accepted: 13.12.2013 • Published Online: 31.03.2014 • Printed: 30.04.2014

Abstract: *Morganella arenicola* Alfredo & Baseia *sp. nov.* from Brazilian forests is proposed as a new species based on its morphological features. A comparative analysis of several collections of *Morganella compacta* (G.Cunn.) Kreisel & Dring, including the holotype, is added. Detailed description, taxonomical remarks, and illustrations with photographs and scanning electron microscopy of the basidiospores are given.

Key words: Gasteromycetes, Lycoperdaceae, Neotropics, puffballs, taxonomy

1. Introduction

Morganella Zeller is a genus of puffballs widely distributed in tropical, subtropical, and temperate regions (Ponce de Leon, 1971; Kirk et al., 2008); however, there are few specific studies for Brazil. Only a short time ago was light shone on this interesting group of gasteroid fungi through the publishing of new records (Kreisel and Dring, 1967; Homrich, 1969; Barbosa et al., 2011) and new species (Cortez et al., 2007; Alfredo et al., 2012; Alves and Cortez, 2013) for the country, although review studies such as those of Ponce de Leon (1971) or Suárez and Wright (1996) from South America also included species of *Morganella* from Brazil. Taxonomic studies of very similar species require comparative analyses with type material in order to determine if they are in fact similar or not. Thus, a review was conducted of recently published collections of *Morganella compacta* (G.Cunn.) Kreisel & Dring (Barbosa et al., 2011) and other recent collections from other localities and biomes deposited in the UFRN and INPA herbaria. Our aim was to confirm the real identity of these collections by comparing them with the holotype of *M. compacta*, in addition to widening its geographic distribution.

2. Materials and methods

Specimens deposited in the UFRN herbarium and collected from Parque Estadual Dunas de Natal 'Jornalista Luiz Maria Alves' (5°46'S, 35°12'W), Natal, Brazil, were used. Moreover, additional specimens that were deposited in the INPA herbarium and collected at the National Institute for

Amazonian Research (INPA) (3°5'31.6'S, 59°59'36.4'W), Manaus, Brazil, were analyzed. With the aim of carrying out a comparative study, the holotype of *Morganella compacta*, from the New Zealand Fungal and Plant Disease Collection (PDD), was used. Macroscopic and microscopic analyses were conducted according to the literature (Zeller, 1948; Kreisel and Dring, 1967; Ponce de Leon, 1971; Suárez and Wright, 1996). Micromorphological dates were observed after rehydration in 5% KOH and/or with the aid of Melzer's reagent (Asef and Muradov, 2012; Kumari et al., 2013). Sample observations and image capturing were done using a Nikon Eclipse Ni light microscope coupled with a Nikon DS-Ri camera, supported by NIS-Elements AR 4.00.03 software. Thirty randomly selected basidiospores were measured (including the ornamentation) at 1000× magnification. Basidiospores were examined under a Shimadzu SSX-550 scanning electron microscope (SEM) following Cortez et al. (2008). Colors were determined in accordance with Küppers (2002). Vouchers are deposited in the UFRN herbarium.

3. Results

Taxonomic observations

Morganella arenicola Alfredo & Baseia, *sp. nov.* (Figures 1–4), MycoBank no.: MB 805081.

Type: Brazil, Rio Grande do Norte: Natal, 22 June 2005, B.D.B.Silva & J.S.Oliveira *s.n.* (Holotype: UFRN-Fungos 1006).

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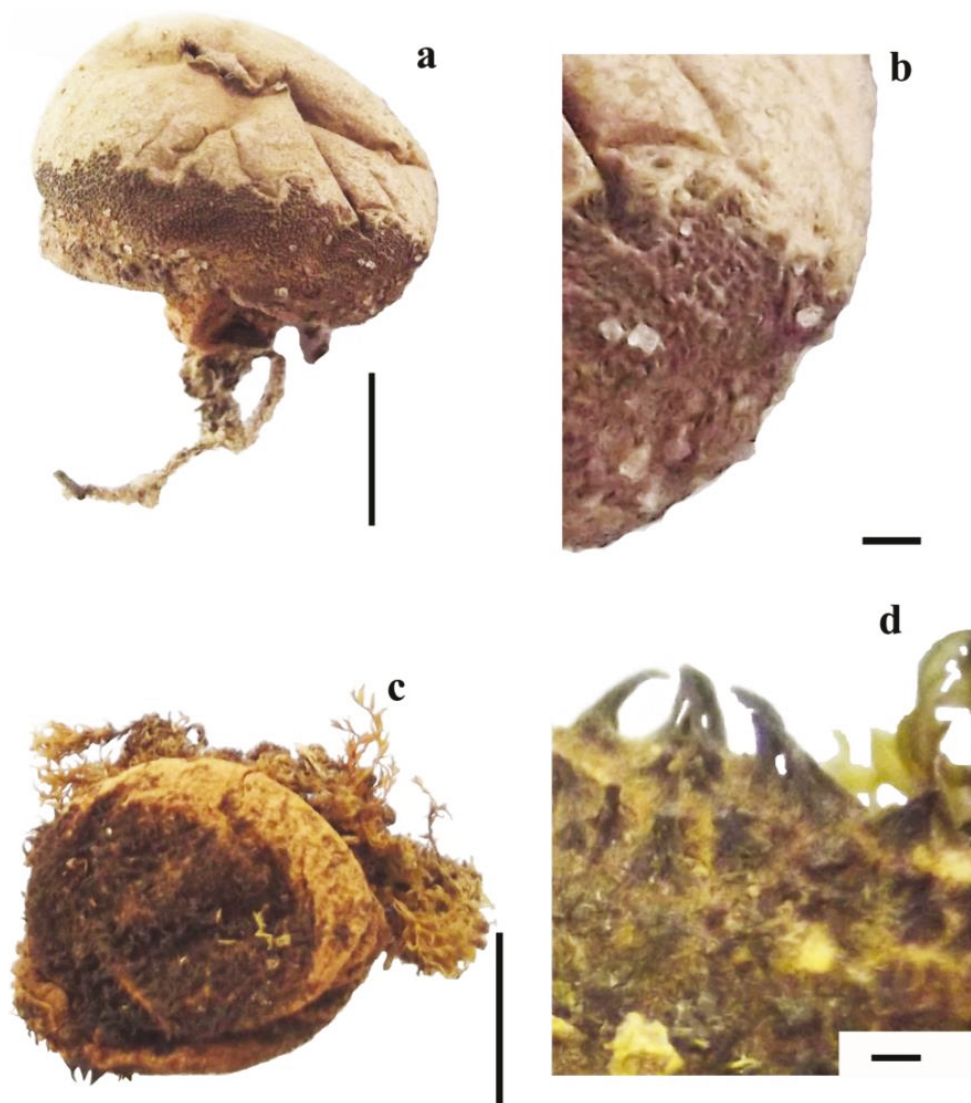


Figure 1. *Morganella arenicola*: a- basidioma, b- detailed of the exoperidium. *Morganella compacta*: c- basidioma, d- detailed of the exoperidium. Scale bars = a and c- 10 mm, b and d- 1 mm.

Etymology: In reference to basidioma growth in sandy soil.

Diagnosis: Basidiomata pyriform to turbinate; exoperidium with minute granules falling from the apex to halfway down the stem of the basidioma at maturity; endoperidium smooth with an apical pore; sterile base conspicuous, cellular; basidiospores globose to subglobose, 3.5–5 μm in diam., punctate, pedicellate; capillitium and paracapillitium abundant.

Description: *Basidiomata* immature, epigeous, 8–15 mm wide, depressed globose to subglobose, velvety surface incrustated with grains of sand, dark lilaceous ($M_{99}Y_{40}C_{90}$). *Basidiomata* mature, epigeous, 16–26 mm wide \times 11–27 mm high, subglobose, pyriform to turbinate,

sessile, with several rhizomorphs attached to substrate <0.5 mm thick. *Exoperidium* incrustated with grains of sand, composed of minute spines (<0.3 mm) that become wart-like or granulose-like in older specimens, which fall from the apex to halfway down the stem of the basidioma at maturity, yellowish brown ($N_{00}Y_{60}M_{20}$) at the base, becoming olive brown ($N_{60}Y_{60}M_{30}$) to gray ($N_{70}M_{00}C_{00}$ to $N_{80}M_{10}C_{10}$) at the apex, sphaerocysts globose, subglobose, ovoid to elliptical, 15.2–31.7 μm in diam. \times 15.2–44.4 μm high, walls <1.5 μm thick, hyaline to yellowish in 5% KOH. *Endoperidium* brownish gray ($N_{20}Y_{40}M_{10}$ to $N_{30}Y_{30}M_{10}$), smooth, dehiscing by an apical pore, hyaline to yellowish, interwoven and brittle hyphae, 2.5–6.3 μm in diam., walls up to 2 μm thick. *Sterile base* cellular, 6–18

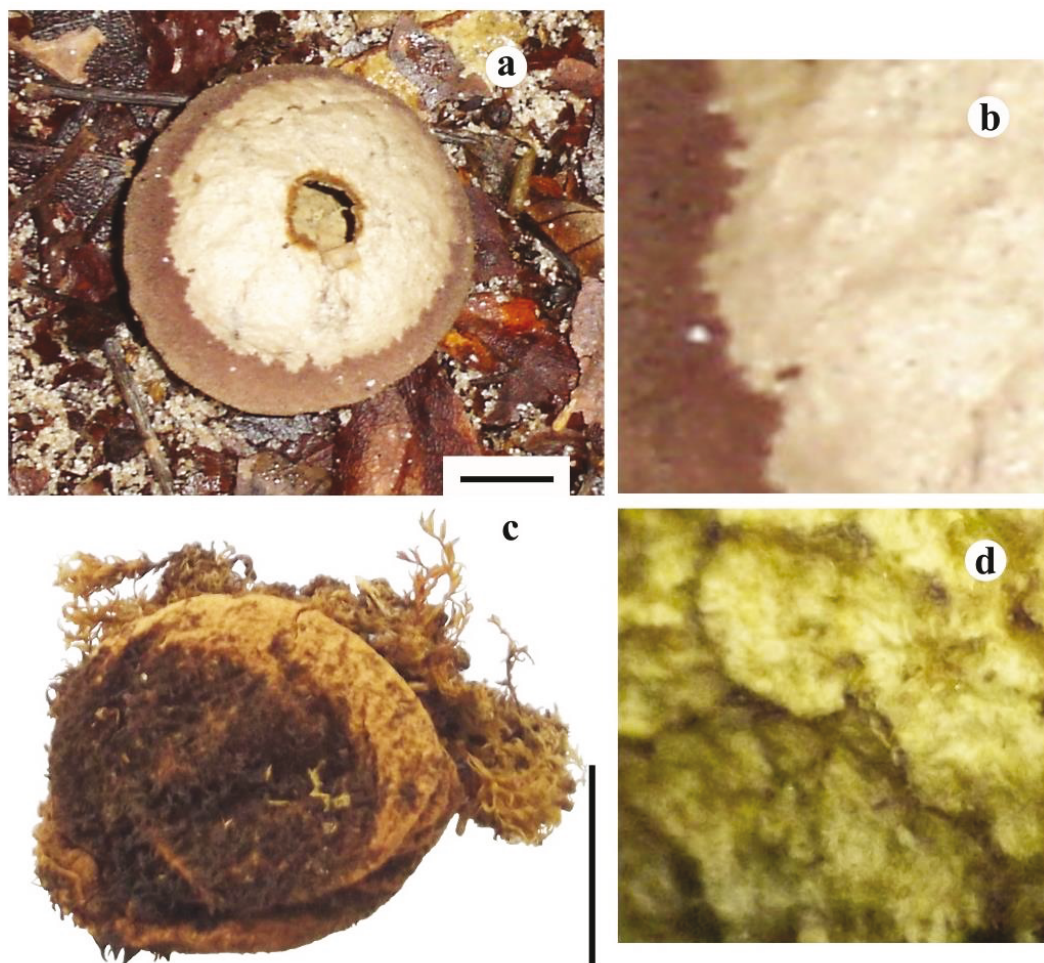


Figure 2. *Morganella arenicola*: a- basidioma, b- detailed of the endoperidium. *Morganella compacta*: c- basidioma, d- detailed of the endoperidium. Scale bars = 10 mm.

mm high, white to cream ($N_{00}Y_{20}M_{10}$) at maturity. *Gleba* white when young, becoming light brown ($N_{40}Y_{40}M_{20}$) to brown ($N_{50}Y_{80}M_{30}$) with age. *Basidiospores* globose to subglobose, 3.5–5 μm in diam., punctate in light microscopy, asperulate in scanning electron microscopy, pedicels 0.6–7.5 μm long, yellowish brown to brown in 5% KOH. *Eucapillitium* 2.5–5 μm in diam., branched, attenuated at tips and walls <1.5 μm thick, yellowish brown in 5% KOH. *Paracapillitium* 2.5–5.7 μm in diam., hyaline in 5% KOH, septate, exhibiting amorphous and hyaline incrustation, walls <1.5 μm thick.

Specimens examined: *Morganella arenicola* (Paratypes): Brazil, Rio Grande do Norte: Natal, 25.05.2005, M.M.B.Barbosa & I.G.Baseia s.n. (UFRN-Fungos 670); ibid., 20.05.2005, M.M.B.Barbosa & I.G.Baseia s.n. (UFRN-Fungos 651); ibid., 08.07.2006, M.M.B.Barbosa, E.P.Fazolino & T.B.S.Otoni s.n. (UFRN-Fungos 864); Amazonas: Manaus, 12.01.2013, T.Accioly

& N.K.Ishikawa s.n. (INPA 251759). *Morganella compacta*: New Zealand, 02.12.1922, E.H.Atkinson s.n. (PDD 10140); ibid., 06.12.1945, J.M.Dingley s.n. (PDD 4530); ibid., 03.12.1922, G.H.Cunningham s.n. (PDD 1102); ibid., 06.12.1930, M.Hodgkins s.n. (PDD 16721); ibid., 07.12.1930, M.Hodgkins s.n. (PDD 8525); ibid., 06.12.1951, G.H.Cunningham s.n. (PDD 11565); ibid., 08.12.1932, E.E.Chamberlain s.n. (PDD 4008); ibid., 07.12.1946, G.H.Cunningham s.n. (PDD 5607); ibid., 06.12.1948, P.M.Ambler s.n. (PDD 11111); ibid., 03.12.1952, J.M.Dingley s.n. (PDD 12039); 05.12.1955, G.H.Cunningham s.n. (PDD16058); ibid., 05.12.1997, R.E.Beever s.n. (PDD 68943).

Distribution, habitat, and phenology: Known to date from Brazil. Grows in sandy soil, rarely on decaying wood. Fruiting from March to August in Atlantic Forest and at least in the beginning of rainy season in Amazon rainforest.

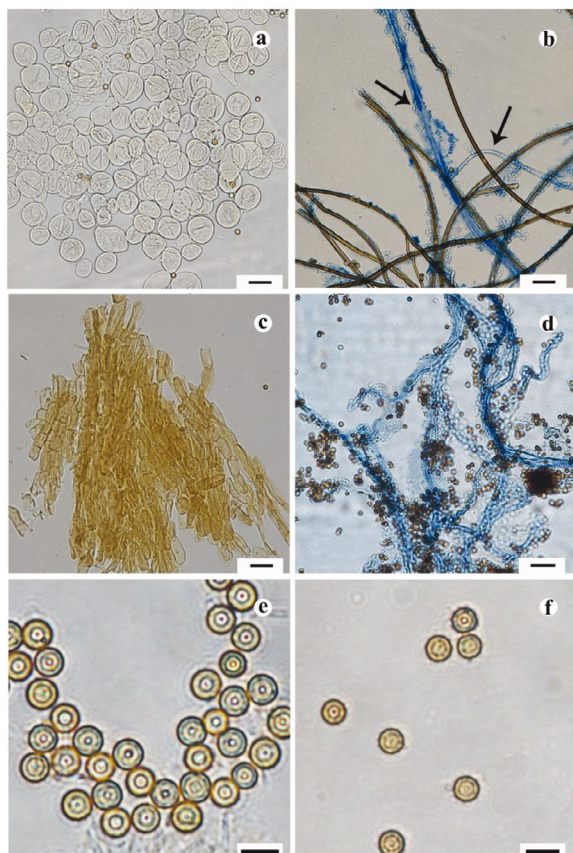


Figure 3. *Morganella arenicola*: a- detailed cells chain of exoperidium, b- capillitium and paracapillitium (arrows indicate paracapillitium), e- basidiospores. *Morganella compacta*: c- detailed cells chain exoperidium, d- paracapillitium, f- basidiospores. Scale bars = a-d- 20 µm, e and f- 5 µm.

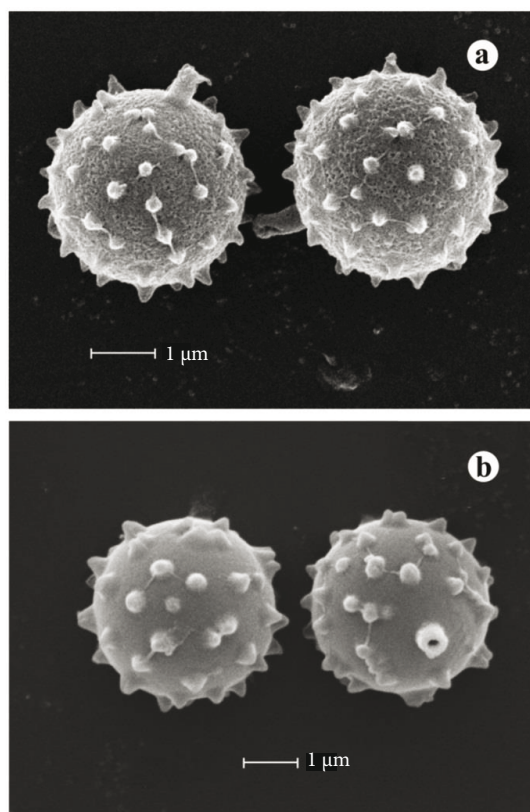


Figure 4. SEM micrograph of basidiospores. a- *Morganella arenicola*, b- *Morganella compacta*.

4. Discussion

Morganella arenicola was recently confused with *M. compacta*, which was registered for the first time for South America (Barbosa et al., 2011). However, a number of characteristics remain discrepant and make the real identity of the Brazilian collections suspicious. One of the differences initially observed was the nature of the sterile base of New Zealand specimens of *M. compacta* and that of the Brazilian specimens, in which the first cellular-like compartments are more narrower. Comparative studies conducted with the type species of *Morganella compacta* (holotype PDD 10140) and other New Zealand specimens demonstrated clear differences from the Brazilian species, until then considered to be *M. compacta*. Indeed, the New Zealand and Brazilian collections displayed several morphological differences, leading us to conclude that they represented 2 very distinct species. Among the discrepancies are: exoperidium ornamentation exhibits granulose to warty aspect, with spines <0.3 mm long (Figure 1), falling from the apex to halfway down the stem of the

basidioma, whereas *M. compacta* displays distinctly spiny ornamentation, with spines >1 mm long (Figure 1), the basal portion remaining spine-free; the endoperidium of *M. arenicola* is smooth and none of the exsiccates analyzed in this species exhibit marks left by the exoperidium (Figure 2), in contrast to *M. compacta*, whose primary characteristic is its reticulate or areolate endoperidium at maturity (Figure 2); and the shape of the cell chains of the exoperidium exhibit sphaerocysts of *M. arenicola* (Figure 3) that contrast with the shape of sphaerocyst chains of *M. compacta*, which provide a spiny aspect (Figure 3). A similar characteristic between these 2 species are the basidiospores (Figure 3) (Cunningham, 1926, 1944), which display the same ornamentation pattern in scanning electron microscopy (Figure 4). Other closely-related species, such as *Morganella afra* Kreisel & Dring, differ from *Morganella arenicola* in their endoperidium, which is areolate in the former, and in the occurrence of only the paracapillitium (Kreisel and Dring, 1967). *Morganella sunbincarnata* (Peck) Kreisel & Dring, another species

close to *M. arenicola*, differs in its reticulate endoperidium and an irregular apical pore (Cunningham, 1944; Ponce de Leon, 1971), which is well defined in *M. arenicola* (Figure 2). *Morganella arenicola* exhibits eucapillitium (Figure 3) as in *Morganella pyriformis* (Schaeff.) Kreisel & D.Krüger (Krüger and Kreisel, 2003), which was recorded in Azerbaijan by Seyidova and Hüseyin (2012) as *Lycoperdon pyriforme*. However, the chains of the exoperidium and the ornamentation pattern of the basidioma of *M. pyriformis* (Krüger and Kreisel, 2003) are quite distinct from that observed in our specimens. The recently described Brazilian species, such as *Morganella allostipitata* Alfredo & Baseia, *Morganella rimosa* Alfredo & Baseia (Alfredo et al., 2012), and *Morganella sulcatostoma* C.R.Alves & Cortez (Alves and Cortez, 2013), are distinct in all the characters discussed. Thus, a comparative study of the characteristics analyzed confirmed that the Brazilian specimens were distinct from the New Zealand specimens of *Morganella compacta*. The specimens considered by Barbosa et al. (2011) actually belong to a distinct taxon, denominated

here by *M. arenicola*. In addition to the Atlantic Forest, the distribution of this new taxon was widened to the Amazon Forest.

Acknowledgments

The authors would like to thank Programa de Capacitação em Taxonomia/Conselho Nacional de Desenvolvimento Científico e Tecnológico (PROTAX/CNPq) and Programa Nacional de Apoio e Desenvolvimento da Botânica/ Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (PNADB/CAPES) for providing a Master's scholarship and financial support for the field trip in Manaus-AM, and Noemia Kazue Ishikawa of Instituto Nacional de Pesquisas da Amazônia (INPA), Instituto Nacional de Ciência e Tecnologia-Centro de Estudos Integrados da Biodiversidade Amazônica (INCT-CENBAM) program. The authors also acknowledge Dr Eric McKenzie, curator of the New Zealand Fungal and Plant Disease Herbarium Collection (PDD), for the loan of exsiccates.

References

- Alfredo DS, Leite AG, Braga-Neto R, Baseia IG (2012). Two new *Morganella* species from the Brazilian Amazon rainforest. *Mycosphere* 3: 66–71.
- Alves CR, Cortez VG (2013). *Morganella sulcatostoma* sp. nov. (Agaricales, Basidiomycota) from Paraná State, Brazil. *Nova Hedwigia* 96: 409–417.
- Asef MR, Muradov P (2012). Lepiotaecous fungi (Agaricaceae) in the Iranian part of Caucasia. *Turk J Bot* 36: 289–294.
- Barbosa MMB, Silva MA, Cruz RHSE, Calonge FD, Baseia IG (2011). First report of *Morganella compacta* (Agaricales, Lycoperdaceae) from South America. *Mycotaxon* 116: 38–386.
- Cortez VG, Baseia IG, Guerrero RT, Silveira RMB (2008). Two sequestrate cortinarioid fungi from Rio Grande do Sul, Brazil. *Hoehnea* 35: 513–518.
- Cortez VG, Calonge FD, Baseia IG (2007). Rick's species revision 2: *Lycoperdon benjaminii* recombined in *Morganella*. *Mycotaxon* 102: 425–429.
- Cunningham GH (1926). Lycoperdaceae of New Zealand. *Transactions of the New Zealand Institute* 57: 187–217.
- Cunningham GH (1944). Gasteromycetes of Australia and New Zealand. Dunedin, New Zealand: J. McIndoe.
- Homrich MH (1969). Etude de quelques Gastéromycètes du Rio Grande do Sul. *Revue de Mycologie* 34: 3–16 (in French).
- Kirk PM, Cannon PF, Minter DW, Stalpers JA (2008). *Dictionary of the Fungi*. 10th ed. Wallingford, UK: CAB International.
- Kreisel H, Dring DM (1967). An emendation of the genus *Morganella* Zeller (Lycoperdaceae). *Feddes Repertorium* 74: 109–122.
- Krüger D, Kreisel H (2003). Proposing *Morganella* subgen. *Apioperdon* subgen. nov. for the puffball *Lycoperdon pyriforme*. *Mycotaxon* 86: 169–177.
- Kumari B, Atri NS, Upadhyay RC (2013). Three new species of basidiomycetous fungi from India. *Turk J Bot* 37: 1188–1194.
- Küppers H (2002). *Atlas de los colores*. Barcelona, Spain: BLUME (in Spanish).
- Ponce de Leon P (1971). Revision of genus *Morganella* (Lycoperdaceae). *Fieldiana Botany* 31: 27–44.
- Seyidova H, Hüseyin E (2012). Macrofungi of Nakhchivan (Azerbaijan) Autonomous Republic. *Turk J Bot* 36: 761–768.
- Suárez VL, Wright JE (1996). South American Gasteromycetes V: The genus *Morganella*. *Mycologia* 88: 655–661.
- Zeller SM (1948). Notes on certain Gasteromycetes, including two new orders. *Mycologia* 40: 639–668.